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The return of the water: Restoring the Waza Logone floodplain in Cameroon

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BLUE SERIES

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## Restoring the Waza Logone floodplain in Cameroon

Paul Loth *(Editor)*

With contributions from M. Acreman, M. Ali, H. Bauer, R. Braund, S. Y. Evans, L. Emerton, H. de Iongh, S. Kari, R. Kouokam, P. Loth, M. Moritz, D. Ngantou, C. Njomaha, P. Oyo, J-Y. Pirot and P. Scholte

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This publication has been made possible in part by funding from the Government of the Netherlands.

Published by: IUCN, Gland, Switzerland and Cambridge, UK



Citation: Loth, P. (Editor), 2004. *The Return of the Water: Restoring the Waza Logone Floodplain in Cameroon*. IUCN, Gland, Switzerland and Cambridge, UK. xvi + 156 pp.

ISBN: 2-8317-0752-8

Cover photograph: Children play in the water that once again flows through the Waza Logone floodplain in Northern Cameroon – from de Noray, M.L. (2003) “Waza Logone – Histoires d’Eaux et d’Hommes”, IUCN, Switzerland

Printed by: Sadag Imprimerie - 01200 Bellegarde, France

Available from: IUCN Publications Services Unit
219c Huntingdon Road, Cambridge CB3 0DL, United Kingdom
Tel.: +44 1223 277894, Fax:+44 1223 277175
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### Institute of Environmental Sciences, CML, the Netherlands

The Department "Environment and Development" (PMO) of the Institute of Environmental Sciences (CML) in Leiden, the Netherlands, focuses on the depletion, protection and rehabilitation of natural resources, such as forests, marine resources, soils and wildlife, in the developing world. It works in Leiden and in a number of developing countries, in particular Cameroon (CEDC), the Philippines and Indonesia.

Its main activities are higher education and scientific research in environmental sciences.

### Centre for Environment and Development Studies, Cameroon

The Centre for Environment and Development Studies in Cameroon (CEDC) in Maroua is the product of co-operation between the former Ministry of Higher Education, Computer Science and Scientific Research (MESIRES) in Cameroon and Leiden University (UL) in the Netherlands.

Its main activities are training, higher education and scientific research. CEDC also provides practical support to field projects in the drylands surrounding Maroua. CEDC has received financial support from the Cameroonian government and from the Dutch Government through UL/CML, IUCN – The World Conservation Union and the Netherlands Organisation for International Co-operation in Higher Education (NUFFIC).

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# Foreword

This book tells the story of times past, when wetlands were considered as wastelands and decision-makers and managers were unaware of their benefits, a time when the adverse impacts of hydropower and irrigation schemes on ecosystems and people downstream seemed unimportant. This story has a happier ending in these more enlightened times when wetland ecosystems are viewed as essential elements in integrated river basin planning, which draws upon the most appropriate modern science and traditional knowledge. The hero of the story is one of the best-known floodplains of the Sahel - the Waza Logone floodplain in the Extreme-North Province of Cameroon. This book tells of the partial restoration of the wetland using lessons from the floodplain's history to partially correct earlier mistakes.

The Logone River in Cameroon is typical of many rivers in Africa. In the dry season, it may almost cease to flow, whereas during the wet season (August-September), with an average flow rate of 1,800 m3/sec, it may overflow its banks. Before the 1980s, when seasonal floods were unimpeded by engineering works, a vast area on the left bank, encompassing a substantial part of Waza National Park, was temporally flooded most years. Fishers, farmers and nomadic pastoralists used the floodplain, following the annual flood pattern in a well-established sequence which allowed all users to benefit from the inundated land before, during, and after the wet season. Thousands of elephants and giraffes, and a huge population of antelopes, roamed the floodplain in and around Waza National Park, providing a significant source of tourism-related income for local people and the government.

However, in the late 1970s, a 30 km long dam was built to create a 400 km$^2$ reservoir (Lake Maga) needed for a series of rice projects (SEMRY 1 and SEMRY 2). This dam and the many kilometres of embankments on the left bank of the Logone River deprived the Waza Logone floodplain of much of its natural flood water and, therefore, of its ecological potential. From 1981until the mid-1990s, this sharp reduction in flooding led to major environmental degradation and severe social upheaval over an area covering 800,000 hectares downstream of Lake Maga.

These dramatic changes had a serious impact on the many people who relied on the natural resources for their livelihoods. Income dropped due to smaller fish catches, reduced arable land available for floating rice or sorghum growing and for flood recession farming, and also because fuel wood, fruits, medicines and tradable products such as Arabic gum, were less plentiful. Dry season grazing lands for cattle and wildlife were also greatly reduced. Thus, the sudden and nearly total alteration of the water regime over several tens of thousands of hectares of floodplain had an immediate impact on ecosystem functions and services, resulting in large-scale emigration of local people, cattle and wildlife to other areas.

In response to the droughts which affected the Sahel in the 1960s and 1970s, many countries opted for large-scale, intensive irrigation schemes to meet their food security needs and to provide export opportunities. Unfortunately, until the early 1990s, these schemes were premised on overly optimistic economic forecasts and, even worse, implemented without any assessment of their impacts on downstream ecosystems and livelihoods. Today, a wealth of evidence demonstrates that, in many instances, these engineering projects (SEMRY being one of them) have not delivered the food increases anticipated during pre-commissioning phases. It has therefore become apparent that full floodplain conversion to irrigated agriculture is economically risky because the traditional farming, herding and fishing activities which such projects replace require no capital investments and often generate higher and more regular (and thus safer) returns per unit of water used.

From 1990-2003, the Government of Cameroon and IUCN - The World Conservation Union, with the support of the Government of the Netherlands, SEMRY, the provincial, local and traditional authorities, the University of Leiden (CML), the Centre for Environment and Development in Cameroon (CEDC) and other technical institutions in Africa and Europe, have been working to rehabilitate the degraded Waza Logone floodplain. The project used the ecosystem approach as the guiding principle for establishing participatory planning and management procedures, carrying out numerous environmental, social and economic studies, as well as for training and communication activities.

The aim of the Waza Logone project has never been to restore the floodplain to its pre-dam status. On the contrary, when seeking alternative water management options, much effort was devoted to ensuring that restoration would not jeopardise the SEMRY rice scheme. This illustrates the idea that the 1970s dam planning process could easily have been carried out in partnership with all stakeholders, giving due consideration to the viability of downstream resources.

The outcome of the project is extremely heartening, with considerable positive impacts on the income and livelihoods of local communities, major increases in fish catches, traditional farming productivity and carrying capacity for livestock and wildlife in Waza National Park.

Locally, the people have understood the need to protect their floodplain ecosystem. They have also become more familiar with planning, community-based resources management and sustainable use practices. Last, but certainly not least, through improved local-level management systems, local people have undertaken to pursue the work initiated by the project. We hope that the results achieved over the past decade will convince policy makers, engineers and donors that water management for irrigation should be an integral part of the overall endeavour to use ecological systems more equitably and sustainably.

Sound environmental management for sustainable development is a key component of the New Partnership for Africa's Development (NEPAD). Integrated water resources management which gives ample consideration to the environment and biodiversity will play an essential role in the fight against poverty in many African countries and will help to place these countries, both individually and collectively, on the path towards sustainable development.

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# Acknowledgements

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For IUCN, its government and NGO members, and the project partners, this book is an opportunity to thank all those who have supported, in many different ways, the Waza Logone project since its inception in the late 1980s.

First and foremost, a heartfelt tribute must be paid to the commitment of all Waza Logone project personnel, especially staff of the Cellule d'Appui aux Initiatives de Développement (CACID), who have been responsible for implementing the project since 2000. We also gratefully acknowledge the dedication of those, often former project staff, who have taken a lead role in establishing the local NGOs (Association Camerounaise pour l'Education Environnementale - ACEEN, Association d'Appui aux Initiatives de Développement Rural - AIDR, Cellule de Formation et d'Appui aux Initiatives de Développement - CFAID) as part of the project's progressive exit strategy.

At provincial level, key institutions have been important in guiding the project through its successive phases. We are grateful to the provincial Governors, especially Governors Benoît Namvou, Seidou Mounchipou, Yene Essomba and Lazare Abate Abate, for their unfailing political support. Likewise, we wish to highlight the constant willingness of the successive regional Delegates for Environment and Forest to provide assistance.

At central level, in the Ministry for Environment and Forest, Ministers Bava Djingoer, Mbede and Naah Ondoua have all monitored the progress made to restore the floodplain very closely. The strategic guidance received from Tchana Mesack, Ebwele Fils Leroy and Yadji Bello has helped the project to overcome many hurdles. At this point in time, CEDC, CML and IUCN also wish to acknowledge the huge contribution made by Dr Tutuwan, whose accidental and most untimely death has deprived us of his energy and vision for environmental conservation in Cameroon.

Invaluable guidance was provided to the project by traditional authorities, in particular the Sultans, Lamidos and Lawans, who have always supported the restoration of the floodplain. Their assistance in fostering close relationships between the project and its key stakeholders, the people of the floodplain, is gratefully acknowledged.

Irrespective of their institutional origins, the following people must be thanked for their unfailing interest in, and strategic contributions to, the implementation of the Waza Logone project. They are: Mike Acreman, Saleh Adam, Madi Ali, Michael Allen, Grazia Borrini-Feyerabend, Richard Braund, Jan Browers, Hans de Iongh, Marie-Laure de Noray, Hanson Njiforti, Annelies Donners, Carel Drijver, Patrick Dugan, Lucy Emerton, Victor Ferrari, Mahamat Habibou, Augusta Henriques, Jaap Kok, Roger Kouokam, Joost Lubbers, Daniel Ngantou, Jean-Claude Nguinguiri, Erick Jan van Oosterhout, Pierre Oyo, Ibrahima Peghouma, Jean-Yves Pirot, Maureen Roël, Paul Scholte, Jaap Schoorle, Martin Tchamba, Franke Toornstra, Piet Wit and Ton van der Zon.

The Institut de Recherche pour le Développement - IRD gave kindly permission to use information from the Atlas de la Province de l'Extrême-Nord du Cameroun to produce the maps in this book. We thank Marco Gylstra of Geovision for preparing the figures based on satellite images. We also thank CML staff, in particular librarian Edith de Roos for her continuous support and Maarten van 't Zelfde for his assistance with the graphics. The comments on earlier versions of the text by Chris Geerling and Joost Brouwer, and the reports from earlier periods made available by Bart van Lavieren and Piet Wit were very helpful. Finally, we thank Hans Bauer for the final review, Peter Hamling for his editing skills and Elroy Bos for overseeing the whole printing process.

All of the above institutions and experts together would not have achieved much without the confidence entrusted in the project and its partners by the sedentary and nomadic inhabitants of the floodplain. This book is a tribute to their understanding, cooperation and hospitality over the past fifteen years.

## Editorial note

This book contains a colour section in the centre of the book. *Plates* refer to colour figures or colour photographs in this section. Black and white photographs are incorporated in the text and are referred to as *Photos*. *Maps* are found at the end of the book.

The exchange rates used in this book are 100 F CFA = 1 FF = 0.1524 €, and 1 US$ = 1 €.

# Abbreviations

| | |
|---|---|
| **ABN** | Niger Basin Authority |
| **CEDC** | Centre for Environment and Development Studies in Cameroon |
| **CCCE** | Caisse Centrale de Coopération Economique |
| **CFDT** | Compagnie française de Développement des Fibres Textiles |
| **CML** | Institute of Environmental Sciences (CML), Leiden University, the Netherlands |
| **EU** | European Union |
| **FAC** | Fonds d'Aide à la Coopération (France) |
| **FIDES** | Fonds d'Investissement pour le Développement Economique et Social des Territoires d'Outre- Mer |
| **GEF** | Global Environment Facility |
| **GEPIS** | Groupe d'Expert sur les Plaines d'Inondation Saheliennes |
| **INADES** | African Institute for Economic and Social Development |
| **IUCN** | The World Conservation Union |
| **IRA** | Institut de Recherche Agronomique |
| **IRAD** | Institut de Recherches Agricoles pour le Développement |
| **IRAT** | Institut de Recherches Agronomiques Tropicales et des cultures vivrières |
| **IRCT** | Institut de la Recherche du Coton et des fibres Textiles |
| **IRGM** | Institut de Recherche Géologique et Miniêre |
| **IRZ** | Institut de Recherche Zootechnique |
| **IWRM** | Integrated Water Resources Management |
| **LCBC** | Lake Chad Basin Commission |
| **MESIRES** | Ministry of Higher Education, Computer Services and Scientific Research (Cameroon) |
| **MINEF** | Ministère de l'Environnement et des Forêts (Cameroon) |
| **MINPAT** | Ministère du Plan et Aménagement du Territoire (Cameroon) |
| **NGO** | Non-Governmental Organisation |
| **OCSD** | Organisation Canadienne pour la Solidarité et le Développement |
| **OECD** | Organisation for Economic Co-operation and Development |
| **OMVG** | Organisation pour le Mise en Valeur du fleuve Gambie |
| **OMVS** | Organisation pour la Mise en Valeur du fleuve Sénégal |
| **ORSTOM** | Institut Français de Recherche Scientifique pour le Développement en Coopération (currently: IRD) |
| **RMP** | Research Master Plan |
| **SAILD** | Service d'Appui aux Initiatives Locales de Développement |
| **SAWEG** | Sahelian Wetlands Expert Group |
| **SEMNORD** | Secteur Expérimental de Modernisation du Nord |
| **SEMRY** | Secteur Expérimental de Modernisation de la Riziculture de Yagoua (later renamed to Société d'Expansion et de Modernisation de la Riziculture de Yagoua) |
| **SNV** | Netherlands Development Organisation |
| **SOGREAH** | Société Grenobloise d'Etudes et d'Applications Hydrauliques |
| **UNDP** | United Nations Development Programme |
| **WLP** | Waza Logone project |

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# Part I
# Introduction

# 1 Introduction

By Paul Loth and Mike Acreman

## 1.1 Floodplains

Floodplains (Plate 1.1) are the flat stretches of land adjacent to rivers that are inundated during floods (Nanson and Croke, 1992). Floodplains are created by the deposition of sediment as the river channel migrates laterally (Marriot, 1998). The periodic nature of the floods means that floodplains are composed of a rich mosaic of habitats including backwaters, swamps, ridges and hollows. Lateral connectivity between rivers and their floodplains during inundation is a key driving force for the river ecosystem (Junk *et al.*, 1989). Rivers provide the floodplain with sediments and nutrients, whilst the floodplain provides a breeding ground for river species (Welcomme, 1979). Figure 1.1 shows how fish catches increase with flooded area.

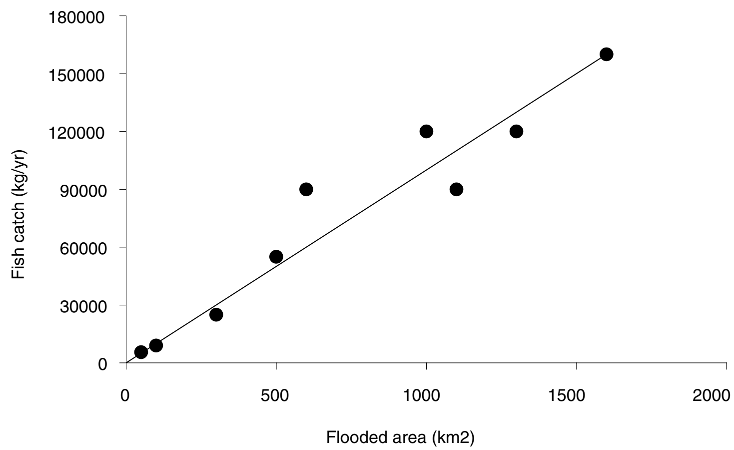


*Figure 1.1 Relationship between flooded area and fish catch on African floodplains (after Welcomme, 1996).*

Floodplains play a key role in regulating river flows: outflows from major floodplains such as the Okavango (Botswana) and Sudd (Sudan) are far less variable (lower floods and higher low flows) than inflows (Sutcliffe and Parks, 1996). Inundated floodplains are also important for replenishing underlying aquifers. Groundwater beyond the wetland has been demonstrated for the floodplains of the River Yamuna, India (Nielsen *et al.*, 1991), the Senegal River in Senegal (Hollis, 1996) and Hadejia-Jamare floodplains, Nigeria (Hollis *et al.*, 1993). In these wetlands generous seasonal water availability is combined with high soil fertility, which supports productive ecosystems of great biodiversity. Floodplains along the Nile, Indus and Tigris and Euphrates supported some of the great civilizations of the world (Mitsch and Gosselink, 1993).

Wetlands in low rainfall areas are particularly important. These ecosystems are often the only places where plant growth remains possible throughout the dry season. This is the reason that highly productive floodplains have been chosen as core areas for human settlement (Acreman and Hollis, 1996; Connah, 1981; Hollis *et al*., 1993). Floodplains are often not suitable for permanent habitation. Floods force inhabitants of the floodplains away, to higher grounds. Aquatic or water-adapted creatures remain, while others including Palaearctic birds, take advantage of the riches of the floods before migrating.

There are many examples of floodplains still fulfilling the same role for human societies today as they have done for many centuries. Nomadic pastoralists in the Sahelian zone take advantage of green fodder, on the floodplains during the dry season (Braukamper, 1996; CTA, 1999). Depressions filled with water after the floods have receded trap fish that are harvested by fishermen and birds. The saturated earth provides water for plant growth to allow cropping into the dry season. Thus, a fine fabric of interwoven ethnic groups exists with various activities succeeding each other during the seasons according to the availability of the resources (Pamo, 1998). Adaptation to the flood cycle is integral to the lives of many communities on the floodplain. Customary laws govern access to resources and festivals celebrate key dates in the calendar.

In recent years, a combination of drought, increasing populations of people and livestock and rising poverty has put increasing pressure on the floodplains and has led to over exploitation of the natural resources. In the face of such pressure, the implementation of major river engineering schemes, such as dams, for intensive irrigation and for hydroelectric power generation has often been seen as the key to development (Acreman, 1996a). Consequently throughout West and Central Africa, successive governments built dams in river systems paying little regard to the economic or environmental consequences for those suffering from the loss of the floods.

## 1.2 Floodplains of the Sahel

The Sahelian region of West Africa is defined roughly by average annual rainfall, extending from about 150 mm in the north (at latitude of around 18°N) to 1,000 mm in the south (latitude 10°N). Rainfall is highly seasonal, with a dry season extending from October to May. Average temperatures in January are around 25°C rising to 30°C in July, although daytime temperatures frequently exceed 45°C. Gash *et al.* (1996) estimated actual evaporation to be, on average, around 2.5 mm per day during the 1992 wet season when rainfall was about 7 mm per day. Thus much of the rainfall evaporates immediately.

Further south rainfall is considerably higher, reaching 3,000-5,000 mm per year in, for example, the Fouta Djallon massif of Guinea. Here the wet season can last for seven to nine months. These humid areas are the sources of the major rivers of the region, including the Senegal, Niger, Yobe and Logone. As they run north, the rivers provide vital water resources to the Sahel. Their flow regimes show a distinct peak, controlled by the rainfall patterns in the headwaters. After the peak flows have passed, the extent of the flooded areas decreases rapidly as the dry season progresses. The maximum extent of flooding varies from year to year in response to the amount of rainfall falling in the catchment area. In an average year the total inundated area of the major wetland systems in the Sahel is about 67,000 km$^2$ (see Table 1.1).

| Wetland | surface area km$^2$ | country |
|---|---|---|
| 1. Senegal delta | 3,000 | Senegal, Mauritania |
| 2. Senegal valley | 5,000 | Senegal, Mauritania |
| 3. Niger inner delta | 30,000 | Mali |
| 4. Niger fringing floodplains | 3,000 | Nigeria |
| 5. Sokoto and Rima valleys | 1,000 | Nigeria |
| 6. Hadejia-Nguru floodplains | 4,000 | Nigeria |
| 7. Logone floodplain | 11,000 | Cameroon, Chad |
| 8. Lake Chad floodplain | 10,000 | Nigeria, Cameroon, Chad |
| **Total** | **67,000** | |

*Table 1.1 Major floodplain wetlands of Sahelian West Africa (after Drijver and Van Wetten, 1992).*

Rainfall in the Sahel is very variable and the historical records show series of years with below or above average values. The 1970s and 1980s were particularly dry (especially in comparison with the average for the years 1931 to 1960, which are often used as a "standard period") creating severe drought conditions. This contrasted with the relatively wet 1950s and 1960s. For example, average annual rainfall in Niamey for the 1950-69 period was 650 mm, whilst in the 1970-1989 period it was 490 mm. Hare (1985) suggested that rainfall in the Sahel actually derives from locally evaporated water and not from the ocean. The deforestation of the West African coastal zone that has occurred over the past two decades has probably reduced wet season evapotranspiration. This in turn may have resulted in less rainfall further north.

Changes in vegetation patterns in the Sahel itself may exacerbate this reduction (De Iongh and Prins, 2000). The vegetation is broadly described as tropical grassland savannah that is dominated by three distinct units: tiger bush on the plateau areas, fallow savannah and millet fields. After the vegetation cover is removed an area can become hotter and drier because water is no longer cycled between plants and the atmosphere. This can lead to a positive feedback cycle of desertification, with increasing loss of water resources in that area. For example, results of simulations using a global circulation model, in which the natural vegetation in the Sahel was completely removed, indicated that rainfall was reduced by 22% between June and August, while the rainy season was delayed by half a month (Xue and Shukla, 1993). Savenije and Hall (1993) concluded that observed rainfall deficiencies over the period 1971-80 compared with the previous two decades could be attributed to a reduction of some 40 percent in evaporation, which may be due to loss of vegetal cover. Vegetation change may be as important as removal of vegetation. Gash *et al.* (1996) calculated that wet season transpiration from millet is 22% less than from the savannah but the heat flow to the atmosphere (sensible heat flux) is 41% greater.

The past 30-40 years has seen a rapid increase in the population of people and livestock in the Sahel. Given the demographic changes and the climatic variability, hydrological management has been seen as the key to development through the implementation of major river engineering schemes. Many dams have been built in the Sahel for irrigation and hydropower production, such as the Manantali dam in the headwaters of the Senegal River in Mali, and the Tiga dam on the Jama'are River, Nigeria. Few of these schemes have ever realised their full potential, and many are facing serious technical, administrative, socio-economic, political and environmental problems. Salinization and water logging are particularly prevalent as many schemes were built without adequate drainage. Irrigation schemes provide ideal conditions for snails, mosquitoes and other disease vectors, which can lead to serious epidemics like schistosomiasis and malaria. A further problem is that there is insufficient manpower to maintain the irrigation plots. The reduction in downstream floodplain inundation has had disastrous effects on the local rural economy, which relies on wetland products and functions. In some cases, these schemes established an inefficient, unsustainable single sector use, in place of the efficient, sustainable multi-functionality of the natural system. Many irrigation schemes have diminished, rather than improved, the living standards and economy of the region as a whole. This experience has highlighted that sustainable use of the natural resources requires a combination of intensive and extensive floodplain farming systems using both customary and modern techniques.

## 1.3 The Waza Logone floodplain

The Waza Logone floodplain (6,000 km$^2$) in northern Cameroon is one of these floodplain systems (Figure 1.2). It is about ten per cent of the total surface of major inland wetlands in the West African Sahel (Wesseling *et al.,* 1994). More than 100,000 people use the floodplain area for fishing, dry season grazing and agriculture. Exploitation may vary by site and by season, corresponding to the dynamic character of the floods and the cultural background of the floodplain users. Both resident and nomadic communities benefit from the wide variety of wetland products: fish, meat, milk, rice and other cereals, wild grains and seeds, medicines, timber, firewood and game. During the dry season particularly, the area plays a pivotal role in sustaining the rural economy of the region. Fish and wetland sorghum ("*muskwari*") are exported and herds from the wider surroundings in Cameroon, Chad and Nigeria can find fresh pastures and water for their survival in the dry season (Seignobos and Iyébi-Mandjek, 2000).


*Figure 1.2 The project area in the floodplain of the Logone River. Dark grey = flooded area, light grey = intervention area of the Waza Logone project.*

Due to the presence of two national parks, Waza and Kalamalue, the Waza Logone floodplain is the only remaining site in this region of the Sahel where a rich diversity of wildlife occurs (Drijver, 1991; see Plate 1.2). Today, wildlife depends largely on the 1,700 km$^2$ Waza National Park. The area was first gazetted as a hunting area in 1934, and subsequently, in 1938 it was classified as a forest reserve. In 1960 the area was designated as a National Park (Flizot, 1962), and in 1979 it was declared a Man and Biosphere Reserve (UNESCO, 2003). Nowadays giraffes, elephants, lions and various species of ungulates, such as korrigum, roan antelope and the western kob can still be found in large numbers. The Waza Logone region hosts various species of birds of prey, vultures, as well as ostriches, secretary birds, marabous and most of the West African wetland birds, including various species of heron, crane, stork and ibis. The region also supports large numbers of migratory birds. Their annual migration over the Sahara to Europe and back again six months later would not be possible without the rich feeding grounds and resting sites of the floodplain.

*Photo 1.1 Rice fields at the SEMRY II irrigation scheme at Maga (Photo P. Loth).*

In 1979, a dam was built across the Waza Logone floodplain to create a reservoir, called Lake Maga, for irrigated rice cultivation (Figure 1.2) in the SEMRY II rice scheme. The dam intercepted feeder rivers that fed water from the Mandara Mountains to the floodplain. Associated embankments along the Logone, built to prevent inundation of the rice scheme, also restricted floodwater extending across the floodplain. This coincided with a succession of years of below average rainfall. As a result, the flooding patterns of the waters overflowing the levees of the Logone River changed (Drijver and Marchand, 1985). The floods extended less far from the river, which led to changes in the vegetation. Palatable grasses disappeared and were replaced by short-lived, low quality grasses, thus significantly depleting the renewable fodder for livestock and wildlife (Pamo, 1998). The floods no longer refilled the water points, scattered around the area, so that animals had to migrate beyond the floodplain to find dry season drinking water. Fish no longer re-colonised the water points and migrating waterbirds could not find suitable habitat. The reduction in flooded area led to a rapid decline of the floodplain ecosystems and local communities found it difficult to continue with their specialised wetland livelihoods. In order to survive, the different groups were forced to diversify into activities previously practised by the other groups. Consequently, the number of conflicts between the different users of the floodplain increased (Hussein *et al.*, 2000; Moritz *et al.*, 2002).

### *The Waza Logone project*

The first studies of the environmental problems in the floodplain that arose from the changing water regime were undertaken under the auspices of the Institute of Environmental Sciences (CML) of Leiden University, the Netherlands (Drijver and Marchand, 1985). The outcome of these studies led to the formulation of a floodplain restoration project. After an initial phase in 1988, the Waza Logone project started in earnest in 1992 (Chapter 9). The general objective of the project was to achieve long-term enhancement of the biodiversity of the Waza Logone area and to provide a sustainable improvement to the quality of life of its population. To reach this objective, the project has formulated a number of specific aims, including re-inundation of the floodplain, institutional strengthening and improved management of the Park and its surrounding area in collaboration with local communities (see Chapter 15). The many pioneering aspects of the Waza Logone project led it to become subsequently a demonstration site for the sustainable management of Sahelian floodplains (IUCN, 2000b) and application of the ecosystem management approach (Pirot *et al.*, 2000).

### *Characteristics of the Waza Logone floodplain*

The flooding of the Waza Logone Floodplain caused by the Logone River depends on the amount of rainfall that falls within the catchment area. Local rainfall is affected by global climate change. A change in rainfall affects the extent and duration of the flooding. The recent prolonged period of reduced flooding was exacerbated by the construction of the Maga dam. The floodplain ecosystem was severly damaged. Recent downward trends in rainfall may be due to short-term variability in rainfall or the result of lasting changes in global climate.

In low rainfall areas, where rainfall is seasonally distributed, the water stored in the soil provides a vital source for plant growth. The ratio of perennial grasses to annual grasses is greater in those places where soil moisture is replenished annually compared to places where available soil moisture is not recharged. In floodplains perennial grasses prevail because adequate soil moisture is available. When the moisture in the soil is not sufficiently replenished less productive annual grasses replace perennial grasses. This has occurred on the Logone floodplain where floodwaters have not reached for a number of years. Local rainfall was sufficient for the rapidly growing annual grass species to complete their life cycle but not sufficient to replenish the water table.

Perennial grasses have a higher annual biomass production than annual grasses, because they continue to grow long after annual grasses have completed their life cycle and died. The growing green parts of a plant contain more nutrients than dead plant parts, so that grazers of perennial grasses attain a better condition than when they feed on annual grasses. When the proportion of perennial grasses increases at the expense of annual grasses grazers will thrive better. Many grazers, including livestock, must drink daily. This limits the distance the animals can move away from a water point. Animals that need to travel far to reach water have to expend more energy  than those who can find water at close range. Grazers that can easily find drinking water thus have more time available to search for the best grazing patches. Grazers profit from ample water availability. The productivity of the floodplains has long been recognised by nomadic herdsmen, who take advantage of the continuing grass growth on the floodplain during the dry season.

Fishers can make substantial incomes from the fish that they can catch in the floodplain. Dry land crops benefit particularly from the stored moisture in the soil after flooding. Since grass growth for livestock, the size of fish stocks, and soil moisture availability for the growing of crops are all positively correlated with the degree of flooding, the income of the local communities depends also on the extent of the flooding.

The Waza Logone floodplain also plays an important role in the conservation of biological diversity, from the global level to the local level. At the global scale, the floodplain is an important foraging area for palaearctic migratory birds. At a regional, West and Central African, scale, the elephant population of the Waza National Park may be one of the last remaining viable populations of this region. Recent data also suggests that the lions of Waza represent one of the last remaining populations in Central and West Africa. The Waza Logone project also focused on the negative impacts that reduced flooding had on the biodiversity in the floodplain.

From its inception, the Waza Logone project faced a situation where conservation efforts were frustrated by the hostile relationships between the conservation authorities and the local communities (Drijver, 1991; Scholte *et al.*, 1996). Additionally, the project found that many conflicts occurred among the various groups of people in the floodplain area:

- Farmers may occupy traditional grazing areas, particularly in the wet season grazing grounds, outside the floodplain area;
- Since cattle and wild grazers eat the same grasses, they may compete with each other;
- Predators may prey on the most abundant prey, so that when cattle out-compete wild grazers, proportionally more cattle will be killed and eaten;
- Herders may allow their livestock to graze illegally within the perimeter of the Park, bringing them into conflict with game wardens;
- Whilst migrating, pastoralists may destroy fishing canals in the floodplain, and cattle may destroy crops that are in the field;
- The fishing rights in the floodplain, traditionally vested with the Kotoko, have been disputed by another tribe, the Musgum (Van Est, 1999);
- Fish caught within the boundaries of the national park, are illegally acquired, thus bringing those fishers in conflict with the Park's authority.

Tourists are attracted by the landscape and the wildlife (Plate 1.2.). Visiting tourists pay entrance fees, the bulk of which are collected by the Central Government. Little was distributed to the local communities around the National Park. This increased the antagonistic attitude of the local population towards the National Park Authorities.

More than 1,000 elephants make use of the floodplain, but the Waza and Kalamalue National Parks are too small for the entire elephant population to find sufficient food. Consequently, many elephants move to other feeding areas, outside the Parks, destroying fields and possessions of the people en route (De Iongh *et al.*, 1999; Tchamba, 1996a,b; Tchamba *et al.*, 1994).

The movement and distribution of wild animals in and around the National Parks necessitate appropriate management efforts involving local populations. This is one of the so-called "*Malawi Principles"* of the Ecosystem Approach for the conservation of biological diversity (CBD, 1998). Guinea fowl populations can be managed for sustainable meat off take at the village level. Many antelopes graze on the floodplain east of the park in the dry season. Lions venture out of the protected area of the Waza National Park in pursuit of their prey. Cows and small stock fall prey to the lions. The solution of the ensuing conflicts arising from livestock predation by lions requires a higher level of management than the Park Warden or the Village Chief. Elephants roam from the Kalamalue Park as far as the town of Maroua, causing destruction on the way. The appropriate level to address the elephant problem therefore would be at the Provincial level of the Governor. The reform of the management of the natural resources and conflict control are the two important pillars of the Waza Logone project. Sharing the responsibilities for the upkeep of protected areas with the local communities may provide the necessary incentives to the disadvantaged people (Barbier, 1992; Drijver, 1991; Drijver, *et al.*, 1995; Moritz *et al.*, 2002; Scholte *et al.*, 1996). Organising all stakeholders on the floodplain is the other innovative approach that recurs in this book.

## 1.4 Organisation of the book

This book describes the efforts undertaken by the Waza Logone project over the past ten years to mitigate the ecological and socio-economic effects of the dam on the floodplain area and its inhabitants. To achieve sustainable use of the natural resources in the floodplain area, the project's main aim was to provide a sustainable livelihood for the local people and to maintain the diversity of the biological resources of the floodplain. The developments in the Logone floodplains can be considered as an example for other floodplain areas in Central and West Africa in general, and those of the Lake Chad Basin in particular.

Part I covers a general introduction to the book. Enhanced food production has been, and still is, a major concern for the governments of many countries that are regularly facing food shortages. In the past, large infrastructural projects have been designed without consideration of the consequences for the environment and without consulting the local populations. Part II describes the historical and political developments that have led to the rice scheme at Maga in the late 1970s. At that time formal environmental impact assessments were not required. Nonetheless, the local population had already forseen many of the problems that later led to the establishment of the Waza Logone project to mitigate the consequences of the infrastructural works.

Part III provides a more detailed overview of the physical and ecological settings of the Waza Logone region. It deals with the various scales at which the region can be considered. In order to find adequate remedies for the deteriorating situation, it is important to realise how the floodplain is used and how the effects of the changing flooding regime impacts on receiving ecosystems.

Part IV deals with the people who live in the floodplain. This Part provides an account of how the livelihoods of the various ethnic groups in the floodplain are dictated by the dynamics of the floodplain, and how this defines the incomes of the various user groups.

The interventions that the project has undertaken so far are presented in Part V. The history of Waza Logone project, its objectives and the actions undertaken by the project to achieve the restoration of inundation of the floodplain are described. After a number of pilot flood releases hydrological models were developed to examine full-scale release options. The benefits associated with a few of these re-flooding options are examined. The project developed a management structure for the sustainable use of the floodplain and its resources.

The book concludes with Part VI, which provides a recipe for ecosystem restoration based on the Ecosystem Approach, adopted by the Convention on the Conservation of Biological Diversity, as the leading principle for ecosystem management. Finally, based on the experiences of the Waza Logone Project, guidelines for Sahelian floodplain management are developed.

# Part II
# The Receding Water

# 2 The Need for Increased Rice Production

By Charles Njomaha and Jean-Yves Pirot

## 2.1 The colonial view of economic development

Foreign involvement in northern Cameroon started in 1902 when the Germans arrived and began to map the territory. Following the German defeat in World War I the League of Nations granted the French and the British the mandate to rule over Cameroon. When the French arrived for the first time in the North of Cameroon in 1916, they had to intervene in the intertribal warfare. They set up an administrative network that was based on the Fulbe traditional chieftaincy. In the 1930s the French wanted to develop the infrastructure in the far North in support of the local administration. The funds required for the improvement of the infrastructure would be generated by an increase in tax revenues gained from the production of cash crops. Thus, people were encouraged to grow groundnuts and cotton. People living in the mountains were already growing groundnuts, so the French were able to increase the production by importing, testing and diffusing additional seeds from Nigeria and other West African countries. The groundnuts were first transported to Garoua, and then shipped via the Benue River to Port Harcourt in Nigeria to be traded on the world market. The trials with annual cotton failed, however, because no research was undertaken to advise farmers on how to grow the cotton under the local circumstances. The nearest location where annual cotton was grown was in Chad.

During the Second World War (1939 – 1945), development activities in the region were significantly reduced. After the war the French recognised that the realisation of the basic infrastructural necessities could not be borne by the agricultural sector alone. Therefore, a French-based investment fund (FIDES[1]), a cotton and textiles development corporation (CFDT[2]), and two research institutes (IRCT[3] and IRAT[4]) were created in 1946 to finance and support infrastructural and agricultural developments in Cameroon and other colonies. In this new structure, tax revenues were used only to supplement the development fund. A few years later, in 1952, a new rural development company (SEMNORD [5]) was created in northern Cameroon with the aim to disseminate technologies on food crops.

Due to the long-lasting floods (6 to 8 months), and the presence of heavy clay soils (vertisols), only floating rice was grown in the Logone floodplain. In the period 1942 to 1947, the total rice production in the north of Cameroon increased from five to ten tonnes of paddy rice, and by 1950, the total rice production had increased to 350 tonnes (Beauvilain, 1989). Not surprisingly, therefore, SEMNORD started with experimental plots for irrigated rice. The positive results of these trials led to the conclusion that irrigated rice would be a suitable crop for the Logone floodplain. In 1954, a rice company, called SEMRY[6], was created to promote the local rice production in the Logone floodplain and to organise the rice marketing activities. By 1965, SEMRY was supervising 10,000 farmers for a total of 6,500 hectares of cultivated land and a production of nearly 10,000 tonnes of paddy rice (Roupsard, 1987). There were four major producing centres: Yagoua, Djafga, Pouss and Ngodeni. From 1953 to 1970, the annual quantity of rice sold in Cameroon by SEMRY increased from 1,500

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1 FIDES: Fonds d'Investissement pour le Développement Economique et Social des Territoires d'Outre- Mer/ Economic and Social Development Fund for Overseas Possessions

2 CFDT: Compagnie française de Développement des Fibres Textiles

3 IRCT: Institut de la Recherche du Coton et des fibres Textiles

4 IRAT: Institut de Recherches Agronomiques Tropicales et des cultures vivrières

5 SEMNORD: Secteur Expérimental de Modernisation du Nord

6 SEMRY: Secteur Expérimental de Modernisation de la Riziculture de Yagoua

tonnes to 4,100 tonnes and this represented about 30% of the national consumption (MINPLAD, 1970b). The major problem facing the company was its inability to control the overflows of the Logone river, which reduced the effects of fertilisers and significantly influenced rice yields. Other problems included the lack of qualified researchers, market distortions due to an informal market of paddy rice and the relatively low price of imported rice arriving in Douala.

## 2.2 Intensification and expansion of rice production

From Independence (1960), the Cameroon administration organised activities and investments within five-year Development Plans. The second Development Plan (1966-1971) had the following objectives: (1) to reduce food imports (2) to increase inter-regional trade within the country and (3) to increase rural household incomes. Within the framework of this second Plan, the government ordered a feasibility study of an intensification of SEMRY activities in 1967 (MINPLAD, 1970a). This intensification programme involved the construction of embankments to stop bank overflows from the Logone river, a controlled irrigation of rice plots through water pumping, the use of fertilisers and improved varieties and the use of adequate machinery to plough the land. The study took three years (1967-1970) and was conducted by IRAT, SOGETHA and a private engineering company. The study concluded that rice yields could be doubled to three tonnes per hectare because farmers could produce twice a year. These projected yields were expected to increase farmers' annual income substantially (estimated in 1968 at 23.80). By 1985 SEMRY could thus attain a yearly production of 16,000 tonnes of white rice. This figure would represent 40% of the estimated national consumption at a projected five per cent growth of urban population, assuming favourable income elasticity for rice. The reduction of annual rice imports resulting from the project would constitute savings of about 610,000 to 760,000 to the treasury. The estimated economic rate of returns of the project varied between 11.6 and 17.7%, depending on the various production scenarios. Although the financial rate of return was relatively low (4 to 5.7%), it was predicted that the external capital investment could be paid back entirely by 1985. Finally, to increase the price competitiveness of SEMRY rice compared to imported rice in Douala and Yaoundé, the consultants recommended an improvement of the road network between Yagoua and Douala, and to levy a levelling tax of € 0.01 per kg on imported rice (MINPLAD, 1970a,b).

Based on these projected agronomic and financial results, the Cameroon government decided to intensify the project. A new SEMRY[7] project was created in Yagoua in 1971, with the objective of increasing rice production. Expected spin-offs were a reduction in famine incidence in north Cameroon, to back-up the country's self-sufficiency in rice, to increase farmers' income and to reduce rural to urban migration. The intensification project started with an investment of € 3.96 million jointly financed by the World Bank, two French institutions (FAC[8] and CCCE[9]) and the Cameroon government (Roupsard, 1987). By 1975-76, SEMRY portrayed outstanding agronomic performances: the paddy yields ranged from four to six tonnes per hectare, far above the predicted three tonnes. The annual production of paddy reached 23,391 tonnes, about 50% more than the production projected by the feasibility studies. Given this agronomic success, the Cameroon government decided to expand the intensification programme to other favourable areas of the Logone floodplain. This expansion was expected to help the company to achieve quickly and fully its objectives listed above. The location studies conducted in 1976 led to the creation of two other SEMRY units in Maga (SEMRY II in 1977) and Kousseri (SEMRY III in 1978). To avoid the high costs of irrigation by pumps, which increased the production costs in Yagoua and Kousseri, the government decided to build a dam in order to create the Lake Maga. The lake would cover an area

[7] SEMRY: Société d'Expansion et de Modernisation de la Riziculture de Yagoua
[8] FAC: Fonds d'Aide à la Coopération (France)
[9] CCCE: Caisse Centrale de Coopération Economique

of 360 km$^2$ and would hold about 500 to 900 millions m$^3$ of water. The total investment amounted to € 21 million. Compared to the investment costs in Yagoua and Kousseri (€ 3.45 and 2.06 million respectively), the SEMRY project at Maga was projected to be the largest production unit, with a potential of 10,000 hectares of irrigated land. SEMRY II and III had great agronomic performances similar to those of SEMRY I in Yagoua. By 1986, the three SEMRY units were producing a total of 102,680 tonnes of paddy rice on 13,000 hectares of land and in collaboration with 22,000 farmers (Harre *et al.*, 1992). Unfortunately, however, the SEMRY rice appeared to be less price competitive compared to imported rice and the corrective actions (levelling tax, compulsory mix ratio) taken by the government turned out to be ineffective. Due to the economic crisis, which started in 1987, the government was forced to stop its subsidies to SEMRY in 1988. The poor financial performance of the company resulted in a drastic reduction of its agronomic performance.

## 2.3 The planning and building of Maga Dam

Very few records are available to explain the process followed to plan, build and operate Maga dam. A series of eight reports produced from 1962 to 1972 by SOGREAH[10] indicate that planning for the construction of an irrigation scheme near Pouss started about 20 years before the reservoir at Maga was finally built in 1979-1981. Another document, dated November 1981, gives a list of the 26 reports produced from April 1975 to March 1981. However, these are mostly tendering documents, feasibility studies and recommendations for the operation and maintenance of the hydraulic equipment. The central library in SOGREAH Headquarters (Grenoble, France) holds only seven reports on the construction of the irrigation schemes under consideration, namely SEMRY I (5,300 hectares, upstream of the dam and reservoir) and SEMRY II (7,000 hectares, for which the dam and reservoir were built). These are also mainly engineering feasibility studies and tendering documents for the construction of the infrastructure, such as the intake sluice gate, inflow channels, 27 km earth dam and 21 km protection embankment along the Logone River. Of some 35 different documents found, only two short reports address, to a limited extent, some of the impacts of the two irrigation projects.

Calo and Cardiles (1977) analysed the impact of SEMRY I on the basis of a ten-day desk study. Their conclusions of the project, which produced 23,000 tons of rice in 1976, were very positive: "SEMRY I has resulted in a fourfold increase in the size of the city of Yagoua and in the number of households in the vicinity of the irrigated perimeter, perhaps due to the break-up of former and larger *sarés* (several houses and concessions belonging to a family group); the project provides employment for about 500 highly-qualified technicians and workers (note: to be reduced to 250 when the scheme became fully operational; in 1992, only 87 staff were left to operate SEMRY I ) and 12,000 rice planters were trained; individual income in the project area (  34) is four times the income in the non-managed area, thus boosting investments in e.g. farming and household equipment". The report stressed the significant increase in government services (new health centres, schools and colleges, police stations etc.) and government employees, and quotes impressive progress in terms of primary and secondary education. The impact of the project on improved community health was much less clear, although the report mentioned that schistosomiasis and amoebas were quite insignificant threats. Overall, given these very positive impacts, the project was considered a major success in terms of water management, food security and improved livelihoods.

More interestingly, SOGREAH (1980) analysed the impact of the dam on water availability in the floodplain and the Waza National Park, following the acute drought of December 1979. The study concluded that this drought was primarily a result of reduced rainfall and associated flooding in 1979 (920 million m$^3$ less than in an average year) compared to the water deficit due to the dam, which is estimated at only 107 million m$^3$. Nevertheless, the report made a case for further research into the proximate causes of the drought in the floodplain. Additionally, there were remarks indicating

[10] SOGREAH: Société Grenobloise d'Etudes et d'Applications Hydrauliques

*Photo 2.1 The dyke along the Logone, completed in September 1982, prevented water to enter the floodplain through the Petit Goroma (Photo Piet Wit).*

River (which blocks several channels providing water to the floodplain), could potentially cause a serious water shortage in the downstream part of the floodplain, including the Waza National Park. To compensate for the loss of water from the rivers upstream, it was suggested to gradually release additional water (from 40 to 70 $m^3$/sec between September and November) to the floodplain using the sluice gate at Vrick (max. of 100 $m^3$/sec). It was also suggested that partly reopening one of the natural channels (Areinata) feeding the Logomatya River channel (north of the rice scheme) could guarantee some water flow to the floodplain and towards the park after August. The complete reopening of the natural channels blocked by the last few kilometres of protective embankment along the Logone River was considered impossible, since this could jeopardise the existence of the rice scheme itself or lessen its drainage capacity.

SOGREAH, which provided detailed guidance to SEMRY on the operation and management of all hydraulic infrastructures, referred to Vrick as a simple sluice gate that could only be used to partially or fully flush the reservoir in the event of dangerously rising water levels (SOGREAH, 1981a). It thus appears that the suggestion made in 1980 to use the Vrick sluice gate to provide for environmental flows was disregarded. Unfortunately, none of the recommendations listed in the impact study (SOGREAH, 1980) were implemented in the following years. Another assessment of options to alleviate the impacts of recurrent droughts in Waza National Park was done in 1982 (Grijsen and Wit, 1983). Commissioned jointly by the Directorate General for Tourism, Cameroon, and the Netherlands Ministry of Foreign Affairs (DGIS), this study recommended implementation of managed flood releases from the Vrick sluice gate at the onset of the rainy season, to increase the outflow of the Logomatya river into the floodplain by lowering its banks and by enlarging a number of natural sloughs, and in any case to assess the feasibility of opening a new channel from Maga (or Guirvidig) to Dieguere. However, it was not until 1994 that the first opening in the embankment along the Logone, at Tekele, resulted in a long-awaited flow of additional water from the river to the floodplain and the National Park.

In 2003, forty years after the first feasibility study, it is relatively easy to pass judgement on the decisions made, or how the planning could have been better. A more ecologically-sensitive and socio-economically acceptable irrigation scheme could have been built and operated over the past thirty years – *i.e.* from 1962 when the first feasibility study was made until 1994 when the Waza Logone project conducted the first pilot release of water into the floodplain. It is clear, however, that the irrigation scheme's builders, whose enthusiasm was quite understandably boosted by the high productivity of SEMRY I in the years immediately following its inception, did not collect any ecological, hydrological and socio-economic data to assess the downstream impacts of the dam. It may be that these detrimental impacts were considered negligible compared to the thousands of tons of rice produced by SEMRY I and the even larger quantities anticipated from SEMRY II. Thus, the protective embankment along the Logone River was built between June, 1979 and February 1980 without the knowledge that protecting SEMRY II from the risk of river flooding did not require a 21 km long embankment. This embankment would instead deprive people downstream of much needed water and, therefore, of their livelihoods. It also had a negative influence on the Waza National Park, which is a UNESCO Biosphere Reserve. Another example is that the sluice gate at Vrick was built mainly to improve the level of safety of the dam and not to manage releases of water to the floodplain in the spirit of the Cameroon-Chad agreement on the use of Logone waters. Lastly, the designers of the rice scheme did not contact the local people, nor did they consult their traditional leaders. That they were mistaken to ignore local involvement became evident when the protective embankment was nearing completion in early 1980. Then, a large delegation of high-ranking sultans and *Lawans* asked the construction company to leave the Petit Guruma channel (which feeds the Logomatya) open to carry water to the floodplain. Unfortunately, their request was simply turned down, because at such a late stage the contractor lacked the necessary downstream hydrological data to support an alternative building plan, and perhaps also failed to understand, or trust in, traditional knowledge.

Environmental impact assessments started to become common features of development projects only in the mid-1980s; not until the 1990s was major progress made in mainstreaming detailed assessment and mitigation actions into natural resources development projects affecting tropical wetlands (Meynell and Pirot, 1996). Indeed, if the recommendations of the World Commission on Dams (WCD, 2000) had been made available earlier, the planning process for SEMRY II would undoubtedly have been significantly different. This is why the Commission's guidance should be used and, if necessary, adjusted to meet the expectations of governments, investors, beneficiaries and affected populations.

# 3 Consequences of the Dam and the Drought

By Paul Loth

## 3.1 Reduced flooding as a consequence of climatic change?

The high productivity of the Waza Logone region depends to a large extent on the over bank flooding of the Logone River each year between September and December. After 1979 the annual inundation of the Waza Logone floodplain was reduced significantly, due to hydro-agricultural works and low rainfall. The construction of the dam to create a reservoir (Lake Maga) for the SEMRY irrigation scheme at the southern boundary of the flood plain has blocked water supplies coming from the Mandara Mountains to the floodplain. In all, the dam reduced the flooded area by almost 1,000 km$^2$ (Drijver and Marchand, 1985).

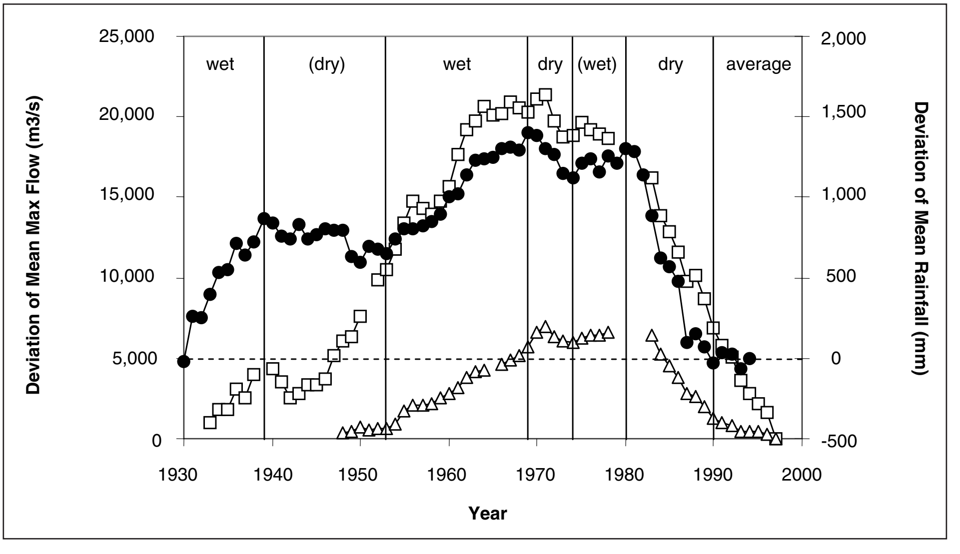


*Figure 3.1 Cumulative deviation of mean annual rainfall (black dots) and maximum flow discharges (m$^3$ per second; open symbols) for two flow gauge stations in the Logone river. Rainfall data is averaged for rainfall stations in the entire Logone floodplain. Squares represent flow gauge measurements at N'Djamena, triangles for flow gauge data at Bongor. The indication of wet and dry periods is based on rainfall data. Dotted line represents zero deviation rainfall.*

The years following the closure of the dam were coincidentally characterised by below average rainfall. In Figure 3.1 the cumulative deviation of the mean annual rainfall for rainfall stations in the Logone floodplain is presented[1]. For the period that rainfall data are available (1930 – 1994), several wet and dry periods can be distinguished. The series begins with a succession of wetter-than-normal years until the late 1930s. The following period is almost normal in rainfall, perhaps with a slight tendency to be drier than the mean. The next 15 years or so are characterised by

[1] A cumulative deviation of the mean graph adds the difference of the total yearly rainfall with the mean rainfall for each year. In this case the mean rainfall over 65 years was 954 mm. A year with less rainfall than average results in a negative value added to the cumulative sum, a rainfall amount higher than the mean value on the other hand adds to the total value of the summed deviations. See also Prins and Loth (1988).

consistently higher rainfall amounts than normal. Although in this period the annual amounts differed only slightly from the long-term mean, there was not a single year with lower than average rainfall. The first half of the 1970s was drier than normal, but the second half of the 1970s was again slightly wetter. A succession of very dry years occurred in the period between 1980 and 1990, after which rainfall in the Logone floodplain returned to the long-term average (Figure 3.1).

In the same figure, the cumulative deviation is plotted of the maximum discharge flow of the Logone River as measured in Bongor and N'Djamena. A hydrological study showed that a significant correlation exists ($r^2 = 0.66$, $P < 0.05$) between the annual maximum flow at Bongor and the duration of the floodwater exceeding bank full discharge (Mott MacDonald, 1999). Hence, these flow rates are indicative of the extent of the floodplain flooded each year. The maximum flow rates of the Logone River measured at these two flow gauging stations also show series of years with more, or less, than the mean discharge. The trends in these two flow curves are very similar. That is not surprising, because the Logone River contributes to both flow records. All three curves show similar trends, although the flow data and the rainfall data are not entirely in phase. This is because the Logone River receives most of its water from upstream of the floodplain. Nonetheless, the strong downward trends in the period between 1980 and 1990 in all three curves suggest that during this period rainfall has been low over a larger area than the Logone floodplain alone (Folland *et al.*, 1991).

The reduction in flood extent over the years following the closure of the dam at Maga in 1979 is illustrated in Map 3.1. In some places, flooding was significantly reduced, or even completely absent during these years, while in other places both the depth and duration of the flooding were reduced.

## 3.2 Ecological consequences of reduced flooding

The reduction in flooding has had devastating consequences for the ecology and biodiversity of the floodplain (Van der Zon and Dong à Echiké, 1985; VanPraet, 1976; Wesseling *et al.*, 1994). Farmers, fishers and pastoralists who depend on the floodplain suffered from the negative impacts of the

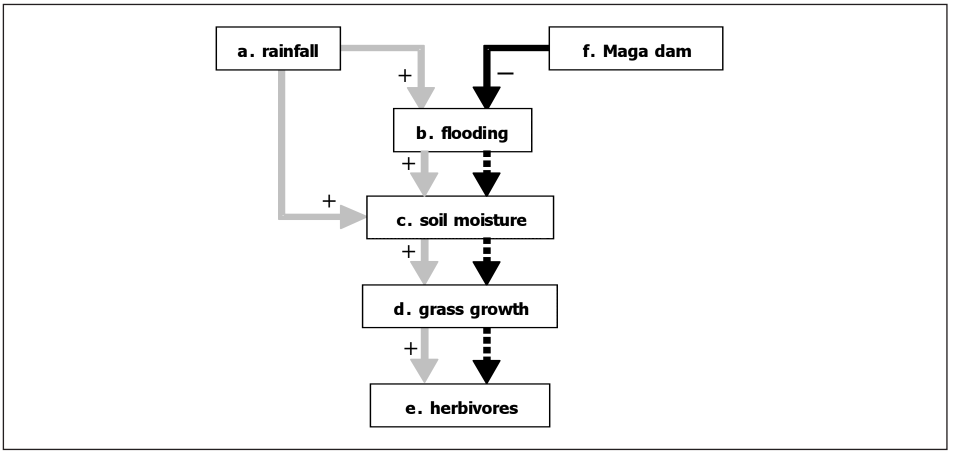


*Figure 3.2. Flow chart illustrating the cascading effects of water through the Logone floodplain ecosystem. Grey arrows indicate a positive effect i.e. an increase results in a higher quantity of the depending factor, while black arrows indicate the reverse, a negative effect. The Maga dam has one direct effect, namely the reduction in flooding (solid arrow), but due to the cascading effects the dam caused reductions in all the other factors as well (broken arrows). Note that low rainfall amounts also result in reduced flooding and lessened recharge of water in the soil.*

reduction in flooding (Drijver and Marchand, 1985; IUCN, 1999a; Wesseling *et al.*, 1994). Wild and domestic herbivores (Figure 3.2; *e*) thrive on good grasses (Figure 3.2; *d*). Grasses grow better after flooding (Scholte *et al.*, 2000b) because the plant available water in the soil is recharged (Figure 3.2; *c*) by rainfall that falls directly on the soil (Figure 3.2; *a*), and by water brought by the flooding of the Logone River (Figure 3.2; *b*). The flooding itself depends on the amount of rainfall that has fallen in the catchment of the Logone River. The dam (Figure 3.2; *f*) that had been constructed for the rice scheme, has a negative impact on the extent of the flooding of the Logone (SOGREAH, 1981b; Wesseling *et al.*, 1994). As a consequence, at some places the recharge of soil moisture has diminished, which in turn has resulted in the proliferation of species that are less palatable for the grass eaters, be they wildlife or livestock (Scholte *et al.*, 1995, 2000b; Van der Zon and Dong à Echiké, 1985).

The deterioration of the feeding grounds of the grazers should therefore be reflected in their numbers. The number of grazing wild ungulates in the Waza National Park indeed declined drastically since commissioning of the Maga dam. Analysis of the numbers of the most common wild grazers in the park, the western kob (*Kobus kob kob*), the korrigum (*Damaliscus korrigum*) and the roan antelope (*Hippotragus equinus*) indicate, however, that the decrease in wild ungulates commenced before the construction of the dam (Figure 3.3).

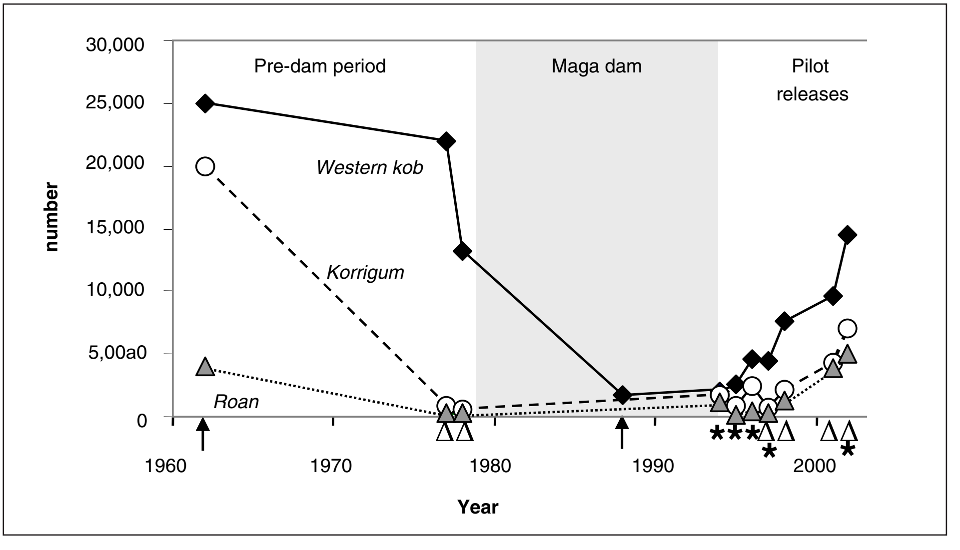


*Figure 3.3 Counts of three common, resident antelope species in Waza National Park, western kob (Kobus kob kob), korrigum (Damaliscus korrigum), and roan (Hippotragus equinus) since 1962 to present. Strongly deviating counts (2000) have been omitted. Note that various counting methods have been used: (↑ based on regular observations in the park, Δ transect counts, * waterhole counts. Three periods are indicated: before the construction of the dam at Maga, the period between 1979 and the first additional releases of water as a result of the pilot releases (see amongst others Chapters 5 and 16). Data from Saleh et al. (2002).*

In 1976 VanPraet (VanPraet, 1976) already concluded that the vegetation in the Waza National Park was degrading due to a process of soil dehydration. VanPraet suggested that this dehydration started as early as 1957, when the embankments along the Logone south of Pouss were constructed for the SEMRY I rice scheme. The increase in the numbers of wild grazers following the pilot releases in 1994 and 1997 form a clear indication that additional flooding of the Waza Logone area is beneficial to the wild grazers of the Waza National Park. Drijver and Marchand (1985) argued that the lack of rain and the corresponding low discharges of the Logone River were mainly responsible for the diminished flooding (Figure 3.4). It was a coincidence that the closure of the dam was followed by two very dry years. This suggestion is supported by the fact that in 1982 the inundated area in the Waza National Park was almost equal to that of 1974 (Map 3.1, end of book), which reportedly were hydrologically comparable years (Grijsen and Wit, 1983; Van Oijen and Kemdo, 1986). Although the hydro-agricultural works of SEMRY may not have been the main cause of the reduction in flooding extent, the Maga dam certainly had effect on the flooding patterns in areas downstream (see areas 4 and 5 in Figure 3.4).

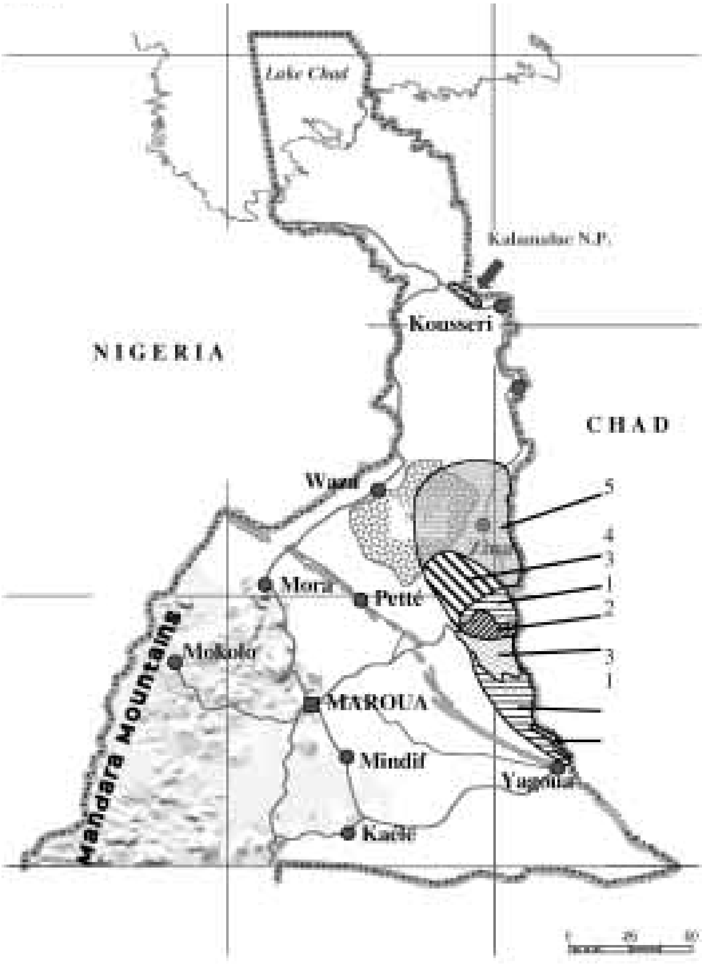


*Figure 3.4 After the construction of the dam at Maga, the natural flooding region was expected to be replaced by: 1) irrigated schemes, approx. 12,000 ha, 2) a reservoir, Lake Maga, approx. 39,000 ha, 3) an adjacent zone where flooding no longer would occur, approx. 59,000 ha, 4) a zone in which natural flooding would significantly have changed approx. 50,000 ha, and 5) a zone in which natural flooding would only slightly be affected, approx. 50,000 ha. After Drijver and Marchand (1985).*

Reduced flooding had additional negative effects on other production systems. The floods no longer refilled waterholes. Lack of surface water not only limited the movement of livestock and reduced fish production (IUCN, 1999a; Wesseling *et al.*, 1994). Waterfowl and other birds were forced into smaller habitats. Bird counts at places where flooding remained could be expected to yield similar, or even higher numbers of birds reflecting the increased density of birds in a reduced suitable habitat.

## 3.3 Socio-economic consequences

The altered flooding patterns also changed the cropping patterns in the floodplain area. When the reservoir at Maga filled up, dry season sorghum (*muskwari*) fields that existed there were lost (Fotsing, 2002; See Figure 3.5). Where the containment embankments prevented the floodwater's progress, people had to give up growing *muskwari*. Rice cultivation replaced the growing of *muskwari* (Fotsing, 2002), but the profits were made mainly by the parastatal rice-growing organisation, SEMRY.

The socio-economic consequences of the loss of natural resources in the floodplain were significant. The monetary losses, caused by the decrease in inundated floodplain area, were estimated at, on average, more than € 2 million per year (see Table 3.1). A significant proportion of the losses were borne by cattle owners. The loss of fishing grounds forced many fishers, in particular the Kotoko, to search for better opportunities. Some fishers moved to Lake Maga, but many of them moved to man-made Lake Lagdo in the North Province.

| Activity | Total loss (million €) | |
|---|---|---|
| | Calculated from [1] | After [2] |
| Livestock keeping | 1.68 | 1.40 |
| Fisheries | 0.54 | 0.50 |
| Agriculture | -- | 0.34 |
| Tourism and hunting | 0.03 | -- |
| Uses of grass | -- | 0.30 |
| Use of surface water supply | -- | 0.02 |
| Net loss | 2.25 | 2.56 |

*Table 3.1 Yearly economic costs of flood loss in the Waza Logone region. Calculation based on average climatic conditions resulting in a reduction of flooded area of 964 km2. Source: [1] Drijver and Marchand (1985), [2] IUCN (1999b).*

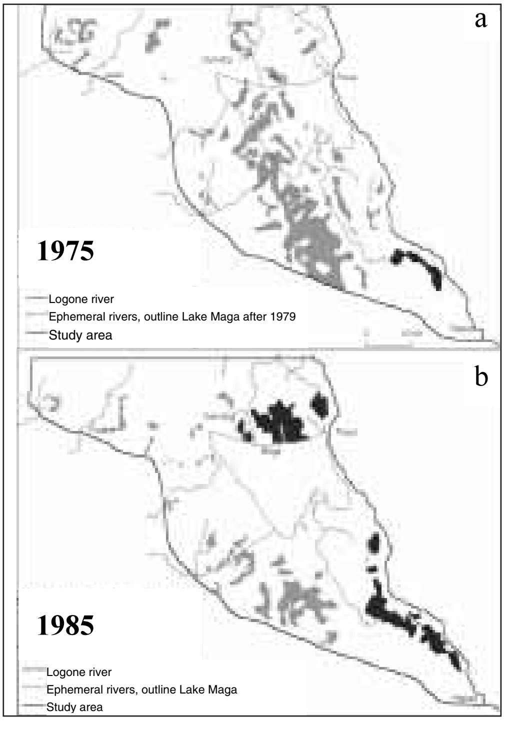


*Figure 3.5. Changes in land use after the construction of the dam at Maga and the containment dykes along the Logone river. a) in 1975, before the construction of the dam and containment dykes, and b) in 1985, after the construction of the dam and containment dykes. Areas with dry season sorghum in light grey (muskwari) and rice cultivation in dark grey. Based on satellite imagery. From Fotsing (2002).*

# Part III
# The Natural Setting

# 4 The Wider Context

By Sun Yan Evans and Paul Loth

The Waza Logone floodplain cannot be seen in isolation from the rest of the world. Global events have had their impact on the region. Similarly incidents that affect the nature of the Logone floodplain have had their impact on a much larger scale, even on a global level. Climate change, for example, is a global event that has implications for the ecosystem of Lake Chad. This is illustrated by the dramatic historical changes in water levels in the lake. However, the extent to which infrastructure works that led to the establishment of the Waza Logone project may also have contributed to the decline in lake levels in Lake Tchad, but this is beyond the scope of this book.

The natural resources of the Waza Logone floodplain are not only of local or national importance. The lavish dry season pastures that exist thanks to the recurring floods attract nomadic pastoralists from the neighbouring countries (see Chapter 7). The area's importance as a staging area for migratory birds is recently being discovered. The floodplain is important on a global scale. The Waza Logone project also has a bearing on a scale beyond the floodplain itself.

## 4.1 The wider context of the Logone floodplain

Situated on the West bank of the lower Logone River in northern Cameroon, the Waza Logone floodplain lies within the basin of Lake Chad. The water levels of Lake Chad have changed considerably over time. Around 10,000 years ago, during the wetter "pluvial" period (corresponding to glacial periods in high latitudes), Lake Chad water level was 100 m higher than at present and covered some 0.5 million km$^2$ (Goudie, 1977). The Lake level and size declined during the Pleistocene period.

During the early 20$^{th}$ century Lake Chad was the sixth largest lake in the world, but over the past three decades its size has drastically diminished. It is now only five percent of its former size. The speed at which the lake is drying-up can be seen from satellite images that have been acquired at different times (Figure 4.1). The earliest image, 1963, shows that the entire lakebed was occupied by water (Figure 4.1.a), while at present day very little water is left (Figure 4.1.b). Although the lake level fluctuated considerably in the past, the recent decline of the lake seems to be a serious downward trend (Figure 4.2). Also the seasonal fluctuations have become more pronounced in the recent years.

The initial decline of the lake has been attributed to the deteriorating climatic conditions in the 1970s, when a series of successive droughts caused the lake to drop to its lowest level ever known. Because less water was available for rain fed agriculture, the demand for water for irrigation purposes increased. Water off take for irrigation from its main feeder rivers, the Chari and the Logone, has increased subsequently, and currently accounts for half of the lack of water in the lake. Hence, climatic change, as well as widespread human use of the water has resulted in the low water levels in Lake Chad (Coe and Foley, 2001).

Lake Chad and the floodplains of its main feeder rivers play an important role on a global level. Many migratory bird species make use of the abundant food resources during one part of the year. The best known flyways are those along the coast of West Africa and the eastern flyway to East

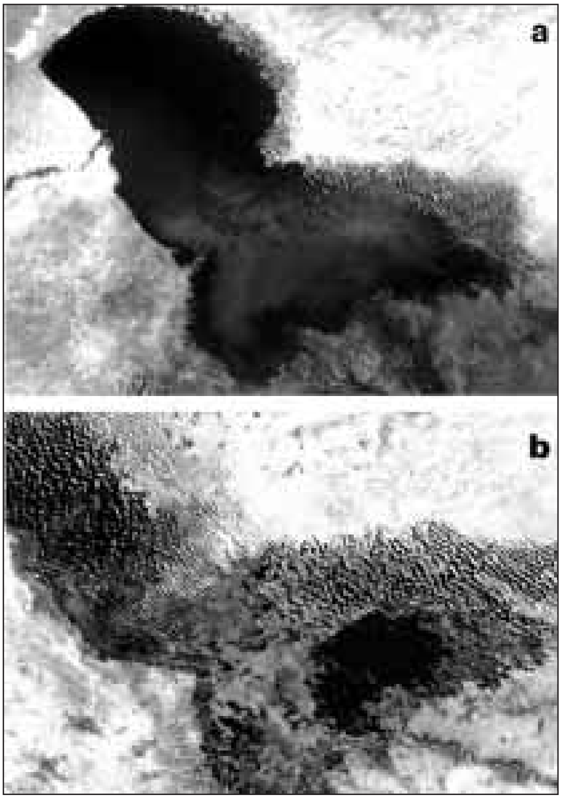


*Figure 4.1 Satellite images of Lake Chad, showing free water in black. In 1963 (a) the water surface was uninterrupted between the northern and the southern part. In 2001 (b) only a small open water body remained in the southern part, surrounded by swampy vegetation (grey). The northern and the southern part of the lake are almost completely separated by sand dunes. The sand dunes can be recognised by the rippled features on this image. (Source: a: Earth Observatory, NASA, US Government: http://www.gsfc.nasa.gov/gsfc /earth/environ/lakechad/chad.htm,b: http:// earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=4714 )*

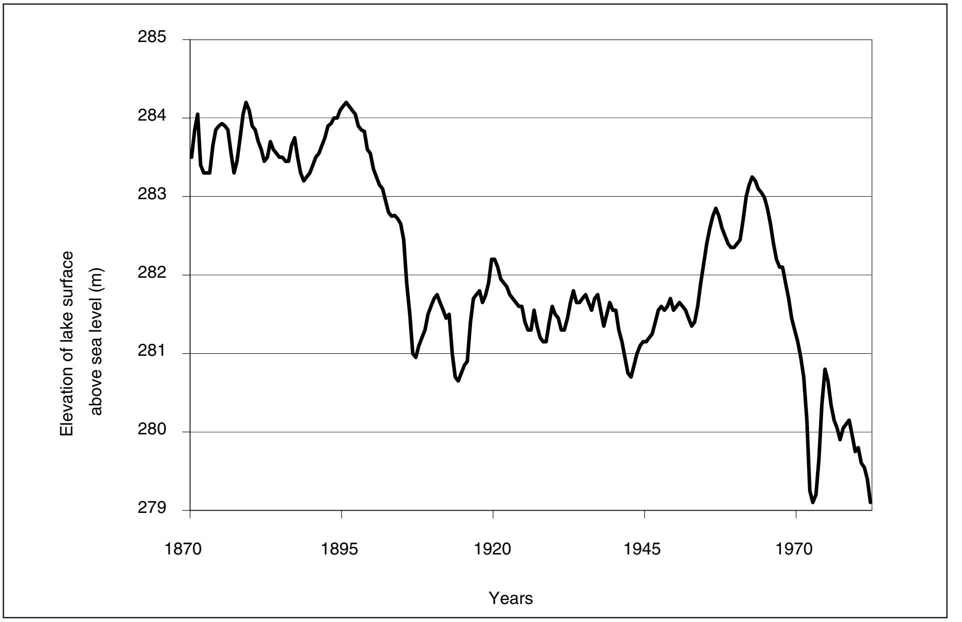


*Figure 4.2 Changes in water level of Lake Chad since 1870, based on minimum and maximum lake levels. After Mott MacDonald (1993) and Sikes (1972).*

Africa. A third migration route to Central Africa has been described, but has not been studied in as much detail as the other two (Figure 4.3). Waterfowl are abundantly present in the Logone floodplain, indicating its importance as a wetland. For some bird species, such as the black crowned crane (*Balearica p. pavonia*) the Logone floodplain meets the Ramsar criteria (Davis, 1994) of an internationally important wetland. This species is a near threatened species, because its numbers show a decreasing trend, and because more than 1% of this species is found in the Logone floodplain (Wetlands International, 2002; see also Table 6.1). Based on the numbers of water birds visiting the area, the floodplain could be included in the Ramsar list as a wetland of international importance.

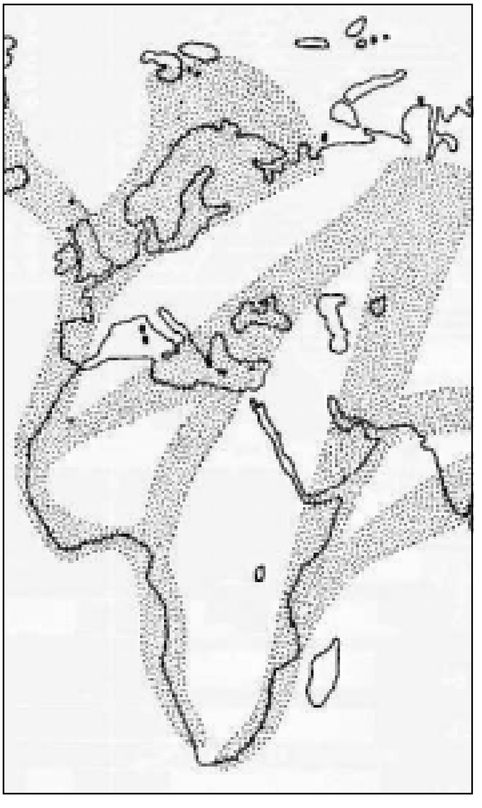

*Figure 4.3 Main flyways of migratory birds from Palae-arctic regions to West, Central and East Africa onto southern Africa. After Roggeri (1995).*

## 4.2 Geographical features of the Lake Chad basin

The Lake Chad Basin is situated between the Aïr Mountains in Niger, the Tibesti Mountains and the Ennedi Plateau in Chad, the Darfoe area in Sudan and the northern edge of the Congo basin in Central African Republic and Cameroon. The northern half of the Basin has a desert landscape with scattered oases, while the southern half consists of extended swamps along the two major river systems draining into Lake Chad, the Komadugu Yobe in Nigeria, and the Chari in Chad.

The Lake Chad basin is generally a flat, featureless, roughly circular plain, less than 400 metres above sea level. Most of the basin rim is mountainous. Rivers flow into the basin from Sudan, Chad, Niger, Nigeria, Central African Republic and Cameroon. Approximately 95 per cent of the inflow to Lake Chad originates in the Chari-Logone catchment in the south (DHV *et al.*, 1979). The remaining inflow comes from the other catchments in Chad, Cameroon, Nigeria and Niger. The Logone River, which forms the boundary between Cameroon and Chad, has its confluence with Chari close to the Lake border. The basin has no outlet to the sea, its natural water losses occur only through evaporation and infiltration.

Traditional land use patterns in the Lake Chad basin tend to follow climatic and geographical constraints. In the arid north, pastoralism prevails; around Lake Chad and the Logone and Chari rivers, fishing predominates; in the well-watered south, rain fed agriculture is practised. Small-scale irrigation is found wherever there is a seasonally reliable source of water, such as along the main river channels.

## 4. 3 Climate

Mean annual temperature in the Waza Logone region is 28°C. December is coolest, with mean monthly minimum of 16°C and maximum of 33°C. April, just before the rains, has a mean monthly minimum of 21°C and maximum of 41°C.

West Africa has no major mountain barriers, either longitudinally or latitudinal oriented, to disrupt the dominant monsoon circulation. Consequently, the rainfall in the Lake Chad basin is to a large extent governed by the movements of the inter-tropical convergence zone (ITCZ[1]). Rainfall in the drier part of West Africa is highly unpredictable, both in time and space, even though all the rain that falls during one year is concentrated in the wet season. Locally the amount of rainfall may vary greatly, depending on whether or not a storm cell generates precipitation. This variability is an inherent feature of the African climate and has been shown to have prevailed for at least several centuries (Rowell *et al.*, 1992).

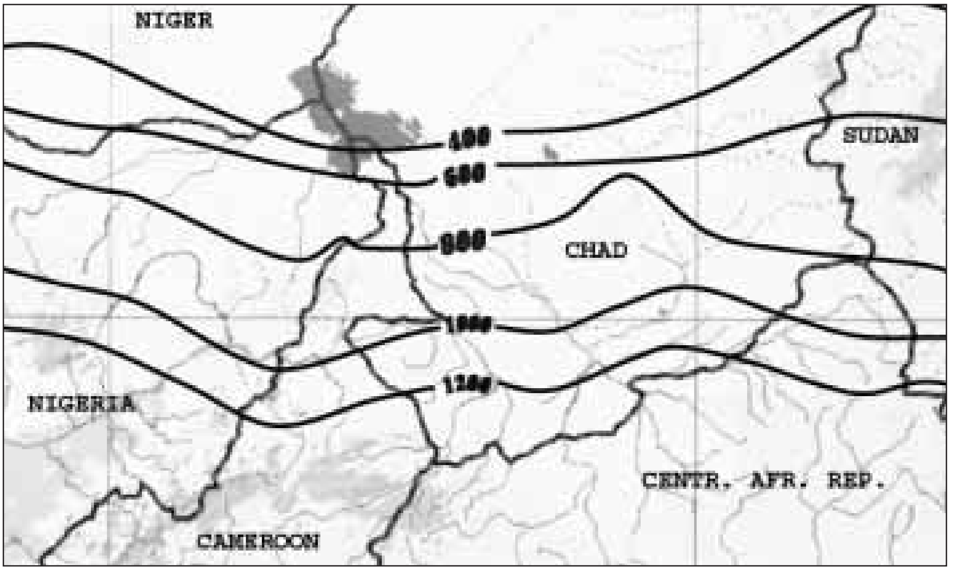


*Figure 4.4 Rainfall isohyets across the catchment areas of the Chari and Logone rivers. Base map courtesy of Wolters-Noordhoff Atlasproducties (Wereld@tlas)*

[1] The ITCZ represents the boundary where dry, hot air from the the north meets warm, humid air from the south. The ITCZ reaches its northernmost position normally near the 19th parallel around mid-August, when Sahel rainfall peaks. After August, the ITCZ typically retreats rapidly southward. Drought years in the Sahel are associated with the ITCZ being south of its normal position, while wet years are associated with the ITCZ north of normal. After http://www.cpc.noaa.gov/products/ african_desk/ITCZ/ITCZ.html

The geographical basin of Lake Chad can be broadly divided into three climatic zones (DHV *et al.*, 1979): a moist tropical zone, a semiarid zone, and an arid zone. Arid areas are defined as those areas where rainfall is not adequate for regular crop production, and semiarid areas are areas where rainfall is sufficient for short-season crops, and where grass is a dominant element of the natural vegetation. The Waza Logone area lies within the semiarid zone.

In general the rainfall isohyets of the Lake Chad basin form parallel east-west lines, as shown in Figure 4.4. At the source of the Logone River in Cameroon, on the Adamawa Plateau in the south, the annual rainfall is the highest and exceeds 1,400 mm. Here the rainy season starts in early March and continues to November. Further north, at N'Djamena for instance, the mean annual rainfall amounts to only 640 mm. There, the rainy season starts at the beginning of April and lasts until the end of October. In the Waza Logone area, a north-south gradient in rainfall is also evident. The average annual rainfall ranges from about 750 mm in the south near Pouss to less than 550 mm near Lake Chad.

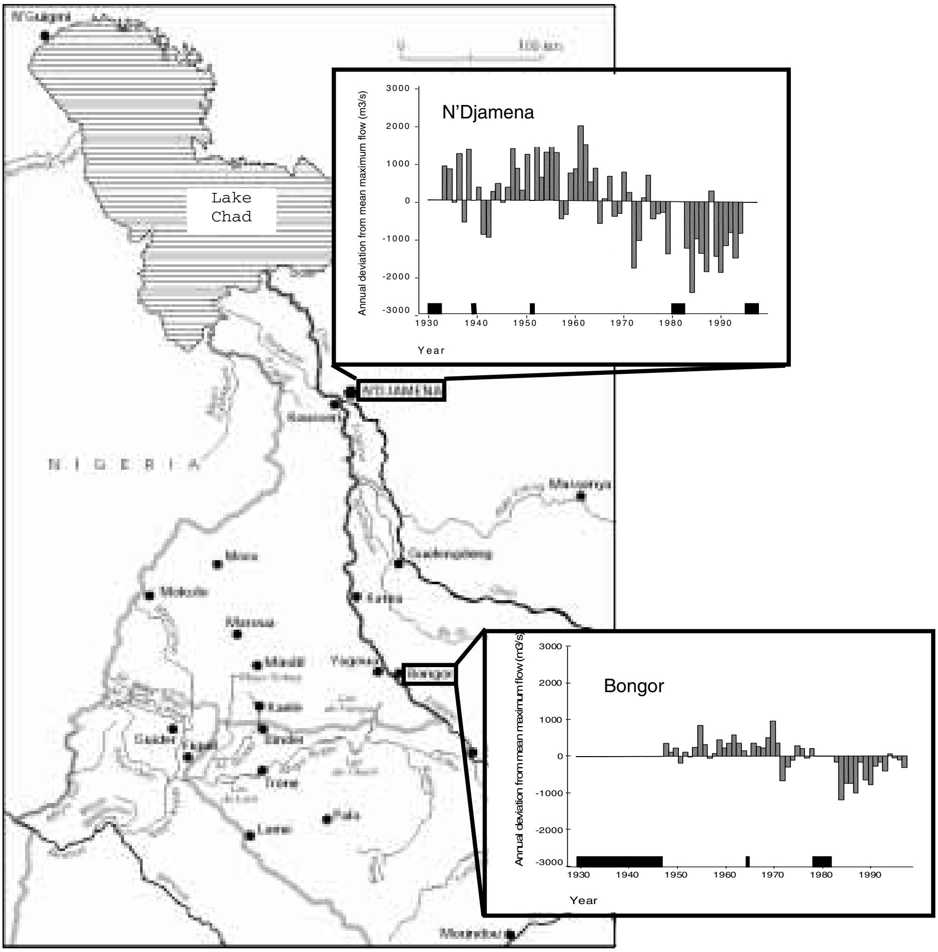


*Figure 4.5 Flow gauge stations in the Logone river. Insets: annual departures from the mean maximum flow rates ($m^3/s$) at N'Djamena and Bongor. The gauge station at N'Djamena is located after the confluence of the Logone and the Chari river. Missing data are indicated with horizontal bars.*

## 4.4 Historical rainfall/river flow relationship

River flow records are good indicators of past rainfall conditions. There is a long-term flow gauging station on the Logone River at Bongor, close to the upstream end of the Waza Logone area (see Figure 4.5). This has records dating from the 1940s. Another flow gauging station was installed in the Chari River at N'Djamena, near the downstream end of the Waza Logone area. Its flow records date from the 1930s. Statistical analysis (Mott MacDonald, 1993) of the flow data at Bongor and N'Djamena reveals that since their records began, the driest decade at Bongor was the 1980s; and the wettest decade was the 1960s. At N'Djamena, the driest decade was also the 1980s, the wettest decade was the 1950s and the second wettest decade was the 1960s. The last 30 years (i.e. since 1970) have been relatively dry compared with the previous 30 years (see graphs in Figure 4.5). However, the length of record is not sufficiently long to allow detailed long-term runoff trend analysis to be undertaken. Therefore, projections of future runoff patterns in the Logone catchment area cannot be made.

The shift to a drier-climatic regime in the 1970s is recognised as a general trend across the Sahel region of Africa, and is not peculiar to the Logone-Chari catchment area. Studies have indicated that this shift may be related to sea surface temperature anomalies (Folland *et al.*, 1991; Rowell *et al.,* 1992). It is not clear whether these changes are cyclical, and a return to a wet period could be expected, or if they represent a modal shift in operation of the global ocean-climate system, in which case persistence of drier conditions is likely to continue. Future predictions are further complicated by the difficulty of predicting the effects of global warming due to increased levels of greenhouse gases.

# 5 Hydrology of the Waza Logone Area

By Sun Yan Evans and Paul Loth

## 5.1 Flooding characteristics and flooding cycle

The lower Logone floodplain, known locally as the "*yaéré*", lies at the southern edge of the semi-arid zone within the Lake Chad basin. A study carried out before the onset of the Sahelian drought in the 1970s (Mott MacDonald, 1993), investigated the relationship between rainfall and runoff of the upper Chari-Logone catchment area. Two important conclusions from this study were that (i) small changes in rainfall produced large variations in surface runoff, and (ii) two, or even only one year of above or below average rainfall resulted in a longer sequence of years with above or below average flows. These conclusions are important in determining the hydrological regime of the floodplain in the past three decades.

Two mechanisms are involved in the seasonal flooding of the flood plain. The first is rain-induced local runoff and the second is flood-induced, which is caused by over bank flooding from the main rivers. In the upper reaches of the River Logone, where rainfall is higher, rain provides a major contribution to the floodings, whereas in the north, over bank flooding predominates. The inundation mechanism depends to a great degree on rainfall patterns. The first rains, which normally occur in May, saturate the soils and begin to fill the deepest depressions.

The over spill from the rivers follows from September to October. This process can be seen clearly in the hydrograph of the seasonal El Beid River where two peaks occur: rain induced local runoff from the Mandara Mountains in September and flood induced in December from the Logone, and, occasionally, from the Serbouel in years of high flow (Figure 5.1).

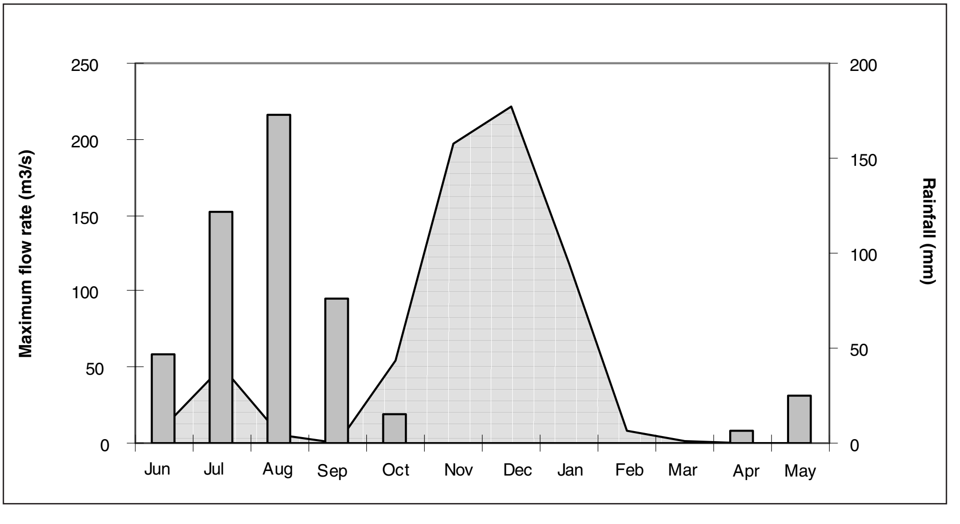


*Figure 5.1 Typical hydrograph of the El Beïd River at Tilde (line graph), and mean monthly rainfall at N'Djamena (bars). Local rainfall saturates the soil and fills the deepest depressions first. Then over bank flooding inundates the entire floodplain. Rainfall data from Beavilain (1995), hydrograph after Mott MacDonald (1993).*

Over-bank flow is, however, by far the biggest contributor to the inundation of the floodplain. The annual over-bank flooding reduces both the peak flows and total volume of water in the River Logone. Water stored on the floodplain is returned during the recession period. Thus, the floodplains regulate the river by distributing flows throughout the year. In low flow years a low flood peak and either a brief period of over spill, or complete failure to overtop the banks, results in decreased losses in the overall flow in the main river. However, it also results in a much-reduced return flow from the *yaérés*. In extremely low flow years, there may be a complete lack of flood-induced inundation.

The annual over-bank flooding reduces both the peak flows and the total volume of water in the Logone River. Between Bongor and N'Djamena, bank over spill seasonally inundates a large area of the land, including the Waza Logone area. As inflows reduce, drainage of the Logone floodplain takes place. Part of the flood water drains slowly to the north-west and eventually into the El Beid River, part of it returns back to the Logone River, part of it contributes to the groundwater through infiltration and part of it is lost through evapotranspiration.

Much of the surface water is lost due to infiltration into the soil, evaporation, and transpiration by plants. Losses due to infiltration, evapotranspiration and transfer to other catchments are sufficiently large that the Logone River progressively decreases in flow between Lai, where major flood-induced inundation begins, and N'Djamena, where the Logone River joins the Chari River. In dry years, with little to no over-bank flooding, the measured flow at Logone Birni was 12% less than in Lai, 400 km further upstream. In average years, the reduction amounted to 28 %, and in very wet years, the total flow was reduced by 40% in this reach. Consequently, the losses during wet years are greater than in dry years (Figure 5.2)

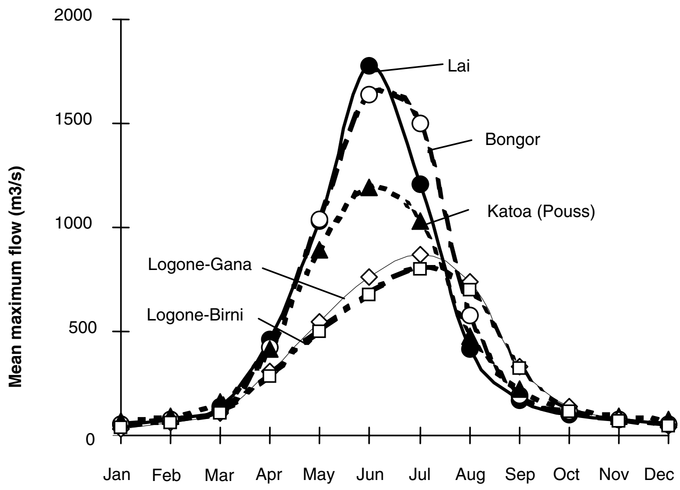


*Figure 5.2 Mean monthly maximum flow rates measured at different flow gauge stations in the Logone river. The highest flow rates are measured in Lai, but the flow rate decreases further downstream along the Logone river. When the flood reaches the floodplain the amount of water passing the flow gauges is spread out more (respectively Pouss, Logone-Gana and Logone-Birni). Data from Seignobos and Iyébi-Mandjek (2000).*

## 5.2 Flooding volume, extent, depth and duration

The volume of floodwater on the lower Logone floodplain depends mainly on the magnitude of the flood peak on the Logone River, and the duration of the floodwater exceeding the bank full capacity of the Logone River (Mott MacDonald, 1999). Since rainfall in the Lake Chad basin is highly variable, the extent, depth, duration and volume of flooding varies from year to year (Chapter 3). The inundation in the Waza Logone area normally extends from August to December in wet years. During dry years, the extent, depth and duration of flooding is much less. However, insufficient data are available to establish the relationship between rainfall and the degree of inundation in detail.

At Laï the maximum flow occurs in September, and amounts to 30% of the total yearly runoff, 70% between August and October, and 97% between July and November. The extent and duration of flooding on the lower Logone floodplain is closely related to the peak flow and the volume of floodwater through Lai. The river overtops its banks mainly in August and September, except in years of low rainfall. In November, part of the residual floodwater drains back to the Logone and part of it drains northwards into the El Beid River at Tilde.

A recent hydraulic study (Mott MacDonald, 1999) modelled the degree of flooding for three categories of hydrological years before the construction of the Maga dam and the containment embankments along the Logone River. Average hydrological years were defined as years with flows that corresponded with the 50 percentile of the annual maximum flow series. Good years were defined as those years with flows that met or exceeded the 75 percentile of the annual maximum flow series, and poor hydrological years as years that had flows that did not exceed the 25 percentile of the annual maximum flow series. The results of the model indicated that the inundated area on the left bank downstream of Pouss could reach 3,400 km$^2$ (under "average" hydrological conditions). The model also showed that in "poor" hydrological years the inundated area on the Waza Logone floodplain could be reduced to less than 2,500 km$^2$, and in 'good' hydrological years the inundated area could exceed 3,800 km$^2$. The inundation depth varies from place to place and from year to year.

## 5.3 Impact of the Maga Dam and the Logone River embankments

The Maga Dam between Guirvidig and Pouss was built in 1979 to create a reservoir for the SEMRY rice irrigation scheme. An embankment along the left bank of the Logone River between Pouss and Tekele was also built in the same year to protect the rice scheme from inundation. The total length of the containment embankments between Yagoua and Tekele is about 100 km long and one to two meter above the original bank levels.

The lake that filled up after the completion of the dam, Lake Maga, has a surface area of approximately 400 km$^2$. The dam intercepts the discharge from the Mandara Mountains in the west via the rivers Tsanaga and Boula. The dam also intercepts the discharge from the Logone River via the Djafga Canal, Mayo Balic and Mayo Guerlo. A 750 m long spillway connects the Lake Maga and the Logone River near Pouss. The spillway allows excessive water in Lake Maga flowing back to the Logone River. It also allows water flowing into the Lake Maga from the Logone River when the water level in the Lake Maga is lower than that in the river. So the water can flow in both directions depending on the water levels in the two systems.

The construction of the Maga dam and the embankment altered the tributary network and drainage. The dam intercepted the flows from a number of feeder rivers to the Waza Logone floodplain. Both the dam and the containment embankment have also altered the interactions and connections between the Logone River and the floodplain, hence altering the flood paths. Therefore the flood mechanism has also been affected. Since flood-induced inundation occurs only at high river stages, any artificial flood peak attenuation and river regulation reduces the extent and the depth of seasonal inundation of the Waza Logone floodplain. The embankment along the Logone River, and the Maga dam itself eliminate flooding immediately to the north of Lake Maga as far as Tekele, and also reduce flooding over the rest of the floodplain.

The hydraulic model showed that, under average hydrological conditions, the flooded area on the left bank of the Logone River downstream of Pouss was reduced by approximately 1,000 km$^2$. This is equivalent to a 30% reduction in area flooded following the construction of the dam and the containment embankments (Mott MacDonald, 1999). The model further calculated that under these conditions the maximum floodplain width on the left bank was reduced by 20 km from about 50 km to approximately 30 km.

Recharging of groundwater is generally recognised as an important function of many wetlands (Roggeri, 1995; Wesseling *et al.,* 1994). On some floodplains, recharge occurs primarily during flood flows, since the floodplain provides a large surface area (Hollis, 1996) and some floodplain soils are permeable (Nielson *et al.*, 1991). The construction of the Maga dam and the embankments along the Logone River has reduced the inundated area, but insufficient data is available to quantify the impact on groundwater.

The effects of the Maga dam were not all negative and environmentally detrimental. It supports an important rice scheme and many people find employment there as workers or as independent farmers. The Maga Lake provides good, year-round fishing grounds for many fishermen, and the lakeshores provide good grazing grounds throughout the dry season. However, the dam and the embankments have had negative effects on the productivity of the floodplain downstream of the dam, and on the livelihoods of communities living there. Yet, there is major concern about the long-term negative effects on soil fertility, the geomorphological changes in the terrain and the expected accompanying loss of biodiversity will prevail for the time to come.

## 5.4 Other factors affecting floodplain inundation

In addition to over bank flooding, and the factors influencing the flooding patterns – such as the Lake Maga and the embankment along the Logone River, inundation of the Logone floodplain is also influenced by soil moisture content, precipitation, evapotranspiration, and infiltration.

### *Soil Moisture*

When in May or June it starts raining on the Logone floodplain, the soil surface becomes saturated: the soil pores are filled with water and the air is driven out. The water then travels downwards under gravity and capillary action. As more water is added through rain and over bank flooding from the Logone River, the depth of saturation increases. When the flooding ends in November or December, water still travels downward through the soil. Soon after the flooding season, the soil moisture content reduces rapidly due to continuous high temperatures that increase evaporation from bare soils, and enhance the transpiration rate of the vegetation. Before the next rainfall season starts, the soil moisture deficit becomes very high. This limits the plant production on the floodplain. So far, detailed data is lacking for the Waza Logone area to assess the variation in soil moisture content through the year.

### *Precipitation*

The primary feature of precipitation in the Waza Logone area is the high variability in time and space of individual storms, of seasonal rainfall, and of annual and cyclical totals. The Logone River receives the greatest part of its flow from its upper catchment in the south. Water is collected in the steeper upper catchment upstream of Laï where the rainfall is plentiful and tributaries collect water on the Adamawa Plateau, a highland area at around 1,000 m in elevation. Below Laï, the main stream extends 456 km before joining the Chari River at N'Djamena. The average rainfall on the Waza Logone area varies from around 750 mm in the south near Pouss to 600 mm in the north near Lake

Chad. Although there are large annual rainfall variations, almost all rain falls during the rainy season from May/June to September/October in the Waza Logone area. The high spatial and temporal variation in rainfall in the Logone floodplain complicates the forecasting of the flooding patterns.

### *Evapotranspiration*

In the semi-arid Waza Logone area, an important feature of the water balance is the high proportion of incoming water that is returned to the atmosphere by evaporation from the water surface and from bare soils. Direct evaporation, and transpiration by plants cause the highest water losses, whereas deep drainage and infiltration have relatively small effects. During the flooding season, the flooding is extensive, and consequently, the volume of water lost through direct evaporation from open water surfaces is considerable. As long as the vegetation cover after the flooding season is low, direct evaporation of water from the soil remains important. When the vegetation has formed a closed grass sward, however, water loss through transpiration is predominant. Therefore, evapotranspiration is one of the most important factors affecting the flooding depth and the water holding on the floodplain of the Logone River.

The factors controlling evaporation have been known for a long time, but their evaluation is difficult because of their interdependent effects. The evaporation rate depends on vapour pressure of the body of water and that of the air. Those vapour pressures depend on temperature of the water and air, wind, atmospheric pressure, quality of the water, and the nature and shape of the water surface. Estimated annual potential evaporation for N'Djamena ranges between 2,275 and 2,800 mm, depending on the method used (SEMRY, 1984).

### *Infiltration*

Infiltration is normally considered as a three-step sequence: surface entry, transmission through the soil, and depletion of storage capacity in the soil. The characteristics of the permeable medium and the percolating fluid determine the percolation rate into the soil. The three-step sequence presents difficulties in the measurement of infiltration. In a previous study (Mott MacDonald, 1993) some estimates were made of appropriate infiltration losses through the bed of Lake Chad. Values of 0.55 mm per day and 1.15 mm per day were derived for seepage from the north and south pools respectively. However, previous studies of the yaéré (lower Logone Floodplain) suggest that after the floodwaters have spread to their full extent, infiltration losses on the lower Logone floodplain are very low. The soils of the floodplain are fine alluvial deposits that seal after initial wetting. The study (Mott MacDonald, 1993) indicates that the main source of recharge to the shallow aquifer is from the rivers and is not significant over the lower Logone floodplain. The water table is recharged vertically or transversely from surface floodwater. The water table could be less than five metres deep in the Waza Logone area. However, the impermeable clay soils that cover the alluvial plains after being wetted up by local rainfall and over bank flooding from the Logone River do not allow infiltration in areas where the floodwaters dry up each year.

The initial losses are to be expected as the soils moisten under the influence of local rainfall, which in the Logone floodplain precedes the main flood by at least a month. There is no direct measurement of the water loss through infiltration on the Logone floodplain. In fact, infiltration is not a real loss of the water resources, as it changes the form from surface water to ground water or the moisture in the soil.

# 6 The Natural Resources of the Waza Logone Floodplain

By Paul Loth, Hans de Iongh and Hans Bauer

## 6.1 Soils and vegetation

The Logone floodplain is part of the vast Lake Chad Basin. The Lake Chad Basin probably originated in the upper Jurassic to lower Cretaceous period (to 130 million years BP), when Gondwanaland broke up into the African and South American continents. The major African rifts, the East African Rift system and the Nigerian northwest-southeast rift were formed as a consequence of the tectonic movements. In the Cretaceous (130 – 75 million years BP) the Lake Chad Basin was formed during various phases of rifting (CTA, 1999). Thereafter the Lake Chad Basin was progressively filled up with sediments. The sediment layers exist of clayey to sandy materials, depending on the geological processes and the parent material from which the sediments were derived. During the Quaternary large variations in climatic and hydrologic conditions influenced the composition of the sediments. A humid period in the Holocene (12,000 years BP) caused a rise in the lake level, while the lake expanded to a surface of 330,00 km$^2$. In this period clayey alluvial sediments were deposited. When the climate became drier, the lake started to retreat, and by 6,000 BP Lake Chad had shrunk to a surface of about 300,000 km$^2$. Dunes and sandy deposits mark this extent of the lake (CTA, 1999; Schneider, 1967).

In Cameroon this ridge of dunes runs in southwest-northeast direction, between Yagoua on the Logone river and Limani at the Nigerian border. From the dune ridge the terrain slopes gently towards the floodplain. Except for some lower lying parts, this area is not flooded. Sandy soils are found adjacent to the dune ridge, being a mix of dune sands and alluvial deposits. Sandy soils along the lakeside of Lake Chad consist of levees formed by the rivers draining into the Lake (Brabant and Gavaud, 1985). The lowest lying area, the floodplain itself, is seasonally flooded (Map 6.1, end of book). The heavy clay soils become impermeable after the first rains and are then inundated by over bank flows of the Logone River (Chapter 4 and 5).

The principal vegetation types can be divided according to these major landscape types. In the Lake Chad Basin, north of the dune cordon, the vegetation types belong to the Sahelo-Sudan shrub savannas, except for the endemic grasslands of the floodplain itself (De Iongh and Prins, 2000; Brabant and Gavaud, 1985). Five major types of shrub savannahs can be distinguished, when the dune cordon is included. The *Guiera senegalensis* open shrub savannah is typical for the sands of the dune cordon. The shrub savannah on the slightly sloping transition zone between the dunes and the floodplains is characterized by the presence of the trees *Anogeissus leiocarpus* and *Sclerocarya birrea.* On the vertisols that form the transition zone between the inundated grasslands and the slightly higher, not flooded soils, thorn tree savannah occurs, with *Acacia seyal* as the typical tree species. North of the floodplain, open thorn shrub savannah is alternated with *A. nilotica* thickets near ponds and river courses, forming a mosaic. Finally, close to the shore of Lake Chad, Sahelian steppe, with open thorn shrub savanna, prevails (Brabant and Gavaud, 1985).

Human influences on the vegetation in this area are limited, to the extent that soil degradation has not occurred. The first settlers who arrived in the floodplain could only remain during the floods by forming earth mounds. The presence of *Celtis integrifolia* on such knolls in the floodplain is evidence that these sites were occupied in the 18$^{th}$ century (Seignobos and Iyébi-Mandjek, 2000). At present commercial fire wood collecting is considerable. In 1997, for instance, 108.5 m$^3$ of firewood was brought to Maroua town from the Waza Division alone (Madi Ali and Peters, 2001). The continuation of fire wood collecting may pose a threat to the continued existence of the remaining bush in the floodplain area. In some parts of the floodplain, the bush has been cleared in order to grow more dry season sorghum (‘*muskwari*’).

The area of the Waza Logone project primarily includes the inundated floodplains and encompasses the entire Waza National Park. The floodplain habitat of the Waza National Park was seriously threatened by the altered flooding patterns caused by the dam at Maga and declining rainfall. It is therefore not surprising that over the years the Waza National Park has been the focus of scientific research. Before turning to this particular species-rich area in the floodplain, the importance of the floodplains as a whole for migratory birds will be discussed.

## 6.2 Bird life

The seasonal migration of Palaearctic birds to tropical Africa is quite well known, although the reason that birds undertake such impressively long flights is only recently being understood. Wetlands in particular are attractive staging areas for migrant water birds. The Logone floodplain in particular is visited by numerous Palaearctic birds, which spend the wintertime foraging in the grasslands. Waterfowl censuses have been carried out in the Lake Chad basin since the 1980s, to act as indicators of the importance of these wetlands. The southern floodplains of Lake Chad appear indeed to be important foraging areas for hundreds of thousands of birds (Table 6.1). The Logone floodplain supports considerably more water birds than the Hadejia-Nguru floodplains in Nigeria. Before 1990 four species, garganey (*Anas querquedula*), pintail (*Anas acuta*), white-faced whistling duck (*Dendrocygna viduata*) and ruff (*Philomachus pugnax*), together accounted for 88 to 96% of all birds counted in the Logone floodplain and the southern part of Lake Chad. In 1993, Pintail did not even represent 1% of all birds counted, and only ruff (29%) was still present in large numbers, followed by squacco heron (*Ardeola ralloides*) with 11%, white-faced whistling duck at 6% and little stint (*Calidris minuta*) at 5%. Thirteen more species, each with numbers between 2 to 4% of the total number of birds counted, made up another 28% of the total number of birds (Van Wetten and Spierenburg, 1998). In addition, the man-made lake at Maga has become an important staging area for large numbers of birds. One of the bird studies suggested that the irrigated rice fields, too, have become extremely important habitats for water birds (OAG Munster, 1991).

The Convention on Wetlands (commonly called Ramsar) provides criteria for identifying internationally important wetlands (Davis, 1994). Such wetlands should regularly support at least 20,000 waterfowl, or should support at least one per cent of the individuals in a population of one species. The Lake Chad Basin as a whole with around one million visiting water birds (see Table 6.1) should thus be considered an important wetland area under the Ramsar Convention. Within this large area, however, there are several distinctive locations that each may support tens of thousands of waterfowl. During the waterfowl count of 1993, for instance, the minimum estimate of waterfowl birds in the 40,000 ha Zilim/Zimado depression narrowly exceeded this threshold number. If, however, the estimates based on the median of the counts are used, the Lake Maga and the Tekele depression by far exceeded this threshold (see Tables 4.9 and 4.10 in Van Wetten and Spierenburg 1998). Also the Waza National Park is an important staging area for water birds (see Table 6.2), even though half of the Park’s area is unsuitable as habitat for most waterfowl. More importantly, however, the western black crowned crane (*Balearica p. pavonia*) is resident in the park and the surrounding areas. The total world population of this species is estimated at 15,000 individuals (Wetlands International, 2002), of which almost 12 percent occur in the Logone floodplain (Unpublished count carried out by the Waza Logone project/Ecole de Faune in 1997). Other species that meet the one per cent criteria in the Logone floodplain area are: the West African populations of white pelican (*Pelecanus onocrotalus*) and long-tailed cormorant (*Phalacrocorax africanus*), each with about two percent; four per cent of the West African population of the white-faced whistling duck (*Dendrocygna viduata*); five percent of the West African population of the spur-winged goose sub-species (*Plectropterus g. gambensis*); one third of the SW European and NW African population of the collared pratincole (*Glareola p. pratincola*). The Waza Logone project has continued the yearly waterfowl counts in co-operation with the Garoua Wildlife School.

| | | | Percentage of a single population | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Logone floodplain + L. Chad | | | *Hadedj--Nguru (Nigeria)* | | | Logone floodplain + L. Chad | | |
| *Species* | | critical pop. size | 1984 | 1986 | 1987 | *1988* | *1989* | *1990* | 1991 | 1993 | 1999 |
| *Ardeola ralloides* | Squacco Heron | 40 | **6,3** | **80,4** | **49,0** | ***3,0*** | ***3,2*** | ***1,7*** | **7,5** | **327,9** | **75.0** |
| *Balearica pavonina* | Crowned Crane | 150 | **4,2** | **7,9** | **18,1** | - | *0,0* | - | - | **26,7** | **14.0** |
| *Glareola pratincola* | Common Pratincole | 190 | - | 0,0 | **16,0** | *0,4* | *0,4* | *0,0* | **15,5** | **15,9** | **51.1** |
| *Ardea (Egretta) alba* | Great White Egret | 470 | - | - | - | *0,0* | *0,3* | *0,3* | 0,0 | **6,7** | **(2.8)** |
| *Calidris minuta* | Little Stint | 2 000 | - | - | 0,0 | *0,3* | ***1,1*** | ***0,1*** | 0,0 | **3,1** | n.a. |
| *Larus cirrhocephalus* | Grey-headed Gull | 300 | **1,8** | **8,0** | **15,5** | *0,0* | *0,2* | *0,2* | **1,0** | **2,8** | **(1.2)** |
| *Phalacrocorax africanus* | Long-tailed Shag | 1 000 | 0,1 | - | **2,0** | *0,0* | *0,2* | *0,1* | 0,1 | **2,5** | **(4.4)** |
| *Nycticorax nycticorax* | Night Heron | 1 200 | - | - | 0,3 | *0,0* | *0,0* | *0,4* | 0,1 | **2,3** | n.a. |
| *Plectropterus gambensis* | Spur-winged Goose | 1 000 | **2,4** | **7,2** | **30,7** | *0,1* | ***1,7*** | ***1,0*** | 0,8 | **2,2** | **2.1** |
| *Dendrocygna viduata* | White-faced Whistling Duck | 3 800 | **5,5** | **5,8** | **33,9** | *0,4* | *0,7* | ***1,7*** | 0,8 | **2,0** | **4.6** |
| *Tringa stagnatilis* | Marsh Sandpiper | 370 | - | - | - | *0,1* | *0,1* | *0,2* | 0,3 | **1,8** | n.a. |
| *Ardea purpurea* | Purple Heron | 880 | 0,0 | 0,1 | 0,2 | *0,0* | *0,1* | *0,2* | 0,1 | **1,6** | n.a. |
| *Ciconia ciconia* | White Stork | 930 | - | - | - | *0,0* | *0,2* | *0,0* | 0,1 | **1,6** | **(4.0)** |
| *Egretta ardesiaca* | Black Heron | 1 000 | 0,2 | 0,0 | 0,9 | *0,0* | *0,0* | *0,0* | - | **1,3** | **(3.6)** |
| *Dendrocygna bicolor* | Fulvous Whistling Duck | 1 000 | **21,0** | **5,1** | **12,5** | *0,3* | ***1,2*** | ***1,2*** | - | **1,0** | 0.1 |
| *Sterna nilotica* | Gull-billed Tern | 130 | 0,0 | 0,2 | **1,6** | *0,1* | *0,0* | *0,1* | 0,4 | **1,0** | - |
| *Threskiornis aethiopicus* | Sacred Ibis | 3 300 | 0,1 | 0,5 | 0,4 | *0,0* | *0,0* | *0,0* | 0,3 | **1,0** | n.a. |
| *Limosa limosa* | Black-tailed Godwit | 1 300 | **10,8** | **23,4** | **6,5** | ***1,2*** | *0,2* | *0,4* | 0,0 | 0,8 | n.a. |
| *Pelecanus onocrotalus* | White Pelican | 600 | 0,0 | **1,0** | **1,3** | *0,2* | *0,0* | *0,0* | 0,1 | 0,7 | 0.3 |
| *Nettapus auritus* | Pigmy Goose | 100 | 0,2 | 0,4 | **1,2** | *0,1* | - | *0,0* | - | 0,7 | n.a. |
| *Sarkidiornis melanotos* | Knob-billed Goose/Comb Duck | 750 | **5,3** | **11,8** | **32,0** | *0,3* | ***3,5*** | ***2,4*** | 0,5 | 0,3 | **1.9** |
| *Himantopus himantopus* | Black-winged Stilt | 10 000 | **1,0** | 0,3 | 0,5 | *0,0* | *0,0* | *0,0* | 0,1 | 0,2 | n.a. |
| *Anas acuta* | Pintail | 10 000 | **25,3** | **10,2** | **52,6** | ***1,5*** | *0,2* | *2,1* | 0,0 | 0,1 | 0.0 |
| *Tringa erythropus* | Spotted Redshank | 1 000 | - | 0,0 | - | *0,7* | ***1,8*** | *0,2* | 0,0 | 0,0 | n.a. |
| *Alopochen aegyptiaca* | Egyptian goose | 180 | 0,3 | **3,4** | **1,2** | - | *0,0* | - | - | 0,0 | - |
| *Aythya nyroca* | Ferruginous Duck | 530 | 0,1 | 0,6 | 0,9 | ***3,0*** | *0,0* | *0,5* | - | - | - |
| *Anas clypeata* | Northern Shoveler | 4 500 | 0,6 | 0,0 | **1,3** | *0,2* | *0,1* | *0,0* | 0,0 | - | - |
| *Recurvirostra avosetta* | Pied Avocet | 470 | 0,1 | **1,5** | 0,3 | *0,1* | *0,2* | *0,1* | - | - | - |
| | Total number of birds counted | | 329 650 | 189 619 | 761 133 | *23 519* | 16 897 | *34 355* | 10 916 | 62 576 | 11 298 |
| | **Estimated total number of birds** | | **964 236** | **622 820** | **1 427 316** | ***43 883*** | ***58 319*** | ***68 856*** | **373 451** | **119 061** | **n.a** |

*Table 6.1 Estimates of fractions of water bird populations present in the southern part of the Lake Chad Basin in the period 1984-1999 (based on Van Wetten and Spierenburg, 1998; Dijkstra et al., 2002). The column critical population size gives the number of individuals at 1% of the size of one population (Wetlands International, 2002). Only species that were present at least once with > 1% (in bold) of one distinct -generally West or Central African- population are listed; counts exceeding 10% of one population in dark grey. Near Threatened species according to IUCN Criteria in light grey (Wetlands International, 2002). - : not encountered; n.a.: population estimates for entire area not available; percentages between brackets: based on counts only (1999 data). Data sources: 1984 - 1987 aerial survey Lake Maga, Logone floodplains, Lake Fitri, Lake Chad (Pérennou, 1991, in Van Wetten and Spierenburg, 1998). 1988 - 1990 ground survey Hadedji - Nguru, Nigeria (Pérennou, 1991). 1991 Ground survey Lake Maga and surroundings (OAG Munster, 1991), 1993 mimimum estimates based on stratified counts Logone floodplain and southern lake side of Lake Chad (Van Wetten and Spierenburg, 1998), 1999 data (Dijkstra et al., 2002).*

## 6.3 Wildlife - the Waza National Park

### *History of the park*

The Waza National Park was established by the French Colonial Administration as a hunting reserve with the name of Zina-Waza on 24 March 1934 (Arrêté No. 71). It was enlarged from 155,000 hectares to 165,000 hectares by *Arrêté* No. 264 of 9 September 1935, and then raised to the level of a forest and fauna reserve by *Arrêté* No. 297 of 30 July 1938. Later, on 5 December 1968 it was proclaimed by the Government of the Republic of Cameroon as *"Parc National de Waza"* by *Arrêté* No. 120. It was classified as a biosphere reserve in May 1979 (WCMC, 1983).

### *General features*

About half of the Park, the northern and eastern side, is located within the floodplain of the Logone River. Here the topography is very flat, only varying by a few centimetres in altitude (Anonymous, 1997). The clay soils are prone to seasonal inundation. The southwestern side of the Park is situated on the sandy deposits of the fringe of the Lake Chad basin. At 320 metres above sea level, this part of the Park is about 20 metres higher than the northeastern part. It is slightly undulating, with height differences of a few metres, and is never flooded. Prominent exceptions are the three isolated hills (*inselbergs)* at Waza village, which form the main entrance to the Park.

The climate of the region is semi-arid, with a dry season from October to May. Rainfall is irregular, with an annual mean of 600 mm (Beauvilain, 1995). Mean annual temperature is 28°C. December is the coolest month, with mean minimum of 16°C and mean maximum of 33°C. April, just before the rains, has a mean minimum of 21°C and mean maximum of 41°C.

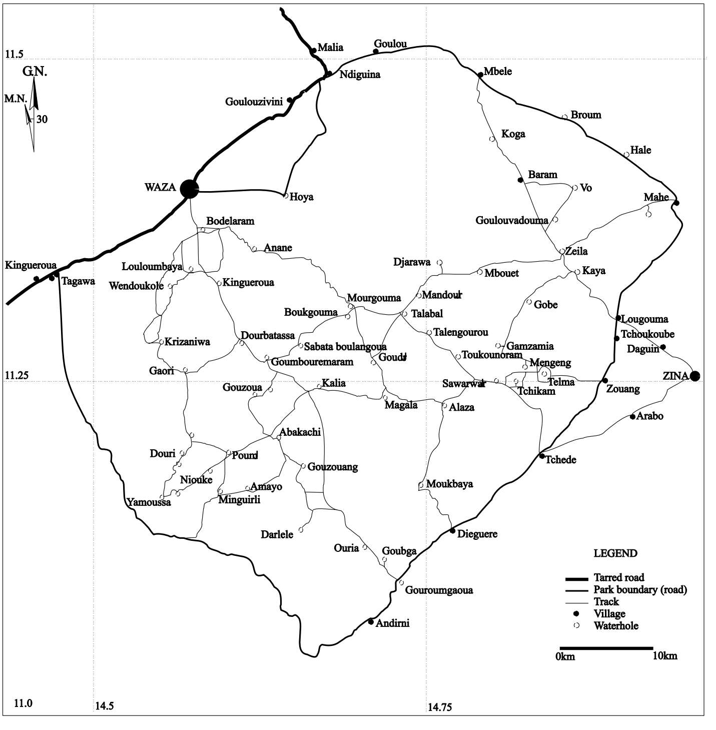


*Figure 6.1 Main topographical features of the Waza National Park. From: Bauer, 2003.*

The Waza National Park does not contain a permanent river and although a considerable number of waterholes occur in the park, only a small number of them are permanent (Figure 6.1). The eastern half has many natural and artificial waterholes that fill up during the rainy season, but in most years all except three artificial waterholes dry out during the dry season. In years with adequate rainfall the eastern half of the Park is largely inundated by rain and flooded by excess water from the Logone river and rivers coming from the Mandara Mountains. Here, too, only a few artificial waterholes remain towards the end of the dry season (Drijver and Marchand, 1985).

### *Vegetation of the Waza National Park*

#### **Vegetation types**

The major vegetation types that characterise the floodplain area can also be distinguished in the Waza National Park (Map 6.2, end of book). In the Park, six vegetation types have been distinguished, based on the species that are dominant in the herb layer (Wit, 1975).

The floodplain is seasonally inundated for prolonged periods and water depth can reach one to two metres. The open, flooded grasslands, or *yaérés*, consist of the perennial grasses *Echinochloa pyramidalis*, *Vetiveria nigritana*, *Oryza longistaminata,* and *Hyparrhenia rufa* (White, 1983). The herb *Sesbania pachycarpa* occurs on places where flooding is less deep or less prolonged, especially on slightly sandy soils and elevated parts of the floodplain (Wit, 1975). Trees are absent in these grasslands and fires common.

Black, clay Karal soils surround the actual floodplain and are saturated with water in the rainy season (WCMC, 1983). *Acacia seyal* is the dominant species here. Below the trees, a layer of herbs and coarse grasses grows to 3 m in height, including *Caperonia palustris*, *Echinochloa colona*, *Hibiscus asper*, *Hygrophila auriculata*, *Sorghum purpureo-sericeum,* and *Schoenfeldia gracilis* (White, 1983).

On the higher dunes and sandy alluvial deposits in the southwest of the Park, open to dense woodland occurs with *Anogeissus leiocarpa* as the dominant tree. Other woody species include those that are also found in the *Sclerocarya birrea* woodlands in the western part of the Park. Open, wooded grassland, characterised by the tree *Lannea humilis* is found at places where the soil is very saline. The presence of the tree *Balanites aegyptiaca* close to the floodplain grasslands gives this woodland a very characteristic appearance.

Old village sites are marked by the presence of tree species that are typical for past human habitation. The differences with the surrounding natural vegetation are very marked in the Karal soils and the floodplain area, and include *Tamarindus indica, Adansonia digitata, Acacia sieberiana,* and various *Ficus* spp. (Wit, 1975).

**Vegetation dynamics**

The composition of the plant communities of the floodplain is mainly determined by the high soil water availability during the dry season, resulting from saturation by floodwater during the wet season. Perennial grasses, such as *Vetiveria nigritana*, *Echinochloa pyramidalis*, and *Oryza longistaminata* continue to grow well into the dry season (Scholte *et al.*, 2000a; Van De Klundert and Oosterhuis, 1997). When perennial grasses are grazed, or when they are burnt, the grasses continue to produce leaves, providing food for the grazers. In those areas of the floodplain where flooding was absent due to the combined effects of the drought in the 1980s and building of Maga

*Photo 6.1 Spur-winged geese in a shallow, dried up depression in Waza National Park (Photo P. Loth).*

dam, the perennial grasses disappeared and were replaced by annual grasses (Scholte *et al.*, 2000a; Van Der Jagt and Pot, 1996). These annuals have a shorter period of growth and rather than investing in vegetative parts, these plants heavily invest in seeds. Herbivores thus not only find less biomass to feed upon when annual grasses dominate grasslands (Scholte *et al.,* 1995, 1996), but also the production period is much shorter. After seed setting annual grasses die, whereas perennial grasses continue to grow. There is evidence, however, that the replacement of perennial grasses by annuals is reversible. Where the floods returned, due to increased rainfall in combination with the pilot flood releases in 1994 and 1997, re-colonisation of perennial grasses was recorded (Scholte *et al.*, 2000b).

### *Birds*

The Waza National Park is renowned for its biodiversity. In total 379 bird species have been identified in the Park. About half of the population of the black crowned crane (*Balearica p. pavonia*), some six per cent of the total world population, resides in the Waza National Park. This population has been (Van der Giessen and Raspe, 1997; Zekveld and Elissen, 1997), and will continue to be monitored by Leiden University. Annual water bird counts have been carried out in the Waza Logone area since 1993. The largest bird populations are white-faced whistling duck (*Dendrocygna viduata*), knob-billed goose (*Sarkidiornis melanotus*), garganey (*Anas querquedula*) and spur-winged goose (*Plectropterus gambensis*) (see Table 6.2).

| Species | 1993 | 1995 | 1996 | 1997 |
|---|---|---|---|---|
| White-faced whistling duck | 7,524 | 5,784 | 5,427 | 15,317 |
| Spur-winged goose | 2,128 | 845 | 2,928 | 5,249 |
| Garganey | 121 | 735 | 6,781 | 2,035 |
| Knob-billed goose | 230 | 623 | 681 | 1,184 |
| Total | 12,103 | 7,986 | 15,817 | 23,795 |

*Table 6.2 Numbers of the four most common waterbird species in and around Waza National Park between 1993 (De Kort and Van Weerd, 1995) and 1995-1997 (Bobo Kadiri, 1997).*

Guinea fowl have been studied intensively in and around the Waza National Park. The idea was to develop a management plan to harvest birds from the populations that occur around the villages near the Park to provide the villagers with extra meat. Before a study was initiated, however, the people were asked whether they would eat meat from these birds. It appeared that there was no taboo on eating guinea fowl and local communities welcomed the idea. Based on field data, a population dynamic model was developed with biotic and abiotic parameters as an input. It appeared that rainfall was a very good predictor for the number of eggs produced. Hence, rainfall amounts can be used to set harvest quota of guinea fowl (Njiforti, 1997, 2001).

### *Mammals*

There are at least 30 species of mammals in the park, including elephant (*Loxodonta africana*), giraffe (*Giraffa camelopardalis*), lion (*Panthera leo*), two species of hyena (*Crocuta crocuta* and *Hyaena hyaena*), kob (*Kobus kob*), korrigum (*Damaliscus korrigum*), roan antelope (*Hippotragus equinus*), gazelle (*Gazella rufifrons*), warthog (*Phacochoerus aethiopicus*), reedbuck (*Redunca redunca*) and Grimm's duiker (*Sylvicarpa grimmia*) in addition to smaller or less abundant species (Flizot, 1962; Tchamba, 1996a; Anonymous, 1997). The latter two species have become extremely rare and might join the list of species that have become locally extinct over the last few decades: leopard (*Panthera pardus*), cheetah (*Acinonyx jubatus*), waterbuck (*Kobus ellipsiprymnus*), bushbuck (*Tragelaphus scriptus*) and red flanked duiker (*Cephalophus rufilatus*) (Anonymous, 1997; pers. obs. H. Bauer).

*Photo 6.2 Young lion with prey in Waza National Park. (Photo H. de Iongh).*

*Photo 6.3 Roan antelope in the harmatan (dust storm) in Waza National Park (Photo P. Loth).*

Declining trends in antelope numbers in the Waza National Park can be explained by the cumulated effects of the construction of the Maga dam in 1979, declining rainfall figures after 1980 and the impact of rinderpest during 1980-1990. Also the reduced management intensity, expressed as the annual budget, or the number of game guards, may have led to increased poaching. To illustrate this point, the number of game guards declined from thirty in 1980 to only eight in 2000.

### *The Elephant Issue*

The herbivore assemblage of the Waza National Park has not remained the same over time. It is not only that species are disappearing from the herbivore list, but also fifty years ago elephants were not recorded in the Park. In 1947 the first groups of elephants crossed the Logone River from Chad, stopped in the Kalamalue National Park and later on travelled to Waza, where they settled (Flizot, 1948; Ngog Nje, 1986). Since then the population has steadily increased, not only due to natural growth, but also to subsequent immigration from Chad and Nigeria (Fry, 1970; Figure 6.2)


*Figure 6.2 Estimated elephant numbers in Waza National Park between 1962 and 2002. The area in the graph shows the difference between counts with low and high numbers counted in the park. Source: Saleh et al., 2002.*

The elephants used the *Acacia seyal* trees in the park as their major dry season food source. The presence of elephants in the Park became a serious concern for the authorities, because the Acacia woodlands began to show signs of degeneration due to the feeding behaviour of the elephants. By 1968 the Park Administration noticed that elephants were destroying mature *A. seyal* trees at an alarming rate. It was also feared that the *A. seyal* woodlands in Waza would be completely destroyed by the elephants (Ngog Nje, 1981). Similar destructive behaviour was known from East Africa, where elephants destroyed mature *A. tortilis* trees in Lake Manyara National Park, Tanzania (Douglas-Hamilton, 1972; Loth, 1999). Since *A. seyal* is the major food source for the giraffes in the Waza National Park, the authorities feared that the giraffe population would also disappear completely. In response, the authorities started a culling operation that lasted from 1968 to 1973. Each year about 60 to 80 elephants were shot of a total estimated population of 500 to 600. Today elephants are still shot by sport hunters around the Waza National Park, but the quota is much lower.

The threat to the Acacia woodlands also led to the study of giraffes in the Waza National Park (Ngog Nje, 1981). During this study, the regeneration potential of *A. seyal* in the Park was investigated. Within the Acacia woodlands, in the central part of the Park, the density of adult trees was 83 per hectare, whereas the density of the age cohort that may provide the regeneration potential was eight times higher. The mortality rate of the trees was 11%, but the regeneration rate was twice this figure at 27%. Ngog Nje (1981) concluded, therefore, that there was no danger that *A. seyal* would disappear from the Park. Nonetheless, Tchamba (1996a) found that damage to the *Acacia* zone caused by elephants was severe. In a recent study in Lake Manyara National Park in Tanzania Loth (1999) found, however, that rejuvenation of Acacia woodlands was possible, *because* elephants killed mature Acacia trees. The study demonstrated that *A. tortilis* could germinate, but not establish in the shade of parental trees. Hence, by opening up the woodlands, and thus allowing establishment of a new generation of Acacia trees, elephants enhanced the resilience of the Acacia woodlands. Whether similar mechanisms also apply to *A. seyal*, remains to be investigated.

Although the elephants found ample food in the Acacia woodlands of the Waza National Park, it was insufficient to feed the herds year round. During the dry season the Acacias are leafless, and possibly their sheer numbers prevented all elephants from finding adequate forage in these woodlands.

During the dry season the elephants foraged in the floodplain grasslands (Flizot, 1948), but they also moved north, to Kalamalue National Park (Eijs and Ekobo, 1987; Steehouwer, 1988). Elephant movements in southern direction were first documented in 1980, when a herd of some 30 elephants was reported roaming in the Mindif area (DDA, 1980). After the construction of Maga dam, however, the number of elephants moving to the north decreased, while elephants started to move in increasingly larger numbers in a southerly direction (De Iongh *et al.*, 1999; Eijs and Ekobo, 1987; Meijvogel and Ekobo, 1986; Steehouwer, 1988). During their migration, the elephants increasingly came in conflict with local communities; destroying agricultural crops, damaging properties and even killing people (Figure 6.3). Steehouwer (1988) suggested that two different sub-populations undertook the southern and the northern movement, respectively.


*Figure 6.3 Movements of the Waza National Park elephant population in northern Cameroon and locations where elepants caused damage to crops in 1986/1987. The trek to the northern direction occurred during the dry season, the southern trek during the wet season. After Steehouwer, 1988.*

By using satellite tracking of a number of collared elephants three sub-populations of elephants were identified in Waza National Park (De Iongh *et al.*, 1999; Tchamba 1996a; see also Map 6.3, end of book). One sub-population resided in the northern part of the Park and migrated to Kalamalue National Park at the beginning of the dry season (January-June). The prolonged stay of a large group of elephants in such a small area (some 300 estimated to be there in 2001; Loth, pers. obs.) caused considerable damages to the natural vegetation (Tchamba, 1996a). This group also made excursions into the bush surrounding Kalamalue National Park. Increasingly, however, the bush has been cleared to make way for agricultural land, leading to yet more conflicts between elephants and people (Loth, pers. obs. 2001 and 2002). A second sub-population resided year-round inside the Waza National Park. A third sub-population used the central and southern part of the Park and migrated to the south at the onset of the rains (June-July). These elephants in particular caused extensive damage to crops throughout the wet season and returned to the park only in November-December. All these elephant populations resided in the Park for at least a part of the year (Tchamba, 1996a).

*Photo 6.4 Sedated elephant after satellite radio transmitter was fitted. (Photo H. de Iongh).*

### *Lions and Livestock*

Lions are a threatened species in West and Central Africa (Bauer *et al.*, 2001). As a flagship species this bleak outlook is of great concern for conservationists. Lions appeal to the general public, especially in Europe and the United States of America and loss of this species would reduce the attractiveness of Parks, such as Waza, for visiting tourists. The monetary value of lions for the tourist industry can be calculated by multiplying the Park's revenue by the proportion of tourists that consider the lion to be the most attractive animal. In the case of the Waza National Park this yielded an annual amount of 9,000 (Tchamba, 1996b). Each individual lion thus adds about 150 per annum to the Park revenue.

On the other hand, lions constituted a nuisance to humans, because they preyed upon livestock. Predation on livestock was a serious phenomenon, especially to the south of the park (Bauer, 1995). Lions created more damage than any other carnivore. Lions killed some 700 cattle and over 1,000 small stock annually, which could be valued at approximately 140,000. Predation was, however, perceived as the third most important problem by the local population (Mbouché, 1995). The total number of livestock killed by lions and hyenas combined, was equal to livestock losses due to diseases. Most losses (62 %) had been reported from the south side of the Park (Sonne, 1998).

The earliest lion population estimates for the Waza National Park were educated guesses: 50-60 in 1962 (Flizot, 1962), 40-50 in 1986 (Ngog Nje, 1986), 50-60 in 1988 (Drijver, 1991), 70 in 1995

(Bauer, 1995) and 30-60 lions -with a mean of 50 - in the 1990s (De Iongh *et al*., 2002;Bauer, 2003). These figures provide an indication of the order of magnitude of the absolute number of lions. They cannot be used, however, to do a meaningful analysis of the trends in lion numbers.

In 1998 five lions in the Waza National Park were fitted with VHF radio collars to determine the home range size and the seasonal use of their territories. The home ranges of these tagged lions remained stable. The movements showed a consistent pattern for every individual throughout the research period. There were certainly differences between individuals: the resident individuals, two females, had smaller home ranges than the two males who spent at least part of their time outside the Park. One female spent the dry season inside Waza Park, but left during the wet season, which increased her home range.

*Photo 6.5 Two radio-collared lions mating in Waza National Park. (Photo P. Loth).*

### *Tourism*

The number of tourists visiting the Waza National Park was at a minimum in the 1994/95 season (Table 6.3). This low was clearly related to the economic crisis and insecurity in the area. During 1995/96 to 1996/97 there was a tendency for numbers to increase. According to the chief game warden the long-term target is 12,000 tourists visiting the park per year, while before the economic crisis started, an average of 7,000 tourists was visiting the Park. Of the tourists visiting Waza, 15% are nationals, 25% residents and 60% non-resident visitors. The average length of a visit to the Park was three days. According to Tchamba (1996b), elephants are the number one attraction for tourists visiting Waza Park, with lions a close second. Tchamba also indicated that as a result of pilot flood releases and the re-inundation of the floodplain, elephants would tend to stay longer in the Park. This could increase the attraction value of elephants for tourists after the full re-inundation.

| Year | before 1984 | 87/88 | 88/89 | 89/90 | 90/91 | 94/95 | 95/96 | 96/97 |
|---|---|---|---|---|---|---|---|---|
| Number | 7000 | 5600 | 5400 | 5700 | 5600 | 4500 | 5000 | 5400 |

*Table 6.3 Number of tourists visiting Waza National Park (source: Chief Game Warden).*

# Part IV
# Living with the Seasons

# 7 The People of the Floodplain

By Paul Loth, Mark Moritz, Roger Kouokam, Paul Scholte and Saïdou Kari

## 7.1 Floodplain livelihood systems

The Waza Logone project strongly depended on the collaboration of the local population to achieve its goals. Several ethnic groups live in the floodplain, each of them with their own interests in the use of and access to the floodplain's natural resources. These interests often collide with those of other groups. The project therefore invested a lot of time and effort to understand the socio-economic background of the different groups in the Logone floodplain.

The human activities that take place on the floodplain depend on the natural resources provided by the floodplain. Activities follow each other, as the resources become available according to the hydrological cycle (Drijver and Marchand, 1985; Welcomme, 1979). Accordingly, the people in the floodplain have different livelihoods, with different degrees of specialisation ranging from pastoralism to agriculture (Roggeri, 1995). Pastoralism is defined as the mode of existence of people who primarily derive their livelihood from the permanent management of livestock on rangelands. Agriculturists make their living from cultivating crops (Van Driel, 2001). The presence of water in the Waza Logone area allows fishing as a third specialisation. The distinction between these different modes of existence is not very strict. Many farmers in the floodplain take the opportunity during the slack period of high water to fish, while other farmers also keep livestock (Kouokam, 1996; Kouokam *et al.,* 1994).

The activities of the people are strongly influenced by the different seasons, which are in particular characterised by the absence or presence of rain and floods (Table 7.1). Pastoralists use the seasonally inundated floodplains in the dry season because grass production continues there for a long time.

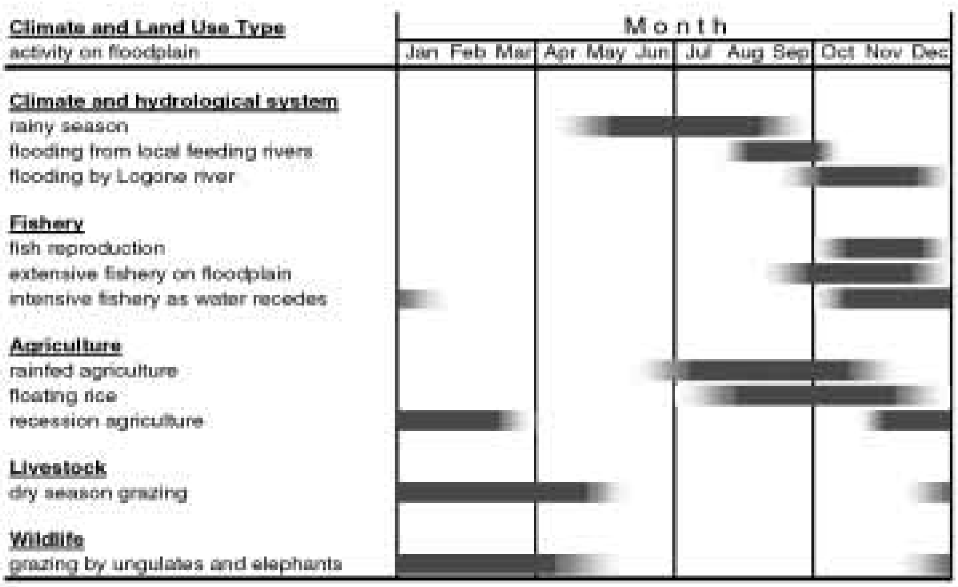


*Table 7.1 Climatic events and main land use types in the Logone floodplain (after Drijver and Marchand, 1985).*

While the flooding restores the soil moisture to enable grass growth in the dry season, the floodwater at the same time forces the pastoralists to take their livestock away to higher grounds to prevent waterborne diseases. This is the time when the fishermen have their biggest catches, because they can use the entire floodplain as fishing grounds. Agriculturists use the rainy season to grow their crops and those who live in the floodplain can extend the cropping season by growing floating rice in the floodwater that follows the rains.

The way in which people use the natural resources of the floodplain depends on the seasonal availability of these resources. The two extremes that characterise people's mobility are at the one hand sedentary agriculturalists, and at the other hand pure nomadic pastoralists. The following definitions are used in this book (after Van Driel, 2001).

*Nomadic pastoralists* are people who specialize in animal production and depend mainly on livestock for their subsistence. They are highly mobile with no fixed homestead in order to be able to find the best patches of grazing areas in the variable climatic conditions of the arid zones. *Semi-nomadic pastoralists s*ometimes have a permanent camp for the elders to which the rest of the household regularly returns.

When pastoralists partially rely on agriculture but keep their pastoral system mobile, they are called *semi-settled agro-pastoralists.* They combine a fixed farming base with a mobile herding camp while transhumance is undertaken. The herd's most important product is milk. Some milk-cows are usually left at the homestead while the rest of the herd is away with a number of the male kin.

The *settled agro-pastoralists* and the *settled agricultural stock-keepers* are people who both farm and keep their livestock around the homestead, and who could be called mixed farmers. Agriculture constitutes an important part of the household economy for the settled agro-pastoralists, but the main focus is still on stock, which is kept around the homestead all year round. They invest any farm surplus in livestock. If the household focuses on agriculture and additionally owns some livestock, the people are seen as settled agricultural stock-keepers, or sedentary farmers. In this case cattle-breeding complements cultivation, and animals are used for draft power while their manure also serves as a means of capital accumulation.

Another animal-based livelihood system is fishing. *Settled or sedentary fishermen* catch sufficient fish in their immediate surroundings that the income from fish sales allows them to buy additional requirements to complement whatever they can gather from their immediate surroundings, for instance wild rice. *Nomadic fishermen* move around in a large area throughout the year in search for the best fishing grounds. Otherwise fishing is a secondary activity among agriculturists who live in the neighbourhood of suitable fishing waters.

## 7.2 Ethnic groups in the floodplain

The specialisation in livelihood is often along ethnic lines, because each ethnic group has a common language and a shared history, which forms their collective identity (Van Driel, 2001).

The Fulbe or Fulani (the English name) is the largest nomadic pastoral group in the world. A number of different Fulbe groups make use of the floodplain, from strictly nomadic to the semi-settled Fulbe who send out their herds to the floodplain, usually under the guidance of hired herdsmen (see below). The Shuwa Arabs are of origin nomadic pastoralists, but many of them are now settled agro-pastoralists.

In the floodplain, the Fulbe have settled in two core areas. One group has settled in the villages Fadaré and Petté, some 50 km north of Maroua. Their herds enter the plain along the southern and eastern border of the Waza National Park. Their animals graze on the left bank of the Logomatya River. The other group live in the villages of Mindif and Kaélé, southeast of Maroua. They get access to the plain in the south via the Maga dam and use pastures of the eastern bank of the Logomatya River.

The groups that are settled are farmers and fishers. The Musgum are of origin also pastoralists but they have turned to farming already quite some time ago. Only recently the Musgum successfully challenged the Kotoko, fishers *pur sang*, their supremacy to fishing rights. Another sedentary group is the Masa but the largest concentrations are found near Yagoua, outside the project area (See Plate 7.1).

## 7.3 Man as part of the ecosystem: pastoralism

### Pastoral groups in the floodplain

The Logone floodplain has always been an important grazing area for thousands of pastoralists in the Lake Chad Basin (Barth, 1965; CTA, 1999). When the grasses in the surrounding plains and mountains shrivel, and water holes dry up, pastoralists from Cameroon, Chad, Nigeria, and Niger move their livestock to the floodplains of the Chari and Logone rivers. The water-soaked soil allows grasses to continue to grow well into the dry season, so that herdsmen find forage and easily accessible surface water for their animals. The grasslands of the floodplain are unsuitable for anything but grazing; solely pastoralists' livestock and wild herbivores exploit the available biomass. This makes pastoralism a sustainable and economically viable way to exploit the grassland savannas of the Logone floodplain.

Cattle are the key animals for most pastoralists in the floodplain, although many also keep other species. Donkeys are used as pack animals, horses for personal transport, while sheep and a few goats serve as change for small expenses. Some of the Uuda shepherds from Niger use camels as pack animals.

During the rainy season, only the cattle of the sedentary Musgum remain in the floodplain but when the water retreats, the situation changes (See Plate 7.2). About three thousand nomadic and semi-nomadic pastoralists from the Diamaré plains, the area north of Kousseri, Nigeria, and Niger enter the floodplain with their herds for a period of six to eight months (Beauvilain, 1981). In the course of the dry season, the number of cattle increases to over 200,000, which is about one-third of the total number of cattle in the Far North Province (Beauvilain, 1981; Gaston and Dulieu, 1976).

#### *Pastoral groups*

There are several groups of nomadic Fulbe that use the floodplain during the dry season (e.g. Mare, Aljiam, Adanko, Hanagamba, Bibbe Woyla, Uuda). Most of them originally came from Nigeria, but have been in Cameroon for the last twenty to sixty years. Most of the nomadic Fulbe identify themselves as Cameroonians and have Cameroonian identity cards, although their kin network extends across all borders. It reflects the readiness of nomadic Fulbe to move whenever rangeland conditions deteriorate, not only because of ecological but also socio-political conditions (*i.e.* insecurity).

The red cattle breed of the nomadic Fulbe is called *bo'deeji*; it is larger than the breed of the sedentary Fulbe, *gudaali*, and is better adapted to the hardships of the transhumance. The *bo'deeji* have long horns and are an impressive sight. There is considerable interbreeding between these two zebu breeds in the floodplain. The agro-pastoral Fulbe generally keep *gudaali* cattle, a breed that is more adapted to a sedentary pastoral system. These animals are smaller than the nomadic breed of the *bo'deeji*, have a wide range of coat colours, and shorter horns. The sedentary Musgum pastoralists keep a livestock breed, which is smaller than that of the Fulbe and Shuwa Arab transhumant pastoralists and better adapted to withstand the rainy and flooding season.

Most of the Shuwa Arabs come either from Borno State in Nigeria or from the Logone-Chari delta north of Kousseri (Hagenburger-Sagripanti, 1977; Tijani, 1986; see Table 7.2). Shuwa pastoralists do not sell milk, but they use it for household consumption or leave it for livestock breeding. The Shuwa are more involved in livestock trading than the other pastoral groups in the floodplain. They increase their herd size by buying additional heads of cattle from their trade profits, and by taking care of entrusted animals from relatives in Nigeria. Both nomadic and agro-pastoral Shuwa Arabs move with their livestock to the Logone floodplain (Schrader, 1986).

| Livelihood system | Mobility | Ethnic group | Wet season grazing area |
|---|---|---|---|
| Nomadic pastoralists | | Shuwa Arabs | Diamaré |
| Nomadic shepherds | | Uuda | Niger, Nigeria |
| Semi-nomadic pastoralists | Transhumant | Fulbe | Diamaré |
| Semi-settled agro-pastoralists | | Shuwa Arabs | North of Kousseri, Diamaré |
| | | Fulbe | Diamaré |
| Settled agro-pastoralists | Sedentary | Musgum | Logone floodplain |

*Table 7.2 Pastoral groups in the Logone floodplain and their wet season grazing areas.*

The Uuda from Niger and Sokoto State (Nigeria) are nomadic Fulbe who breed sheep as their most important animal. These shepherds come to the floodplain to exploit the woody savannah surrounding the floodplain. By lopping and cutting trees, mainly *Acacia seyal* and *A. sieberiana*, the Uuda feed their black and white sheep and leave a degraded environment wherever they pastured their animals (Scholte *et al.,* 1996).

### *Pastoral use of the floodplain ecosystem*

Mobility is the key strategy of pastoralists who use the seasonally inundated floodplains of the Logone River. The trekking movements of the pastoralists to the floodplain depend on whether they practice transhumance with their family, the breed and number of animals, presence of epizootics, traditions, and the political situation. In the pastoral exploitation of the floodplain several phases can be distinguished.

The majority of the nomadic pastoralists arrive in the floodplain in November and December, when the water retreats (see Table 7.1). From November through January, after the recession of the floodwater, the animals feed on the young shoots of grass, especially *Echinochloa stagnina* and *Vossia cuspidata*. At the beginning of this phase, pastoralists on transhumance enter the floodplain and split their herds in two; older animals and the majority of the milking animals stay with the families, while young herders take the best and healthy animals on a separate route. The young men follow the retreat of the water in search of ungrazed pastures. During this period, the animals often graze while standing in the water. The mobility and flexibility of these herds is enormous. The young men have no tents or camp, they just carry a mat on their back and sleep wherever they end up at the end of the day. The only food available for these herders for several months is milk (from the one or two milk cows that are in these herds). In January or February, the herds are combined again and the households settle in one or two campsites for the rest of the dry season.

In the next phase of exploitation of the floodplain grasslands, lasting from January/February to the beginning of the rainy season in May, the animals feed on the regrowth of perennial grasses that result from fires. Once the water has retreated again to the depressions and rivers in the floodplain, the rangelands are set on fire. Pastoralists burn dry grasses to stimulate the regrowth of perennial grasses. Also hunters set the plains on fire to facilitate game hunting. The moisture that is still available in the soil enables the regrowth of *Hyparrhenia rufa*, *Echinochloa stagnina*, and *Vetiveria nigritana*. These fires are a key component of the pastoral ecosystem, because they ensure that green pastures are available in the floodplain until the end of the dry season.

*Photo 7.1 Cattle and sheep roaming the bush near Petté, south of Waza National Park (Photo P. Loth).*

At the onset of the rainy season in May or June, pastoralists direct their animals to those places where the first rains have fallen. Scouts are sent out to find out where there is enough grass and surface water to support their herds. They also find this information at the local livestock markets, where they ask fellow pastoralists, and compare the condition of animals coming from different regions. As soon as there is enough pasture and water outside the floodplain, the pastoralists leave. The trek to the rainy season pastures of the Diamaré does not follow a direct route. Instead, pastoralists first follow the rains in search of the best pastures for a period of one or two months (June – July). In August, when the rainy season is in full effect, pastoralists go to their customary campsites where they camp for a month or two. At the end of the rainy season, when water sources are running dry and the quality of the pastures declines, they move straight back to the floodplain in just a few days. The cycle is about to start anew.

### *Hazards for herders*

All pastoralists, except the sedentary Musgum, practice night grazing in the floodplain. The advantage of night grazing is reduced heat stress and increased forage intake (*cf*. Ayantunde *et al.,* 2000). Most herds start grazing somewhere between 21:00 and 23:00 and return between 3:00 and 5:00. Night grazing is labour demanding, but maintains the animals in better condition (*cf*. Ayantunde *et al.,* 2000). The main disadvantage of night grazing in the Logone floodplain is insecurity; most cattle raids take place at night when herders are taking their animals to pasture. Insecurity has been the main reason for pastoralists leaving the Logone floodplain over the last thirty years, and was considered more important than the ecological decline that resulted from the Maga Dam and SEMRY II (Scholte *et al.,* 1996).

The various pastoralist groups on transhumance enter the floodplain from the south around November. Later, they move to the north of the floodplain, but the speed of movement depends on the rate at which the floodwater recedes. Their arrival is usually earlier in dry years, and later in years with better rainfall. When they arrive early, and the millet has not yet been harvested, the cows and bulls cause significant damage to crops, creating problems for local farmers. Fishers are also concerned when pastoralists enter the plain at such a time, because large quantities of fish remain in the fishing canals. In addition to the costs involved in repairing damage caused to the canals, fish can escape through the broken canal levees when cattle herds cross the floodplain. Details of these conflicts are presented in Chapter 8.

Apart from conflicts that arise occasionally between pastoralists and farmers or between pastoralists and fishermen, herdsmen face other constraints, notably waterborne diseases, such as pasteurellosis and liver fluke. Cattle theft is high in the plain compared to the neighbouring zones. Predation by the animals from the Waza National Park mainly affects cattle grazing in the peripheral zone of the park.

All these constraints represent a considerable loss for the cattle owners. The total number of cattle lost due to disease, theft and predation is estimated to be 6.7% of the total herd size. Cattle losses can be reduced if the pastoralists start their migration into the floodplain after the harvesting period of the red sorghum during mid-October or if they access certain grazing lands after the fishing in the canals (December - January) is finished. Cattle owners can also restrict their losses if they avoid grazing around the vicinity of the park, and if they systematically vaccinate their herds before they go on transhumance, or if they strictly adhere to the corridors that are set up to facilitate their migration in the plain.

### *Pastoral economy*

The Logone floodplain is economically important for pastoralists, both for the marketing of livestock as well as for the production and sale of milk. Livestock buyers from Cameroon and Nigeria, who come to the Logone floodplain to buy animals, frequent livestock markets in and near the floodplain (Zimado, Pouss, Kaykay Bourkoumandje, and Mazera). About 300 animals are sold every week in the floodplain, which supplies the markets of Bogo, Maroua, and Banki (Nigeria) where the animals are resold.

Pastoralists face several costs in order to maintain their herd (Table 7.3). Vaccination costs have been estimated at € 0.15 per cow per year. Some herdsmen give their livestock additional fodder, such as salt and cattle cakes, at an estimated average cost of € 1.35 per animal per year. Finally, in the case of absentee herd owners, they need to pay the shepherd's monthly salary (€ 15). An average cattle owner will pay out an annual sum of € 5.35 to keep one animal.

Occasionally other costs are incurred during transhumance due to conflicts between pastoralists and other users of the floodplain. These are estimated to amount to € 30 – 40 per herd. Nomadic herders understand that the size of a herd cannot increase without having to pay compensation for damages inflicted upon the fields of farmers. Sometimes the herders even intentionally cause damages to cultivated areas for this end. More costly, however, are the various taxes and levies the herdsmen have to pay. The amount of these taxes depends on the mobility of the herds.

### *Nomadic pastoralists*

The nomadic Uuda sheepherders from Niger (100 households) and from Sokoto State in Nigeria (108 households; Kouokam and Saidou, 1998) pay taxes at the international border between Cameroon and Nigeria. They also pay € 0.25 to € 0.50 per sheep as local council fees, and each camp must give some sheep to the local authority (*Lamido*) as the traditional charges for using the pastures. In addition to this, they must give one sheep per herd of 150 to 200 animals when they move into the floodplain area.

| Livelihood system *Ethnic group* | No people | No hh | No of camps | Cattle: No of herds | Cattle: Mean herd size | Cattle: Tot # cattle | Tot # small livestock | Value (€11 small, €110 cattle) * $10^6$ | Taxes (€) per herd: Council fee | Taxes (€) per herd: Traditional |
|---|---|---|---|---|---|---|---|---|---|---|
| Nomadic pastoralists | | | | | | | | | | |
| *Fulbe –Woïla* | 1 134 | 248 | 31 | 217 | 80 | 17 360 | 6 510 | 1.98 | 60 | 15 |
| *Fulbe –Addanko* | 217 | 40 | 10 | 40 | 48 | 1 920 | 2 000 | 0.23 | 30 | 12 |
| *Fulbe –Alidjam* | 347 | 56 | 11 | 88 | 50 | 4 400 | 1 760 | 0.50 | 30 | 12 |
| *Fulbe –Uuda* | 810* | 208* | 52* | - | 0 | 0 | 62 400* | 0.69 | 35 | 20 |
| *Shuwa Arabs* | 932 | 198 | 22 | 260 | 110 | 31 460 | 8 580 | 3.23 | 75 | 22 |
| **Totals** | **3 440** | **750** | **126** | **605** | | **55 140** | **81 250** | | | |
| Semi-nomadic pastoralists | | | | | | | | | | |
| *Fulbe (N)* | 441 | 119 | 21 | 168 | 85 | 14 280 | 168 | 1.57 | 70 | 15 |
| *Fulbe (S)* | 342 | 72 | 19 | 190 | 82 | 15 580 | 1 900 | 1.73 | 60 | 12 |
| **Totals** | **783** | **181** | **40** | **358** | | **29 860** | **2 068** | | | |
| Semi-settled agro-pastoralists‡ | | | | | | | | | | |
| *Shuwa Arabs* | n.a. | 1 937 | n.a. | n.a. | 18 | 34 850 | 38 750 | 4.26 | | |
| *Fulbe* | n.a. | 2 105 | n.a. | n.a. | 20 | 42 100 | 42 100 | 5.09 | | |
| **Totals** | | **4 042** | | | | **76 950** | **80 850** | | | |
| Settled (agro-)pastoralists | | | | | | | | | | |
| *Musgum* | n.a. | 6 063 | n.a. | n.a. | 10 | 60 630 | 151 500 | 8.34 | | |
| *Kotoko* | n.a. | 1 347 | n.a. | n.a. | 1 | 1 347 | 10 800 | 0.27 | | |
| *Bornois* | n.a. | 3 705 | n.a. | n.a. | 1 | 3 705 | 74 100 | 1.22 | | |
| **Totals** | | **11 115** | | | | **65 682** | **236 400** | | | |
| ***Grand Total*** | | ***16 088*** | | | | ***227 632*** | ***400 578*** | | | |

Source: socio-economic surveys carried out in 1996, 1997 and 1998 in Waza Logone region.

*Table 7.3 Number of livestock per livelihood system in various ethnic groups, and taxes to be paid as grazing rights. Data for nomadic and semi-nomadic pastoralists ( † ) based on surveys carried out by the Waza Logone project in 1997 and 1998, data for agro-pastoralsits and settled agriculturalists ( ‡ ) based on 1996 survey. hh= house holds, n.a. = not available; * = estimated data.*

Nomadic pastoralists pay taxes varying € 30 to € 75 per herd to the local councils where they settle. In addition, a traditional tax equivalent to € 15 is paid to the *Lamido* to obtain his permission to use the pastures.

During transhumance, the chairman of the council allows three days free passage for the herds. After that period, the council fees must be paid. Thus, the herder may decide to quickly pass the territory of one council, in order to save the fees he should otherwise have to pay. Nomadic groups usually send someone to the *Lamido* to discuss the situation ahead. They will enquire with the *Lamido* whether the road is free, or whether there have been recent reports of cattle theft, and so on. The *Lamido* from his side asks for the size of the herd, and then the required fees are negotiated, payable in goats, sheep or calves. (see Plate 7.5).

### *Semi-nomadic pastoralists*

These Fulbe pastoralists hire herdsmen to graze their cattle in the floodplain at a cost of € 15 per month. Their herds are made up of sheep and cows. They have to pay taxes for grazing rights to the council where they stay. In 1998 some 72 households camped in the southern part of the floodplain, close to Maroua, and 199 households camped in the northern part of the floodplain. The rates vary from € 0.75 to € 1.50 per head of cattle. In addition, they have to give at least one tenth of their annual production to the local traditional authority.

### *Sedentary pastoralists*

The animals of the sedentary pastoralists graze around their villages. Some of them give part of their herds to nomads while they move into the plain, and these livestock owners could then be considered to be semi-settled agro-pastoralists. This means that these animals stay in the floodplain for a whole year. Sedentary pastoralists live in the villages of the Waza Logone region; they number 730 households, representing 3.2% of the total population (Kouokam, 1996). All ethnic groups breed cows, donkeys, sheep and goats, except for the Kotoko, who keep only small ruminants. As residents living in the villages, they only pay the annual tax of € 5.35 (fixed by the government) to the local councils in order to use land for cultivation and as pastures. If they move to others parts of the floodplain to fish or to graze their cattle, they also have to pay transhumance fees to the council where they stay. In addition to these fees, a breeder can willingly give part of his annual production (1 goat or sheep, or 1 cow) to the traditional local authority. This part, less or equal to 10% of his annual revenue, gives him the right to use the village land.

In general, small ruminants and cow milk are sold in order to buy clothes and cereals (millet). The number of sheep or goats sold per year and per household varies from one to five. Cows are scarcely sold; generally only one or two are yearly sold by any one household. Cattle owners normally prefer keeping cattle for social events, such as marriage or birth celebrations. Within the Musgum ethnic group, a man has to give 6 to 12 cows in order to marry a wife. The market value for a sheep or goat ranges between € 7 and € 15, and for a cow between € 75 and € 150. In recent years, the breeding rate of cattle has increased from 15% to 50% and breeders as well as traders obtain considerable benefits from livestock. Indeed, breeders who use the floodplain will be able to sell more animals. In addition, traders whose margin is now estimated at 30% of their investments will also buy and sell more animals to improve their annual incomes that is currently estimated at € 370 per trader.

### *Herd size and herd productivity*

The average number of animals per household ranges between 50 and 110 head of cattle with about 10 to 50 small stock for nomadic and semi-settled pastoralists, and ranges between 1 to 20 cows and 8 to 25 goats and sheep for sedentary breeders (Table 7.3). The latter prefer small ruminants for several reasons. Children can guide these animals in the pasture, or they can graze around the village without any herdsman, thus saving the fee for a herder. Additionally, sedentary breeders are busy with other activities, including farming and fishing. There is not enough time to take care of a big cattle herd. The Kotoko ethnic group, for example, consists mostly of fishermen who hardly keep cattle. Indeed, an average of one cow per household was recorded and even then Kotoko women complained of the need to sweep cow dung.

Surveys that were held among different ethnic groups from 1996 to 1998 showed that the breeding rate of animals grazing in the floodplain had improved over this period. For cows, it increased from 16 % in 1996 to 50 % in 1998. It remained stable at this level up to date (2000). For the small ruminants, the breeding rate was 15% in 1994, increased to 32% in 1996 and reached 50% in 1998. The increase of the reproductive rates of livestock coincided with the improved conditions of the floodplain grasslands, which resulted from the pilot flood releases undertaken by the Waza Logone project in 1994 and 1997.

### *Milk production*

In the dry season, the reproductive rates and milk yields are generally higher in the floodplain than in other parts of the province, because the pasture conditions are better. The average milk production is one to two litres a day per cow under poor feeding conditions (April to June) and three to four litres a day per cow under good feeding conditions in the floodplain (July to March). The daily average production of milk per cow is 2.5 litres a day for a period of 6 to 20 months. Women exploit milk; a woman can sell at most 20 litres a day and keep 10 litres for family consumption (5 persons on average per household). Human population densities in the floodplain, however, are low, which limits the marketing opportunities for diary products by pastoral women. The major portion of milk collected (40 litres) everyday is thrown away in order to avoid overfeeding of calves. In recent years, however, businessmen from Maroua, the main urban centre in the Far North Province, have bought milk at the local markets of Guirvidig and Pouss, throughout the dry season, and in Mazera during the Muslim fasting month of Ramadan (Moritz *et al.*, 2002). The main drawbacks to dairy marketing are the remoteness, and the poor conditions of the roads between the local markets of the floodplain and the urban consumers in Maroua.

*Supplemental fodder*

Apart from the direct benefits gained in selling animals, there are other indirect profits drawn from transhumance. The floodplain is a dry season grazing area exploited by sedentary, nomadic and transhumant breeders. If these pastures were not available, the herders would need to mitigate the poor feeding conditions, entailing considerable costs. The only other strategy would be to feed their cattle throughout the year with some additional source of feeding such as cattle cakes, red sorghum and groundnuts leaves. All these produces are expensive on the market. A detailed calculation has shown that, during the dry season, a breeder needs 57.60 to feed a cow properly for a period of six months. He would have avoided these expenses by practising transhumance in the floodplain (De Iongh *et al.*, 1998). It is true that transhumance causes some losses due to theft (1.2%), waterborne diseases (5%), predation (2%) and accidents (0.3%) representing in all an annual average loss rate of 6.7% per head of cattle per year (Kouokam and Saidou, 1998). However, these losses are marginal compared to benefits deriving from transhumance, because a breeder looses only about 8 per animal - that is 6.7% of the average market value - when grazing in the floodplain.

*Conclusion*

During the dry season the Logone floodplain is a key resource within the larger pastoral ecosystem of the Lake Chad Basin. By itself it cannot sustain livestock herds throughout the year. Rainy season rangelands are equally important for pastoralists. If pastoralists cannot move freely to, from, and within rainy season rangelands, they also cannot use the floodplain. Contrary to what is frequently stated in the literature, crossing national borders is relatively easy, and does not form a major impediment for the transhumance movement. Pastoralists move back and forth between Cameroon, Nigeria, and Chad and many Cameroonian pastoralists spend part of the cold dry season in Chad. However, encroachments on rangelands and transhumance routes by farmers and fishers within the Far North Province of Cameroon do threaten their mobility, and thus, the sustainability of the pastoral ecosystem.

## 7.4 The fishers

*Fishing history*

The sedentary Kotoko have long been the traditional fishers in the floodplain. During the floods they used to fish wherever they pleased. Even well into the dry season they could still continue to fish in designated fishing reserves. These reserves, water-filled depressions in the floodplain, were managed by traditional chiefs who decided who could, and who could not, fish. The result of this system was that the Kotoko fishers were ensured of fish throughout the year. Drying of fish also ensured the availability of fish for trading in lean periods, because dried fish could be kept in stock (Van Est, 1999).

The Musgum came in the floodplain at the end of the 19th century, where the Kotoko sultan reigned. Initially the Musgum complied with the ruling of the Kotoko. They allowed the newcomers to settle on uninhabited small islands under strict conditions. Only during the last decade of the 20th century the power base of the Kotoko Sultanate declined. The Musgum no longer accepted certain Kotoko privileges and access rights to fishing grounds. This led to vehement conflicts between the two ethnic groups. In the end the Kotoko gave up their exclusive fishing rights (Van Est, 1999).

During the last few years, the fishing grounds have been open to everyone. Together with the reduced extent of the flooding, these developments resulted in decreased fish yields for the Kotoko fishers. Some of the fishermen decided to look for better fishing areas, and found these in Lake Chad and in the new man-made lakes, Lagdo and Maga in Cameroon. The reduced level of Lake Chad in the past decade increased the fish biomass in the remaining waters, so that fishing became efficient. Before these events young Kotoko fishermen ventured out in search of alternative fishing grounds, and thus became nomadic fishers.

### *The fishing*

The fishery production cycle begins in the rainy season. In September and October the river water rises and the water starts to spread onto the floodplain. Fish leave the rivers or other permanent water bodies, where they have spent the dry season. With the floods, *Clarias* spp migrate further onto the floodplain to feed and spawn. In the same period other species like *Petrocephalus bovei, Brycinus nurse, Oreochromis niloticus* and *Synodontis nigrita* spawn in the watercourses. The adult fish, the juveniles and the newly hatched fry grow up quickly on the abundant food. When the floodwaters recede the fish return to the river to await the next flood cycle.

*Photo 7.2 A Kotoko fisher (Photo H. de Iongh).*

*Photo 7.3 Fish on sale at Maroua market. (Photo H. de Iongh).*

The exact pattern of fish migration varies from species to species. The hardy African Catfish (*Clarias* spp) is usually the first to move (Plate 7.7, 7.8). Large catfish can be found in water barely covering their backs, and they have even been found at night, moving in wet grass. Catfish are also the last to leave the plain as the flood recedes. Sardines (*Alestes* spp.), on the other hand, are very sensitive to the water level. They are the last to arrive on the floodplain, and they will leave as soon as they sense the water beginning to recede (De Iongh *et al.*, 1998). Fish productivity in floodplains is usually estimated to lie between 40 and 60 kg (Benech and Quensiere, 1982; Welcomme, 1979) per hectare of flooded area. In these seasonally flooded wetlands, catch sizes are, however, correlated with the intensity of the flooding (depth and duration) in the preceding year (Welcomme, 1979).

The habits of the species and their biological requirements dictate the method of fishing employed in their capture. Although people may fish throughout the year, two broad fishing seasons can be defined. The "Great Fishery" begins at the height of the flood. Although the rains begin some time in June, the waters only begin to rise and spread onto the floodplain in July. In the shallow water, large Catfish can be speared, or clubbed, as they leave the river or pools where they have spent the dry season. In September the normally sedentary local fishers move with their families into camps on the floodplain. Here they set baited traps in cleared areas for the widely dispersed fish. As the water begins to recede migrant fishermen from neighbouring areas join the fishery swelling the numbers of fishermen, from the 3,600 locals, to about 6,800, estimated during 1996/97 or even more in previous years (Djuikom, 1996; see Plate 7.2)

There is a short concentrated period of sardine (*Alestes* sp.) fishing, just as the flood turns and these fish migrate *en masse* to the safety of the river. All fishermen temporarily leave the floodplain to exploit this fishery along the Logone River and other large watercourses. After the harvest, the fishermen return to the floodplain once again (De Iongh *et al.*, 1998).

The receding water concentrates the fish in natural depressions and watercourses, where they are easily caught with set nets, grass barriers, traps and hooks. Some fishermen have dug many canals to concentrate the fish and facilitate the catching further. This is the most productive fishing period. Once the full flood has receded and the fishing in the canals is over, the migrants leave the fishery.

The floodplain is, however, still dotted with pools in natural depressions, and other water bodies that are full of trapped fish; fish that could not reach the safety of the river. These depressions gradually become swampy, then dry up so that the trapped fish are further concentrated. When these places are suitable for fishing, the men use dragnets to catch as many fish as they can. The woman and children then all join in a communal and social fishing event, called "Haring". They all enter the water with special basket-shaped traps, which they repeatedly plunge into the water to trap the remaining fish (see Plate 7.6). Other natural and artificial depressions may hold water throughout the dry season. These, as well as the river itself, are fished on a subsistence basis with set nets, throw nets and hook lines (Plate 7.3). This period is called the "Small Fishery" (De Iongh *et al.*, 1998).

### *Fishing tactics*

In September and October, while the water rises to its highest level, the fishermen make the last preparations for the imminent fishing season. They finish the maintenance of their fishing gear and buy new equipment when needed. They start fishing in the floodplain when the flood reaches its maximum level, normally in October.

The main fishing season on the floodplains extends from September or October to February. The fishermen use fishing baskets, called "*mama*" in the floodplain to harvest the sardines. Each fisher uses on average about 130 "*mamas*". These fishing baskets are made of grasses that grow in flooded areas. For *Claria* spp., the fishers use fifteen different types of fishing gear, called "*nasse malienne*". After the fishers have installed the "*mamas*" or the "*nasse malienne*" in the floodplain, the fishers check their traps once every two days. In general, the quantity of fish caught in the first month or so is low, but this will significantly increase in November and December.

Fishing becomes more intensive in November, when the water level in rivers starts to drop. The fishers continue to fish intensively in the rivers and canals (Plate 7.4) until the end of December. During these months almost the complete fishing population is active in the rivers of the Waza Logone region. The average number of fishing gears used by fishermen in this period is estimated at 20 lines of 1,000 hooks each, one fishing net used with a boat, and one fishing net used without a boat. The species favoured by fishers is *Clarias anguillaris*, because it tastes good and therefore fetches the highest price.

After December the intensity of the fishing reduces. In January and February a number of fishermen exploit their fishing canals in the floodplain. These are trenches that the fishers dig in the dry season and that join a depression to a river located in the floodplain. Gillnets are placed in the canals and nets are installed at the entrance of the canals near the river. *Clarias spp*. (54%), *Tilapia niloticus* (32%), *Hemichromis fasciatus* (3.7%), *Synodontis* spec. (3.6%) and *Ctenopoma petherici* (2%) are the main species harvested with this fishing method (Bobo Kadiri and Boukar, 1997; Bobo Kadiri *et al.*, 1996; Mahamat and Kouokam, 1997).

### *Fishing reserves*

Although the fishing period ends for most fishers in February, some continue fishing in the special fishing reserves until May. In general, a fishing reserve belongs to one or two neighbouring villages, whose inhabitants organise themselves to look after it. The reserves remain closed for everyone from mid-November until a date that usually falls after the main fishing season. The date of the reserve opening for fishing is determined during a meeting where the majority of villagers reach consensus. Following this, fishermen inform the *Lamido*, the traditional authority in the area. He will receive a part of the whole production. In general, a third of the harvest is assigned to hire special fishing gear (dragnets) that is only used at this occasion. The other two thirds is shared among fishermen. In many cases, the rest is sold and the money gained is used as co-funding for wells or other social infrastructures that help the entire population of the village.

Some fishing reserves may also be important refuge areas for fish that spawn again during the next flooding event. Furthermore, the fishing reserves may also be used at special occasions at the onset of the fishing season, which involve ceremonials to evoke favourable fishing conditions.

### *Fishing economy*

The Waza Logone project carried out a socio-economic study of 21 villages in the floodplain, revealing that the floodplain population is made up of different wealth groups, characterised by distinct livelihood strategies. All groups were involved in the same activities, *i.e.* farming, fishing, cattle-holding and trading. The better off relied mainly on farming, but the time spent on fishing increased with poverty. The majority of the population in this study was comprised of Musgum (76%), Masa and Kotoko (each 10%) and others (Béné *et al.,* 2000). The villages included in this study are between Zina and Maga. This study confirmed the general notion that small-scale fishing communities, particularly in tropical countries, belong to the poorest and most disadvantaged part of rural societies.

The total amount of fish caught in the 2,600 $km^2$ floodplain, which encompassed in the Waza Logone project area during the 1996/1997 fishing season, was estimated at 12,000 tonnes. The yield thus amounted to 46 kg of fresh fish per hectare of flooded area, which agrees with the earlier quoted estimates. From the results of the socio-economic surveys it was estimated that the total catch per fisher was 10 sacks of dry fish with an average weight of 40 kg per sack; after sun-drying each fish






*Plate 1.1 Different views on the Logone floodplain. a) Herders trekking to collect water; b) Two men in a dug-out canoe (during the wet season people can only move by boat); c) artificial mounds on which people retreated during floods are a typical view of the floodplains near Waza National Park; d) a village on the floodplain during the dry season; e) cattle grazing on the floodplain at the beginning of the dry season (Photos P. Loth).*

*Plate 1.2 Kob antelopes at the Mahe water point in the floodplain, near the eastern border of Waza National Park.*

*Plate 6.4 The population of black crowned cranes in Waza National Park accounts for more than 1% of their total population (Photos P. Loth).*

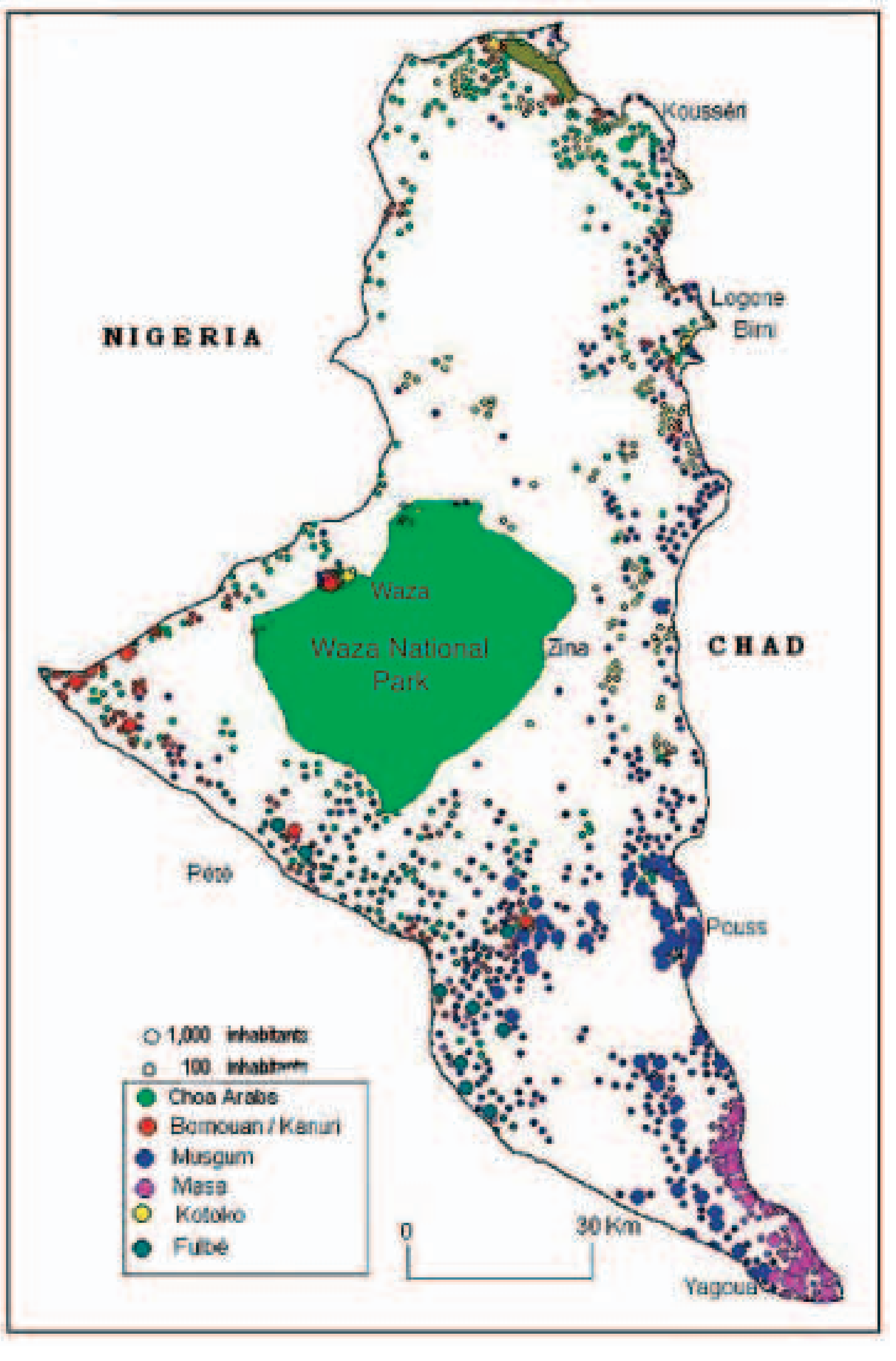


Plate 7.1 Distribution of ethnic groups in the Logone floodplain.

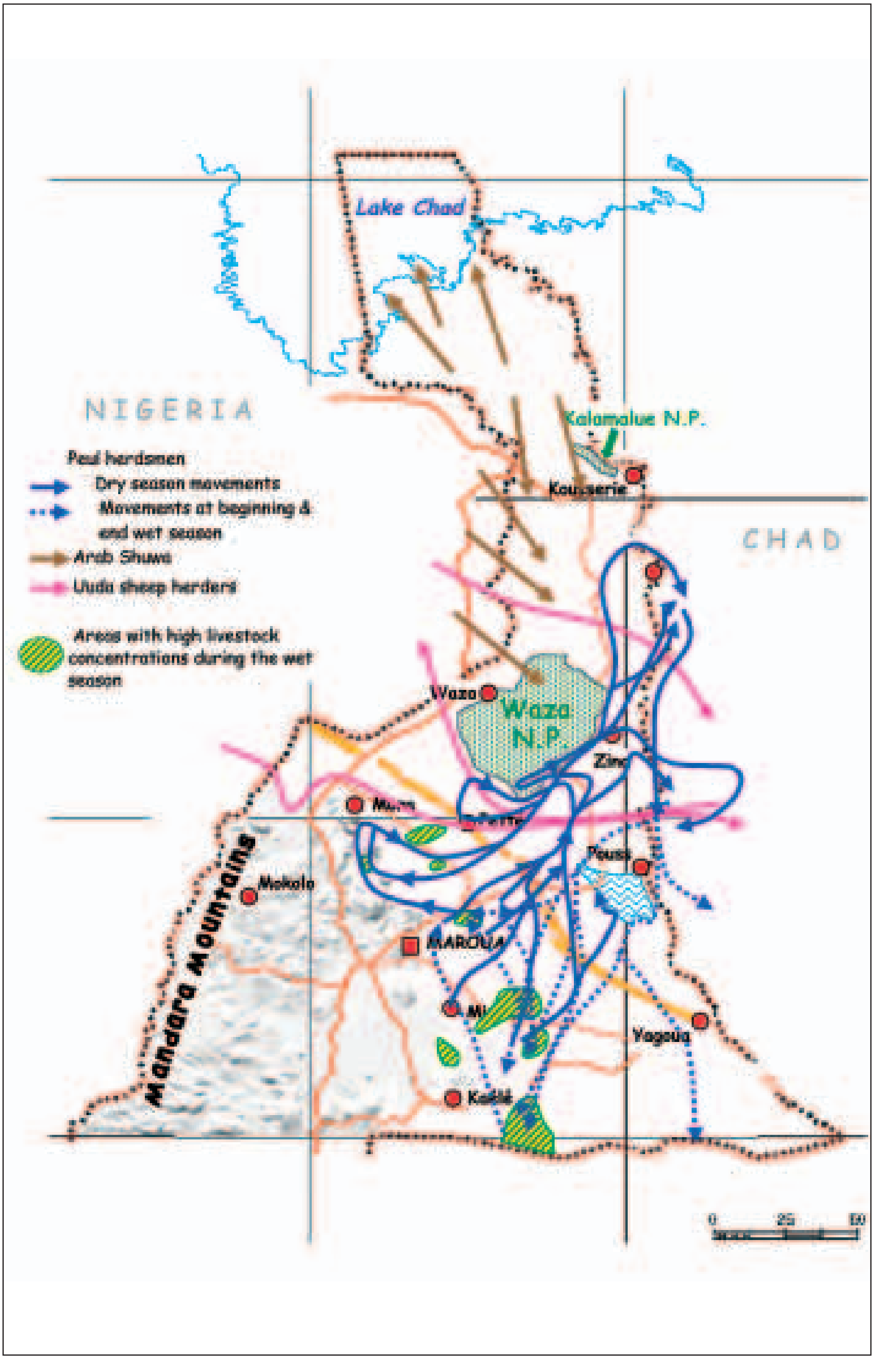


*Plate 7.2 Seasonal movements of pastoralists to and from the Logone floodplain in 1990.*

*Plate 7.3 Fishers along the Logone river throwing out their nets (Photos P. Loth).*

*Plate 7.4 Fishing cannals in the Logone floodplain. During the dry season, (a) the canals are repaired or newly dug. (b) Fishing canal during the floods (Photos P. Loth).*

*Plate 7.5 A nomadic herder with his cattle (Photo IUCN).*

*Plate 7.6 Fishing with basket-shaped traps at Haring (Photo IUCN).*

*Plate 7.7 Big fish are only caught by traditional techniques such as spearing, which requires a high water level. (Photo I. Harkes).*

*Plate 7.8 Adam Aba Djouro, a Kotoko fisher, with a freshly caught fish. Big fish are increasingly rare because of the degradation of the traditional fishing rules and the introduction of modern fishing techniques such as the drag net (Photo I. Harkes).*

has lost 60% to 70% of its fresh weight. It was estimated that 10,000 fishermen were active (Mahamat and Kouokam, 1997). From an earlier survey carried out in 1994, just before the first pilot release, only half this amount was caught (Kouokam *et al.,* 1994). Since the number of fishing days per season is 75 days, the daily catch is more than 8 kg.

Members of a fishing-household fish and process the fish together. The father and some of his children install fishing gear and harvest the fish. Women process and dry the fish. The dry fish weight range from 25 kg per sack of *Tilapia niloticus* to 50 kg per sack of *Gymnarchus niloticus*.

Whatever their status, fishers pay access fees. The traditional tax, estimated at 10% of the total production, is paid to the *Lamido* (the traditional Chief) and varies from 2 kg up to 20 kg of dry fish per fisher. In addition, they pay a tax to the municipality that ranges from just over € 5 to € 45. Fishers who own a fishing canal pay the most.

The yearly investment is around € 105 for each fishing-household. This money is allocated to pay for fishing gear, transportation of products to the local market and to hire labour. Considering the weighted price of € 29 per sack of fish, the gross annual incomes of a fishing household is estimated at € 290.

Fish traders earn much more than the fishers themselves. They buy fish at local markets and resell it in other markets in the province. The turnover of an average trader is 385 sacks with a mark-up of around € 3.80 per sack, yielding a net benefit of € 1,425 (Kouokam, 1996). In terms of economic value, fishing activities bring nearly € 2 million to the economy of the Waza Logone region (Mahamat and Kouokam, 1997).

Despite its significant contribution to the local economy, fishing activities face a number of problems. Among the most important are the power exercised by the majority of traders over fishermen, conflicts between fishermen and other floodplain user groups (pastoralist, transhumant fishermen), and lack of respect for fishing regulations, especially the bound fishing period and dimensions of fishing gears.

## 7.5 Farming

The rainy season in the north of Cameroon extends from June to September. It is marked by a uneven distribution of rain in space and time. The annual total amount of rainfall in the area, about 600 mm in the south of the area to just under 500 mm in the north, is enough to produce red and white millet, maize, rice, cotton, and vegetables. About once every three years, however, crop production may fail. This occurs because either there is simply not enough rainfall, or the distribution over the growing season has been erratic. Fortunately the government provides emergency food aid in such circumstances to relief the plight of local people.

Agriculture is the main production activity in the Waza Logone region. A census carried out by the Waza Logone project in 1996 has shown that out of the 200,000 people that live in this region, 60,000 people live in urban areas and 140,000 in rural areas. The same census has shown that for 25% of the rural population agriculture is the main activity, and a secondary activity for 34% (Djuikom, 1996). Food crops are primarily grown for home consumption. Part of the crops is sold when money is urgently needed.

*Farming practices*

In June, fields are ploughed and sowed with red and white millet, maize, and vegetables. Cotton, the main industrial crop, is also sown at this time. Red millet is harvested in October. Millet is the staple food for the majority of the local people. Nursery plants of dry season millet are transplanted at the end of September. They use the soil moisture to grow and reach the stage of maturity in February when they are harvested. Rice is sown in July, and nursery plants are transplanted in August. Rice growth is fed initially by rain and is then irrigated by floodwater to reach maturity in February.

Despite the fact that tractors are used in some rice and cotton farms, most people use locally made manual equipment. Because of the labour intensive way of farming, the field size per household is restricted. Furthermore, the floodplain itself is suitable for only a few crops because of the wet conditions during the growing season and the high temperatures during the dry season. The size of the farms range from one eighth of a hectare to a quarter of a hectare for red millet, from a quarter of a hectare to one and a half hectare for dry season millet, and from one eighth of a hectare to one hectare for rice. The average surface of cotton fields is one quarter of a hectare per household.

### *Farming production and income*

Annual production per household ranges from 0.5 tons to 3.5 tons for red and white millet, from 0.5 tons to 4 tons for paddy rice. Rice has the highest production of agricultural produce sold in markets within the Waza Logone region. A market survey carried out from 1995 to 1998 by the Waza Logone project showed that almost 60 % of white and red millet and dry season millet and about 90 % of rice are sold in local markets. In 1996, another survey carried out by Kouokam (1996) in 17 villages gave the following results. The annual net income deriving from agriculture ranges from € 30 to € 380 per household. The average investment per agricultural household is estimated at € 36.50.

Food crop yields could be doubled if farms were not affected by pests species, such as birds (*Quelea quelea*), insects and, in the case of farms located in the vicinity of the national parks, wildlife. In some years, excessive flooding may cause additional losses of crops. The total losses caused by the above factors are estimated at 50% of the potential production of the whole region (Kouokam, 1996; Kouokam *et al.*, 1994).

## 7.6 Other Activities

In addition to the main activities of fishing, livestock keeping and agriculture, many people engage in other income generating activities. These are generally carried out during periods when the main activities are at a low level. Fishermen also repair their nets and boats at this time.

### *Gum arabic collecting*

Men, women and children all pick gum arabic (Plate 7.6) in the vicinity of the Waza National Park and in the north of the Waza district. This activity extends from November to May, but it becomes intensive between February and May. Gum arabic farms are active four days per week. The quantity collected per day is estimated at 5.5 kg per man, 4.0 kg per woman, and 4.5 kg per child. This implies an average of 4.6 kg per day and per individual representing a total production of 122 tons in the year 2000 for 295 pickers counted during 90 days of work. Gum arabic is sold at € 0.25 per kg at local markets. The annual income per picker is estimated at € 100 (414 kg of gum per picker per year). In addition to pickers, there are traders who earn € 0.19 per kg sold.

A preliminary study was carried out during the 2001 dry season on the effects of gum collecting on *Acacia seyal* trees. The results of this study suggest that gum harvesting by itself may be harmless to the trees. The study carried out in and around the Waza National Park, concluded that the gum collectors did not wilfully damage the trees. The study did not provide, however, any insight to what extent the presence of people influenced the use of the Acacia woodlands by wildlife (Van Brederode, 2001).

### *Roof thatching*

The sedentary population in the floodplain has to renew the grass of their thatched roofs once every three years. In general, the compound of a household contains on average five huts. This means that each household has to renew around two roofs yearly. At the same time, the walls of the huts are covered with roughcast; the women usually do this work. For thatching the common floodplain grasses are used.

### *Handicrafts*

Women make mats and brooms of materials harvested from the floodplain. The weekly average production per household is around one mat sold at € 2.30 and five brooms sold at € 0.04 each. Handicraft activities are carried out by around 50% of the households in the Waza Logone region during the three months off-season. Handicraft activities earn each household a total of around € 30 per year. Some men are also specialised in making "*seccos*", a type of mat made of the grass *Hypharrhenia rufa*. They produce one "*secco*" per week during a period of three months. Each "*secco*" is sold at € 1.50, and the total annual earnings from this activity amount to € 23.

# 8 Conflicts and Conflict Management in the Waza Logone Floodplain

By Roger Kouokam, Mark Moritz, Daniel Ngantou and Paul Loth

## 8.1 Fighting for access to the resources

The rich diversity of the natural resources in the Waza Logone floodplain has always attracted many different users. In the past, these users gained access to the resources in an organised way, because the traditional leaders governed the rights to use them. Over the past few decades the authority of the traditional leaders has been eroded among the communities. Consequently, access to the floodplain resources no longer was organised by a generally accepted authority, and serious conflicts resulted when different user groups claimed the exclusive right to use specific resources. A clear example of such conflicts resulting from the breaking down of the traditional power base occurred in the fisheries. The Kotoko, traditionally the most skilled fishers lost their supremacy over fishing rights in their conflict with the Musgum, pragmatic herdsmen turned farmer *cum* fisher. Since then access to fishing was no longer regulated, leading to an explosion of fishing canals dug in the floodplain. These canals, often several kilometres long, blocked the usual routes of the cattle herds of the floodplain. The cattle that had no alternative route but to go across these canals eroded the walls of the canals with their hoofs, leading to skirmishes between fishermen and herdsmen. Notorious were the clashes between pastoralists and farmers, which occurred when cattle trampled the crops or fed upon crops still on the fields.

Wildlife, searching for food beyond the exclusive reserved areas, competed with people for the bush resources. Where the bush was turned into farmland, the cropped land formed a readily available food source for hungry herds. The Waza National Park attracted tourists, but the local communities did not share any of the revenues generated by tourism. Consequently, the people living in the area felt not committed to assist the authorities in the maintenance of the park. Rather, they took advantage of the inadequate surveillance capacity of the government and exploited whatever resources in the park.

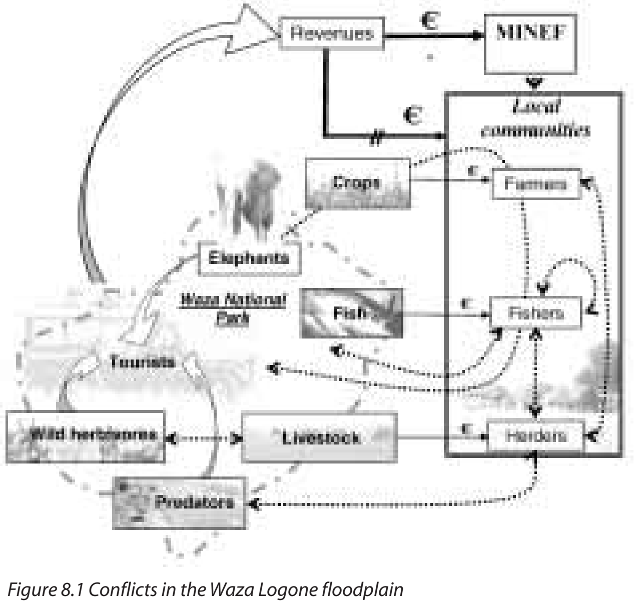


*Figure 8.1 Conflicts in the Waza Logone floodplain*

These were the circumstances in which the Waza Logone project started its work. One of the tasks of the project was to solve the conflicts among the users. The conflicts are summarised in Figure 8.1 and are described in more detail in the following paragraphs. The solutions to the problems found by the project are discussed in Chapter 10.

### *Conflicts between herders and farmers*

Conflicts between herders and farmers usually relate to damage to crops caused by livestock. In the Waza Logone area especially the nomadic pastoralists were involved in such conflicts. Conflicts occurred particularly when the herds entered the floodplain. In order to prevent cattle from roaming onto fields containing food crops, corridors had been established for free passage to and from the floodplain. Existing transhumance corridors shrank due to progressive land occupation by farmers, who established more and more dry season sorghum fields. As a result it became increasingly difficult to keep the cattle herds within the corridor boundaries. After the two pilot releases had been carried out in 1994 and in 1997, not only the sedentary population in the floodplain increased, but also the number of pastoralists that made use of the floodplain. Hence, damage to the farmed land occurred more frequently over the last five years.

Another cause of conflict arose when herds arrived at the time that the traditional floating rice was still ripening or before the sorghum had been harvested. Despite the goodwill of the pastoralists, they could not prevent their animals feeding on these crops. Sometimes farmers deliberately caused these conflicts by the establishment of sorghum farms in areas reserved as pastureland. Intentional provocations could also come from pastoralists who calculated that it was worth paying farmers damage and thus allowing animals to feed on crops.

A particularly good example is the case of the Uuda sheepherders from Nigeria. The Uuda believed that, as soon as they paid their taxes to the local councils, they had the right to use the pastures as they saw fit. Hence the sheepherders thought that these "*grazing rights*" permitted them to cut branches of *Acacia seyal* and *A. sieberiana* trees to feed their animals. These herders in particular caused grave damage to the environment. This attitude created conflicts with the local communities, who were aware of the importance of trees in the combat against desertification. In some areas, such as around Petté, south of the Waza National Park, the local traditional authority forbade tree cutting. This rule existed throughout the Province, but it had been rarely implemented as in the Petté area.

### *Conflicts between pastoralists and fishermen*

Conflicts between pastoralists and fishermen were caused by the existence of fishing canals. In 1999/2000, almost 2,500 canals were counted in the floodplain and about 1,000 were situated on the banks of the Logomatya River alone (Figure 8.2). This gave an average of two canals for every hundred metres, while the canals themselves typically were between one and two kilometres long. The dense network of fishing canals frequently intersected the transhumance corridors, and pastoralists could not gain access to pastures without passing through the canals. While passing, the embankments of the canals were damaged by the animals. This added to the costs of scouring the canals. Fishers also claimed that such damage led to a reduction in the fish catch, because the canals remained full of water. The fishers asserted that the fish hid itself in more secure places.

### *Conflicts between pastoralists and the Waza National Park authorities*

Confrontations between pastoralists and the Waza National Park administration took place whenever herders were caught while illegally grazing their cattle inside the park. They did so because there the pastures were abundant and water was available year-round in several of the park's waterholes. When herders were caught with their herd in the park as a first offender, they only had to pay a modest fine. If they were caught again, the warden could take them to court. Although the herders were well aware that grazing of livestock within the Park was forbidden, they took these risks because they knew that settling outside the court was possible with the game-guards. Moreover, the risk of being caught was very low, because the handful of game guards could not possibly patrol the 160,000 ha of the Park effectively.

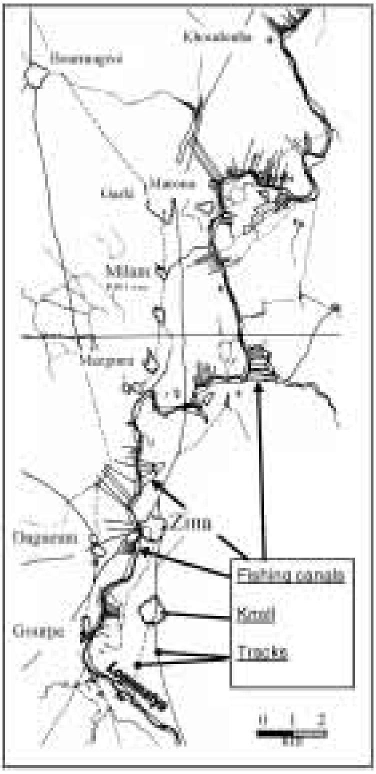


*Figure 8.2 Fishing canals in the Logone floodplain near Zina in the 1980s*

The predation of livestock by lions had further soured the relationship between the Park authorities and the neighbouring communities. When wild carnivores took livestock, the livestock owners turned to the Park Warden for action, because people held him also responsible for wildlife outside the Park's perimeter. A recent study of the lions of Waza concluded that some lions were problematic by nature (Bauer, 2003). Such "*problem*" lions made a habit of killing livestock. Other lions could shift temporarily to livestock as their prey, when they were wounded, or when they were otherwise in a poor condition, as livestock makes easy prey for them. The study could not provide an answer to why some animals were problem animals, while others only killed livestock occasionally. It is also not known whether the habitual grazing of livestock within the Park's boundaries could have enticed the lions to switch over to other easy accessible prey, and that they thus had acquired a taste for livestock.

### *Conflicts between fishermen and the Waza National Park authorities*

Animosities also occurred between the Waza National Park administration and fishermen who live in the vicinity of this protected area. According to the fishers, three ponds located within the Park belonged to them because they were forcibly removed from the current Waza National Park limits during its extension in 1968. For this reason, they continued to fish in these ponds (Vo, Tchikam and Telma). They were aware of the risks taken while entering the Park, and therefore the majority of fishers entered the park during the night.

*Photo 8.1 Efficient protection of the predators may increase the losses of livestock due to predation by lions (Photo P. Loth).*

*Conflicts among fishers*

Formerly, fishing was the prerogative of the Kotoko. Recently, however, the Musgum successfully challenged their privilege of exclusively determining the access rights to the fishing grounds. The Musgum, who originally were pastoralists, had since long settled in the floodplain as settled agro-pastoralists, and defied the fishing authority of the Kotoko. After years of conflicts between these two ethnic groups over access to fishing grounds, the Kotoko yielded to the pressure of the Musgum. Consequently, fishing has become a free for all, resulting in excessive numbers of canals being dug.

## 8.2 Conflict Management

*From the grassroots to supra-national levels*

Institutional arrangements in the Waza Logone area vary from the local level to the regional level. At the local level, the use of the natural resources is well organised. There are 555 villages, each headed by a village chief (*Djaoro*), who is assisted by a number of counsellors, appointed by the village chief. In the administration the village chiefs take the position of administrative auxiliaries, because they help levying government taxes. They are responsible for the local management of the land, and for the people who live within their administrative units. They also have the authority to allow new families to settle in their village, when they ask for it. The village chief has, however, to inform his senior in the hierarchy, the *Lamido*, who has the power to overturn the village chief's decision. Nomadic pastoralists and fishermen must obtain permission to use the village area, and have to follow the same processes as those who want to settle permanently in a village.
The Waza Logone region is divided into a number of administrative units, the so-called *cantons*. Each *canton* encompasses a number of villages and is headed by a *Lamido* who is the most influential traditional chief at the local level. He enforces the rules according to which the use of the natural resources is regulated, in particular those related to the exploitation of fish and pastures. The *Lamido*

also has the responsibility for controlling conflicts that could not be solved at the village level. He is accountable to the divisional officer who is the head of the division within which the *canton* resorts. The divisional officer represents and defends the state's interests in his administrative unit. He is important in the solving of conflicts related to access to natural resources. Local committees have been set in place by the government for this purpose, and the divisional officer presides this committee. The divisional officer can refer complicated cases, for instance conflicts between ethnic groups and those related to the use of trans-boundary resources, to the Governor of the Far North Province. The Governor can solve the cases himself, or he in turn can submit cases to the central government or to the Lake Chad Basin Commission (LCBC).

Cameroon is one of the five members of the LCBC. The other members are Nigeria, Chad, Niger and the Central African Republic. This organisation examines problems related to water management in the entire basin of Lake Chad, and those concerning the exploitation of trans-boundary natural resources by user groups coming from neighbouring countries. Cameroon is well represented in the executive secretariat of LCBC. The Governor of the Far North Province is the *de facto* representative of Cameroon at the LCBC. He can address problems that arise in the Waza Logone region and can submit trans-boundary problems to the LCBC for examination.

Conflicts over land management in the floodplain among the sedentary population and between the sedentary population and the nomadic pastoralists are an ancient occupation. Several ways were in place to manage these conflicts. With the arrival of the French administration, institutions for arbitration became available. This section provides an overview of the power structures as they were in place before the Waza Logone project mediated in the solving the type of conflicts descrived above.

### *Institutional arrangements and agro-pastoral conflict management*

Customary, access to the resources of the floodplain was regulated on the basis of the generic understanding that everybody in the floodplain has the right to use the natural resources for his or her own subsistence. Thus, the sedentary farmers always acknowledged that nomadic herdsmen had the right to graze in the floodplain. According to the protocols the nomad leader had the obligation to solicit the right of way from the *Lamido*, or the right to exploit the pastures within his territory. This was generally accepted, but a levy had to be paid. The height of the levy was determined according to the number of animals in a herd and the relations that existed between the *Lamido* and the pastoralists' leader. Conflicts were resolved amicably between the nomadic pastoralists and the farmers. The village head and the leader of the pastoralists were the mediators. Occasionally the conflicting parties can not reach a mutually accepted agreement. In such situations the case is brought before the *Lamido*.

In addition to these normative procedures, nomadic and sedentary communities established reciprocal relations, which diminish the chances of conflicts. These were formed by the traditional barter trade (milk for sorghum) and other agreements. The presence of a herder's camp near a farm increased the soil fertility through the concentration of cow dung near the camp. In some cases the farmers and the herders negotiated about the cow dung. Another important part of the contract was that cattle owners of the village entrusted their own cattle to the nomadic pastoralists, who took the animals to the bush during the dry season.

These traditional mechanisms to manage conflicts are less and less frequently used because a system based on arbitration is gaining preference. A commission for agro-pastoral conflict settling was instituted in each administrative division. These commissions are composed of the divisional officer (president of the commission), the Mayor, the *gendarmerie* (police) brigade squadron, the local officer of the Ministry of Animal Husbandry, the Ministry of Agriculture, the village head, and representatives of the conflicting pastoralists and farmers. The procedures in the commission are defined by legal and administrative regulations. The verdicts are mainly based on the act regulating the itineraries of livestock.

Despite the existence of various mechanisms to manage conflicts between the various user groups in the floodplain the number of conflicts did not decrease. The demand for more farmland, and the inadequate delineation of livestock corridors contributed tot the conflicts that involved pastoralists. One of the major achievements of the Waza Logone project was that, indeed, the project made a difference in the control and management of conflicts.

# Part V
# The Intervention

# 9 The Waza Logone Project: History, Objectives and Main Results

By Paul Loth and Hans de Iongh

The previous chapters describe the Logone floodplain at the time the Waza Logone Project started. This section of the book reviews the history and the objectives of the Waza Logone Project, then summarises the most significant results achieved up to the end of Phase III, which ended in 2000. The project started with a trial re-flooding operation, which was extended. The project monitored the ecological and socio-economic consequences of the pilot releases. The admission of additional water to the floodplain had widespread ecological consequences for those areas of the floodplain that were no longer flooded after the dam and the embankments were constructed for the irrigated rice scheme at Maga. The re-admission of the water increased the amount of fish, and turned the degraded grasslands into productive dry land pastures again. The project collected enough data, which enabled the project to model the costs and benefits of different re-flooding options. Re-flooding would help mitigate the impact of the confinements of the floodwaters of the Logone River.

From its inception the Waza Logone Project was convinced that to be successful, the project should be fully accepted by the local communities. At the same time that the project was working towards the restoration of the natural resources of the floodplain, the Waza Logone project concentrated efforts to ensure active participation of the local communities. The project won local goodwill by acting as a facilitator to solve conflicts between different user groups over access to the natural resources of the floodplain.

## 9.1 Historical background

The Institute of Environmental Sciences (CML) of Leiden University in the Netherlands has been involved in research in the Waza Logone Floodplain since 1986. The first field surveys by CML staff and students, to study the impact of the Maga dam on the ecology of the floodplain were implemented during 1986 and 1987, with funds of Leiden University and the European Union. The surveys showed that the Maga dam had a significant impact on the floodplain vegetation, on fisheries, wildlife and on nomadic livestock migration.

Based on the preliminary results of these surveys, a project proposal with a modest budget was submitted to the Directorate-General for International Co-operation (DGIS) of the Netherlands' Ministry of Foreign Affairs to support further studies with the aim to quantify the environmental impact of the dam. This marked Phase I of the Waza Logone project (WLP). This project finally led to a number of recommendations pointing towards a major rehabilitation project. The outlines of this Phase II proposal were drafted jointly by IUCN and CML and submitted to and approved by DGIS for funding in 1990. The Waza Logone project was established with the objectives of:

- Pursuing the integrated management of the natural resources of the floodplain;
- Providing a sustainable livelihood for local people;
- Maintaining biodiversity, both inside the boundaries of the Waza National Park, and in the surroundings of the Park.

Phase II started in 1992. Phase III was subsequently approved in 1995, ending in April 2000 (IUCN, 1995). Under a Memorandum of Understanding between IUCN and CML the responsibilities and tasks in this partnership were further defined. A new Memorandum of Understanding was drafted for the Exit phase 2000-2003 (Phase IV). This book only describes the experiences of the project up to the Exit Phase.

## 9.2 Phase I (1988)

The first phase of the project began in 1988 with a year-long consultancy funded by the Ministry of Foreign Affairs (DGIS) of the Netherlands. The consultancy culminated in a seminar (held at Waza, September 1988) on the conservation and development in the Waza-Logone region. Also a programme document was formulated that formed the basis of the Waza Logone project.

## 9.3 Phase II (1992-1995)

With funding from DGIS assured for three years, the second phase consisted of the planning and implementation of activities to restore the productivity and biological diversity of the Logone floodplain and to develop mechanisms for sustainable resource management.

The project was established on the ground and became effective in September 1991 with the signing of an agreement between the Ministry of Planning and Regional Development (MinPAT) and IUCN. This was followed in November 1991 by the signature of a Memorandum of Understanding between IUCN and the Institute of Environmental Sciences (CML) of Leiden University, for joint implementation and supervision of the project. Early in 1992, the Ministry of Environment and Forestry (MINEF) was created and Government responsibility of the project was transferred to this new Ministry, this change being notified to IUCN by the Minister of Environment and Forestry in March 1994.

Phase II became operational with the recruitment for three years of the IUCN project Director on 1 April 1992. MINEF appointed a Cameroonian Co-Director in December 1992 and the CML ecologist joined the project in May 1993. The technical staff of the project was completed by the arrival of two technical assistants from SNV (Netherlands Development Organisation) in May and June 1993, under an agreement signed between the project and SNV-Cameroon.

*Goal and objectives of Phase II*

The overall goal of the project for Phase II was to assist the Government of Cameroon in pursuing the integrated management of natural resources in the Waza Logone region, so as to provide a sustainable livelihood for the local people and to maintain the diversity of the biological resources of the floodplain. The specific objectives for Phase II were:

- To investigate, design and implement an operational plan for the rehabilitation of the hydrological regime of the Logone floodplain;
- To formulate and test an operational action programme for the management and development of the area around the Waza National Park, in collaboration with the local communities and in accordance with the principles of the Biosphere Reserve network;
- To contribute to ongoing government efforts towards regional development planning by means of field evaluations of the environmental impacts of existing development projects;
- To develop a methodology for the design and implementation of conservation and development activities in other similar situations in the Sudano-Sahelian region;
- To strengthen institutional capacity to manage the natural resources of the Waza Logone region, in particular through training national staff participating in the project.

*Activities carried out during Phase II*

To achieve the objectives for this Phase of the project, the following activities were carried out:

- Investigations and the design of options for the preliminary hydrological rehabilitation of

the floodplain by controlled release of water through the Logone embankment and a plan for major rehabilitation;
- The execution of a limited pilot release of water in preparation for, and as a basis for estimating the future impact of the main rehabilitation;
- Definition of mechanisms for sustainable floodplain resource use, based on socio-economic and ecological assessments of the relationships between human and wildlife communities, especially in relation to their use of water;
- Development and implementation of a management strategy for the Waza National Park and its periphery, with a view to providing local communities with clear and direct benefits from the park, and to improving the sustainability of resource use and conservation;
- Strengthening the capacity at government and village levels to manage the natural resources of the region, through the participation of national personnel in the project's work;
- Strengthening of regional planning capacities based on a specific training programme and a series of environmental impact assessments.

Project activities were implemented in co-operation with local communities who hold the key to the wise use of natural resources in the future. In addition, the project aimed to increase the capacity of regional government services to respond to the needs of local communities, in a manner that is compatible with the conservation of the natural resource base and the biological diversity. Close involvement of provincial institutions in the implementation of the project would also ensure long-term institutional sustainability.

At the end of phase II, the project had made baseline surveys of the resources and socio-economy of the region, in preparation for a pilot release of water onto the floodplain, which was successfully achieved in August 1994 (see Chapter 10). This pilot release was evaluated by a survey of the population and their reaction was found to be very positive. The project has set in place systems for monitoring the impacts of this pilot release, using local expertise and manpower. It has also trained several professionals from Cameroon, through an Environmental Impact Assessment of a related project, and has performed a training exercise preparatory to a full Environmental Impact Assessment of the Waza-Logone project itself. Finally, it has established the framework allowing permanent formal institutions to follow the work of the project and it has laid the foundations for village level, participatory resource management in the floodplain and in the surroundings of the Waza National Park.

*Main results of Phase II*

**Hydrological studies and pilot release of water**

At first, hydrological studies concentrated on field monitoring to identify the mechanisms of floodplain inundation and the role played by the former water courses and fish canals. Rainfall data for the catchment since 1960 and water-level figures for the River Logone complemented this information. Later, a programme was carried out to provide detailed topographical data to map all watercourses. This produced an understanding of the sequence and processes of flooding and the construction of a simple hydrological model of the floodplain, which indicated the likely changes to water movements resulting from various floodplain rehabilitation options. On the basis of this analysis, a range of options for enhancing the volume of floodwater that reaches the floodplain was presented (Chapter 10). These are based on various combinations of managing the flow of water through Lake Maga and the embankments of the Logone River.

One of the options, for a limited re-flooding, provided the opportunity for a pilot release, to be used to verify the understanding of the hydrology and to gauge local reactions to the return of flood water, before planning the full scale release of water. This pilot release, which was originally intended to take place during the 1995 wet season, was brought forward to August 1994, for reasons that are both technical and political:

- The area had been studied periodically over the years and the local people had lived through a number of broken promises. The pilot release would prove the reality of the project to the villagers and it would bring immediate benefits to an area in years of good rainfall. In the worst case, that there were no future phases of the project, the pilot release would ensure that at least a minimum inundation of the floodplain takes place each year;
- The pilot release represented the best means of obtaining information on the ecological and hydrological effects of rehabilitation measures and allowed much more realistic assessment of the reaction of the local population, the administration and the legislature. It would especially be the case when tackling questions of water and resource management, resource ownership, grazing rights and fish canal rights;
- The risks of an early pilot release were small. The topographical studies indicated that these measures could be taken without threatening the rice fields of the SEMRY scheme, and the floods would certainly not surpass what villagers had lived with in the past. The population had shown itself to be overwhelmingly in favour of the trial;
- The pilot release would enhance the project's international value as an example of floodplain rehabilitation. Meetings at the LCBC had shown that water basin authorities in the region were awaiting the results of the pilot release with interest. Other donors (such as UNDP) were considering a regional programme of floodplain restoration in several neighbouring countries, which would take the experience of the Waza Logone region as a model.

After extensive discussions with all villages likely to be affected, the earthworks necessary for the pilot release were carried out by SEMRY in May 1994. A grid of observation points had been established in the area to allow regular measurement of the flood level, direction of water flows and changes in vegetation, and these data were analysed in 1995 along with ecological information collected from the same sampling points. The pilot release took place in August and September 1994, its magnitude being increased by an exceptionally good rainy season. The result of the pilot release was evaluated in December 1994 by a survey of local populations and their reaction was found to be very positive (IUCN, 1995).

### Sustainable resource use (ecological and socio-economic surveys)

In collaboration with CEDC the project used Geographical Information Systems and Remote Sensing data to develop a framework for mapping the main vegetation types of the floodplain, to which subsequent field work would add detail. This permitted the estimation of the productivity of the different parts of the area, leading to the cost/benefit estimates of the re-flooding options. The present situation was compared to information from photographs of the area taken during the 1970s and 1980s to help understand the historical development of the floodplain vegetation. In parallel, a system for the long-term monitoring of vegetation in the floodplain was developed with the University of Dschang and the Maroua Research Centre of the national Institute of Agronomic Research IRA. Results from this study showed rather unexpected effects of the drought on the vegetation, and suggested that effects from re-flooding would be similarly unpredictable.

Fieldwork for a vegetation map of Kalamalue National Park had to be abandoned in January 1994, because of the civil insecurity in the area. Later, two counts of large mammals could, however, be conducted in the same area by Park personnel, under supervision from the project and the Garoua Wildlife School. Unexpectedly, these counts showed that a considerable increase in the large mammal population of this protected area had occurred since the last counts in 1984. This is in marked contrast to the situation in the Waza National Park, where a decrease in population (especially of Kob antelope) was recorded in counts around the water holes in the hottest period of the year. These counts were verified with aerial surveys of all large mammals (wild and domestic) in the floodplain, with the view of perfecting a relatively cheap, ground-based methodology for monitoring animal populations in the long-term. Eventually, such counts may have to be verified at much less frequent intervals by aerial surveys. In addition, the project sponsored the work of two students to compare bird populations in different ecosystems. This indicated that the presence of bird species could be used as an indicator of biodiversity in the project area.

A database was established containing locations an herd sizes of all pastoralists who visited the Logone floodplain in the dry season. Details about the composition of their groups as well as their migratory pattern were also incorporated. Based on this information, regular contacts have been organised, leading to discussions about pastoralists' appreciation of re-flooding activities and their pressing problems. This will help to determine the long-term effects of improvements in the floodplain pastures, in terms of livestock populations, migration and carrying capacities. Fishing systems and fish catches are being monitored in the pilot zone with similar intentions.

A Rapid Rural Appraisal (RRA) of the wider project area was carried out with the participation of several members of different Provincial Services (particularly environment and forests, livestock, community development, women and social affairs), which were trained at CEDC during a twelve-day course in participative research techniques. The project's ecologist and members of the fisheries, crop protection and other services, as well as and IRA for vegetation aspects, were involved in giving additional background information to the research team members.

Together with a census of human sedentary populations, carried out by a member of the Delegation of the Ministry of Planning, this provided a wealth of information which guided the project's and the Administration's activities in the floodplain. Several issues were highlighted by this work. These are currently being considered by the Permanent Committee.

**Management of the National Parks and their peripheral zones**

The management of the Waza and Kalamalue National Parks was not included in the original project documents. Subsequently, a proposal for an additional component (entitled "Emergency Action Plan for Improved Park Management in Northern Cameroon") was approved by DGIS August 1994. Issues covering the relationship between the local population and the National Parks, for which solutions must be developed over a long time, were included in this project document. A number of studies were carried out aimed specifically at natural resource utilisation in the peripheral zones of the National Parks.

**Institutional strengthening**

Formal training during the Phase II was limited to local short courses, such as those at CEDC on environmental impact assessments and on participatory research methods. A limited number of international training workshops were also attended.

The project provided informal on-the-job training to technical governmental services and to partners within the local communities. Villagers were employed to monitor the impacts of the pilot release. This was done to broaden their understanding of the situation, to implicate them in the decisions to be made, to give them a greater sense of responsibility for the natural resources in their environment and to develop a capacity at village level to handle such monitoring activities in the future.

The environmental impact assessments (EIAs) were specifically introduced during phase II with two aims: for educational purposes, to train a multi-disciplinary group of Cameroonians to be capable to carry out such studies; and for purely technical purposes, to perform a technically competent analysis of the impacts of the projects.

## 9.4 Phase III (1995 – 2000)

*Goal and objectives of Phase III*

The global objective of Phase III was to achieve sustainable improvement of the quality of life of the population, and the long-term enhancement of the biological diversity of the Waza Logone region

(IUCN 2000a). The specific objectives were:

- To restore natural resources (fish, pasture, land water) by hydrological and ecological rehabilitation of the floodplain;
- To safeguard the national parks Waza and Kalamalue as important centres of global biodiversity;
- To develop and maintain systems of resources management that sustain the biodiversity of each of the ecological sub-zones of the region, whilst ensuring the socio-economic development of the resident and migrant populations that depend on the region;
- To ensure the capacity of the government and the local communities to maintain sustainable resource management and development in the long term;
- To develop a community-level eco-development strategy that leads to sustainable development of the population, sustainable use of the natural resources and conservation of the environment.

Key to the success in obtaining its objectives was the project's process approach, by which the full participation of the people of the floodplain was ensured, while enabling them to determine their own development paths. This required the involvement of the target groups in all levels of decision-making. Furthermore it was necessary to establish institutional structures with representations from all levels (communities, traditional chiefs and administration) for the implementation of the floodplain resource and national park management plans that were developed by the project in co-operation with all the stakeholders.

*Activities carried out during Phase III*

The implementation of the project's strategy foresaw three distinct stages:

- Ecosystem evaluation, including the definition of the ecosystem boundaries to be managed, the provision of the understanding of the natural and socio-economic processes, and the identification of alternative management approaches;
- Resource management by ecosystem rehabilitation, ecosystem management planning, and implementation of development activities; the re-inundation of the floodplain was the central theme of each of these elements;
- Exit strategy, ensuring sustainability and involved the transfer of responsibilities and the processes of management and financing from the project to its long-term successors in the region, the support organisations. During phase III of the project a preparatory phase (collection of data, establishing partnerships, capacity building, management planning) was to be followed by a development stage (institution building, development of management structures. An exit phase (project Phase IV) was foreseen during which the transfer of all processes would be completed.

*Main results Phase III*

Data gathering and studies continued to be carried out on a wide range of socio-economic issues and ecological and hydrological processes. These included village and market surveys, gender, demography, water-related diseases and the social effects of re-flooding, fishing canals, fish population dynamics and migration, livestock densities and movements, vegetation studies, bird and mammal populations, hydrology, hydro-geology and water quality. Some examples of the activities and achievements are described below (IUCN, 2000a,b).

**Institutional strengthening and training**

Technical training programmes provided courses for villagers and project personnel in pluvial rice growing, apiculture, and on gender issues. Project and government personnel further received training in Participatory - and Rapid Rural Appraisal (PRA and RRA), health and sanitation, computer use, project planning, and in Geographical Information Systems (GIS). Project and government personnel also benefited from attending seminars and from study tours in Cameroon and abroad (Netherlands, Switzerland, Zimbabwe, and Guinea-Bissau).

### Eco-development

Eco-development activities included the development of resource management programmes in livestock (three cattle migration corridors established), forestry (six villages within a community forest), apiculture (two groups), and fisheries. Furthermore, community development projects were implemented in rice growing (15 villages, with 15 groups for men, 15 for women), and eco-tourism (in three locations, with 3 women's groups, 2 men's groups). Lastly, clean water and sanitation facilities were provided (37 wells in 33 villages), combined with a programme of health and hygiene education that resulted in a decrease of 70% of diarrhoea.

Community participation and awareness was further encouraged through the project's communications programme, which included the integration of gender issues into project activities, and the launching of the environmental education programme, which included adult awareness and a regular appearing bulletin for schools.

### Floodplain re-inundation programme

Proposals were developed for the rehabilitation of the floodplain through a programme of large-scale re-inundation. After the first pilot release during Phase II, in 1994, a second pilot release was effectuated in 1997 by modifying and opening a second channel blocked by the rice scheme works. The combined channel flows of both pilot releases totalled approximately 35 $m^3/s$ for a duration of 6 - 8 weeks. The additional water resulted in an annual increase in the area flooded in an average year of around 200 $km^2$ (see also Chapter 10). The releases provided additional hydrological, hydraulic, ecological and socio-economic data on the planned large-scale re-inundation, and established the credibility of the project amongst the local population. The improved conditions resulted in an expansion of economic activities, and a recent economic evaluation confirmed the substantial economic benefits that will be available from a major re-inundation.

A preliminary Environmental Impact Assessment in 1995 of the proposed large-scale re-inundation concluded that the impact would be mostly beneficial. Monitoring of the effects of the pilot re-flooding since 1994 indicated a significant improvement in the state of the environment (vegetation, wildlife, and fishery).

The European Commission provided financial support for the re-inundation programme by funding the development of a hydrodynamic model of the floodplain that calculated the areas of additional flooding resulting from the various release options developed by the project. Although the remainder of the re-inundation programme was not funded, the large-scale re-inundation of the floodplain by releasing water from the Logone River and from Lake Maga remained fundamental to the achievement of the project's objectives.

### Sustainable resource use

Propositions for the sustainable use of natural resources in the floodplain was prepared as part of a draft management plan. Management committees and local groups had been established to assure local participation and to prepare for long-term sustainability. An agreement was signed with SEMRY to establish a Water Management Committee for the management of the waters of Lake Maga and areas downstream. A support mission to the project in Institutional Development provided guidance in the way in which local participation could be mobilised and assured for long-term resource use and management.

## 9.5 The Waza National Park Management Plan

*Introduction*

The integrity of the floodplain ecosystem, of which Waza National Park is an integral part, became threatened after the SEMRY earthworks allowed less floodwater onto the Logone floodplain. This threat was the direct reason for the formulation of the Waza Logone project.

People are, and always have been part of the floodplain ecosystem (Chapter 7). Indeed, the ecology of the present-day park was partially shaped by people living in it before it was a protected area. Several villages and fishermen's camps existed within the current boundaries of the park. The mounds on which the people lived and the excavated waterholes for the fishermen added to the overall species richness. When the area became a protected area, most villages moved to the contemporary boundary of the park, while others re-established further away. Some villages, however, refused to move out of the area. These were forcibly removed, but one remained and even today the village Baram exists within the park boundary (IUCN, 1997)

Several studies undertaken by the project showed that the park area was important for the economy of the nearby communities, because the people –illegally- harvested the natural resources of the park, such as fish and grass. Villagers also grazed their livestock within the confines of the park. When the people were asked to rank their problems, the lack of floodwater came out as the most pressing problem. Other often-mentioned problems were the killing of livestock by predators and the raiding of crops by wildlife. At the same time the illegal use of the resources inside the park created a tense relationship between the local communities and the park authorities.

Since the construction of the Maga dam and related earth works, the management of the Waza National Park faced considerable problems:

- Reduced rainfall coupled with decreased inundation as a consequence of the SEMRY works caused a lowering of the groundwater table. This and the occurrence of uncontrolled bush fires resulted in a reduction of the primary production, and consequently, a reduction of the number of wild and domestic herbivores in the floodplain (IUCN, 1997; see Chapter 3). At the same time the number of elephants using the Waza National Park and surroundings shot up since the beginning of the 1980s. The increase in elephant numbers was not an indication that the ecosystem was recovering again, but rather reflected the relative safety of northern Cameroon in comparison to the neighbouring countries.
- The introduction of large-scale irrigation at Maga was at the cost of traditional forms of small-scale floating rice cultivation and other traditional forms of agriculture. The degradation of the pasturelands for the livestock as a result of lessened flooding has been described in other chapters (Chapters 3 and 10). In order to survive the people living in the vicinity of the park had no other option than to use the natural resources in the Waza National Park, and to resort to poaching (IUCN, 1997).
- Meanwhile the overall situation in the area also deteriorated, notably because of increasing activities of bandits and because governmental services broke down. There was no research programme to monitor the changes in the park as a result of the changing situation.

Not surprisingly the management of the park fell short in providing adequate responses to all these changes. The Waza Logone project therefore promoted a different way of park management, based on the zoning of the park. Within each zone the degree in which the natural resources can be used is defined.

The new management plan proposed by the project was based on three criteria:

- The priority should lie in the conservation of the natural resources;
- The management of the park should be sustainable, while the park should contribute to the

revenues of the state;
- The management of the park should be participative to guarantee that the needs of the local population are taken into account.

*Objectives of the management plan*

At the end of the five-year management plan the following objectives should have been achieved:
- The ecosystem, of which the park forms part, is in a good state. This meant that not only water should be permanently present in the waterholes of the floodplain, but also the vegetation and the wildlife populations must have met certain levels. More specifically, adequate regeneration of woody species should have occurred in the *Acacia seyal* woodland, and perennial grasses should have attained a good cover in the floodplain area. The herbivore populations should have increased and their population structure should be sound.
- Sustainable management of the park and its immediate surroundings is assured, meaning that the required structures are in place and well integrated in the social context. This is reflected in both the legal aspects and the adequate provision of the necessary means provided by the government, in terms of personnel, equipment and finances.
- Regular monitoring of the condition of the natural resources of the park is initiated.
- The local communities participate in effective, sustainable management. The communities should therefore be aware that the park is essential for their livelihood. The people should be involved in conservation activities.

To achieve sustainable management and conservation of the natural resources of the park, the project insisted on an integrated approach, the people's participation in management, and the gradual delegation of the decision power to the people.

*Operational strategy*

**People's participation**

Participation of the local population was deemed indispensable since on the one hand the people were indifferent towards the park, and on the other hand the government did not make available sufficient means to provide adequate protection of the natural resources. For the peripheral zone[1] it would mean that the local communities are actively involved in the decision making process, while for decisions concerning the park area itself the local communities should be timely informed and consulted. Thus, transparency concerning the management of the park will be assured, so that measures taken by the park authorities will be better understood and accepted by the local communities.

The local communities will have the exclusive access rights to the natural resources of the park. These rights will only be granted after the relevant stakeholders have been identified, such as the villages in the immediate vicinity of the park, the nomadic herdsmen who come to the area to graze their livestock, and the traditional leaders. The traditional leaders have a lot of power and, since their area of jurisdiction also included the park area, they profited of the resources collected of this area through the levying of taxes.

All parties should be fully aware that conservation is the first priority. Hence, the government is responsible to ascertain that the use of certain resources will not be at the detriment of conservation, but rather to the contrary. This requires the regulation with possibilities to use sanctions in case one

[1] National parks in Cameroon by law must have a buffer zone around their territory of 5 km wide. In the case of the Waza National Park such a buffer zone could not be effectuated, because the people who before lived inside the park, had already been moved once before. Since there was not sufficient space available for a proper buffer zone, a peripheral zone was instated of much less width.

of the partners does not respect the terms of the agreement that has been drawn up to specify the responsibilities of each party.

**Delegation of the decision power for efficient conservation**
Decentralized mechanisms are required to efficiently secure future funding of conservation efforts. This can be achieved by setting up an autonomous institution for the Waza National Park.

**Integrated approach**
The problems concerning the conservation of the Waza National Park are many and complex. Each problem must therefore be examined as part of this complex of factors, and proper solutions sought.

*Action plan*

For the implementation of the management plan of the Waza National Park an action plan was developed with three main points: anti-poaching activities, the ecological management of the natural resources of the park and its surroundings, and the integration of the park in the development of the region.

**Anti-poaching activities**
The occurrence of poaching forces the authorities to take appropriate law-enforcing action, but such activities do not go well with the local communities. The long-term protection of the park requires the support of the local communities through a participative approach and a system of prevention and repression should be based on reports made by the village scouts. These village scouts have been trained by the project to assist the park authorities by patrolling the area in the vicinity of their own village. The village scouts thus help to defend the exclusive rights to the resources for their villages. The illegal use of the natural resources of the park by other Cameroonians and foreigners requires a strategy of strong repression.

**Ecological management**
The conservation of the natural resources of the Waza National Park and its peripheral zone depends on the proper functioning of its ecosystems on which these resources depend. Hence, key indicators should be monitored to assess whether the functioning of the ecosystem is changing, to the better or to the worse. In the latter case, the management of the area should be adopted to improve the situation. Beyond these tasks, the ecological management of the park includes the use of controlled fires, the zoning of the park, the maintenance of roads and waterholes in the park, etc.

**Integration in the development activities of the region**
The implementation of this part requires an integrated and participative approach. As much as the people around the park need to use the resources from the park for their survival, the park equally depends on the peripheral zone for its existence. To assure the collaboration of the local communities, it is important that the people recognize that the park adds to their income and, hence, their survival. This means, that the resources around the park and to a limited extent some resources inside the park will be to the exclusive disposal of the local communities living around the park. The participative management of the peripheral zone hence should exclude the people who do not belong to the local communities around the park.

*Future organisation of the Waza National Park*

To achieve the management goals as explained above, the current management structure has to be re-organized into a number of different units. These are, with some of their tasks:

- Conservation service. General co-ordination; human resource management; financial responsibility; maintenance activities; planning; liaison with other national and international organisations; monitoring of research; defend the interests of the park in the management committee

- Administrative and financial unit: human resource management; financial management.
- Anti-poaching unit: anti-poaching activities; monitoring and control of the use of the natural resources; raising awareness among the local communities.
- Ecological monitoring unit: planning and implementation of the use of natural resources from the park (in collaboration with the scientific council); data collecting and monitoring of research; implementation of fire as a management tool.
- Development integration unit: reconciliation of the different views on the diverging views on the use of the natural resources; development of the treaties signed between the park authorities and representatives of the local communities; tourism; PR activities.

This means, amongst others, that more and better-qualified personnel are needed. A total of 22 staff and 34 anti-poaching personnel is proposed.

*Co-ordination with other institutions*

To streamline the communication with the stakeholders, two consultative bodies were established: the Management Committee of Waza National Park and its peripheral zone, and the Scientific Council.

**The Management Committee of WZNP**

The objective of the Management Committee is to defend the rights and demands of the local population against the park authorities, and *vice versa.* Furthermore, the Committee maintains and improves the livelihoods of the users of the peripheral zone with the aim to reduce the negative effects of exploitation of the natural resources on those of the park.

Representatives of the local communities, both male and female equally represented, and representatives of governmental institutions are members.

The mandate of the Committee is to be a forum between the local population and the conservation service, where the local people can express their views on the way that the park authorities manage the natural resources in the park. The Committee manages the peripheral zone.

**Scientific Council**

The aim of the Scientific Council is to analyse the proposed activities in the park and in its peripheral zone, to assess the impact thereof on the conservation of the natural resources of the park. It has an advisory role. Experts in the field of vegetation and wildlife, and nature conservation of universities and research institutes are member of the Scientific Council (see for details IUCN, 1997).

# 10 The Waza Logone Project in Action

By Richard Braund, Paul Loth, Mark Moritz, Paul Scholte, Saïdou Kari, Daniel Ngantou and Roger Kouokam

## 10.1 Restoration of the flooding regime

Studies carried out under the aegis of the Waza Logone project clearly demonstrated how a period of dry years, aggravated by the presence of the Maga dam, had deteriorated the functioning of the floodplain ecosystem. This in turn had a negative impact on the local economy. These negative consequences provided the justification to undertake large-scale hydrological restoration of the floodplain that would mitigate the adverse effects of the dam on the ecosystem.

The project consulted all concerned parties on the need and the extent of an undertaking to restore flooding. The stakeholders that were identified by the project were the local communities, the local, regional and provincial government, the Lake Chad Basin Commission (LCBC) and SEMRY, the parastatal organisation who was the operator of the rice scheme. The local communities who would be affected if flooding returned, were asked what their opinion was of a large-scale flooding restoration project. The local communities certainly wished to see the return of the floodwaters, because they expected that their livelihoods in fishing and grazing would improve. Government officials at various levels and the LCBC welcomed the projected improvements to the floodplain ecosystem and the expected corresponding upturn in the local economy.

All stakeholders agreed that restoration of the original flooding patterns would be beneficial. Many were suspicious, however, of whether the required infrastructural changes would indeed result in the predicted improvements, without causing adverse side effects, such as loss of dry land crops by increased flooding, and added inconveniences due to increased isolation by the higher floods. Therefore, the project proposed to create a pilot flood release to determine the actual benefits of additional flooding in comparison to the disadvantages, and to assess the feasibility of large-scale re-flooding. Furthermore, a pilot flood release could improve relationships with the local communities, and enhance means of communication and consultation for the re-flooding project. A small-scale pilot release would also provide indispensable additional hydrological data that were needed to simulate the effects of large-scale flood releases.

The lack of hydrological and topographical data for the Logone River and its floodplain was a major constraint in devising options to restore the flooding patterns. The need for such data was recognised by the Waza Logone project, and consequently, the project started a programme to collect hydrological and topographical data.

### *The Pilot Releases*

The first hydrological study was carried out in 1993 by consultants Delft Hydraulics with the aid of local experts (Wesseling *et al.*, 1994). During the study tentative proposals for the re-inundation of the floodplain were made, including those for the pilot release. Following consultations the Waza Logone project decided to implement the pilot scheme in time for the 1994 rainy season.

As part of the civil works that had been carried out for the SEMRY II rice scheme, a containment embankment 20 km in length was built along the Logone river to prevent floodwater from reaching the rice fields that lie immediately downstream of the Maga dam. At the end of the embankment, at the village of Tekele, a river channel named the Petit Guruma, had also been cut off (Photo 10.1). Consequently, water could no longer enter the floodplain via this route. Since the Petit Guruma is situated more than ten kilometres downstream of the rice fields, the project concluded after consultations with SEMRY engineers that water entering the floodplain at this point would not threaten the rice scheme. Hence, the project decided to reopen this channel. The decision to open up the Petit Guruma was only taken after extensive consultations with villages next to the breach and those further downstream, who could be affected by the return of flooding. Indeed, all villages in the floodplain agreed that the former river course should be opened up again, because almost everyone preferred the return of the full extent of floods, even though several individuals remained worried about the possible side effects of the pilot release.

During the 1993-1994 dry season the embankment that blocked the opening of the watercourse was removed with the assistance of SEMRY earth moving equipment (see photo 12.1). At the same time a monitoring programme was set up. Project staff worked with the government hydrological institute in the installation of monitoring equipment and the collection and the collation of data. Rain gauges were placed throughout the floodplain and water flow gauges were installed in important watercourses. In addition, government land surveyors seconded to the project carried out topographical surveys on parts of the floodplain and selected watercourses. A grid system was laid out, on which water levels would be regularly measured, and ground level data taken at each point. Channel cross-sections were made to provide base line data. Local observers were trained to take daily rainfall records and to read the water depth at the grid points twice weekly.

*Photo 10.1 The opening at Areitekele (Photo P. Loth).*

In July 1994 water flowed again through the Petit Guruma, at a rate of 20 $m^3/s$. The total area that was additionally flooded was estimated at almost 300 $km^2$ (IUCN, 1996), which was much more than was expected. The predictions of additional flooding had been based on records of the annual flood for the drought years of the 1980s. The 1994 rainfall was nearer the long-term average, which resulted in more flooding independently of the pilot release.

An environmental impact assessment of the pilot release was carried out in 1994 to assess the possible environmental and socio-economic implications of re-flooding on a large scale. The report questioned the success of the large scale re-flooding, because there was no proper mechanism in place to manage the water level of the Lake in accordance with the requirements of a successful flooding regime.

Furthermore fears were expressed in the report that the release of stored water in the long term would result in salinization of the soils, and that less sediment would be deposited on the floodplain, thus reducing the fertility of the soils. Additional worries included the possible flooding of homesteads and fields, causing people to move away. This could lead to social unrest and even conflicts among the people living in the floodplain. Health hazards caused by standing water were also mentioned as a negative consequence of large-scale re-flooding. On the other hand, there was recognition that an increase in the duration, depth and extent of flooding would lead to benefits to the environment, through improvement in the productivity of grazing land, increase in fish production and in agriculture, with the commensurate augmentation in earnings of the population. This was indeed confirmed during studies carried out by the project after the pilot release.

By the end of 1996, it became evident that the data, which were collected before and during the pilot release, were insufficient to develop models for large-scale re-flooding options. Therefore it was necessary to monitor a much larger area. Furthermore the people living in the floodplain had experienced the benefits of the first pilot release, and were asking for more. Since the development of a large-scale flood release option would take several years to execute, the advantages of a second pilot release would provide further short-term credibility to the project among the local communities. The Waza-Logone project also had to demonstrate to SEMRY that there was no risk to its rice scheme operation through well-designed re-flooding methods.

The second opening was planned on the Areitekele, another channel that was cut off by the embankment protecting the rice scheme, approximately one kilometre upstream of the Petit Guruma. It discharged into a waterway that drained a large part of the irrigated rice fields. SEMRY managers were concerned that the opening of this former watercourse would cause a rise in water levels that would hamper the drainage of the rice fields. The project calculated that the expected rise in water levels south of the opening of the Areitekele would be within acceptable limits and could not cause any harm to the rice scheme. This convinced SEMRY that the second pilot release could be carried out; later it turned out that the actual rise in water level during the flooding following the opening was only just over 5% higher than predicted. A control weir at the entrance was planned to restrict the inflow from the Logone River so that the water level would be sufficiently reduced at places where the channel passed through the villages, to avoid the flooding of the villages and the dry season sorghum (*muskwari*) fields.

The channel of the Areitekele was opened up early 1997, and the flood of that same year passed through the opening at a maximum flow of 10 $m^3/s$ (IUCN, 2000b). Although the rainfall in this year was lower than in the three years following the opening of the Petit Guruma, there was more flooding, in particular immediately downstream of the channel. There was a small rise in water level downstream of the rice drainage outfalls, as was expected (see above), but this had no effect on the functioning of the rice scheme. The new opening provided additional flow and water level data, and a better understanding of the flooding mechanisms. Equally important, it also established the confidence among the management of SEMRY and the local people that the predictions of the project about the magnitude of the side effects were trustworthy. The projected negative effects were by far outweighed by the benefits.

### *Feasibility studies for re-flooding options*

The results of the monitoring studies accompanying the two pilot releases had convincingly demonstrated that each additional re-flooded hectare resulted in increased production of the natural resources in the floodplain. Livestock benefited from the improved pasture conditions, and fishermen had bigger catches. Hence, additional release options were developed with the objective to re-flood as much area as possible (Table 10.1). This meant that the flooding patterns that existed before 1979, the year that the SEMRY rice scheme was built, should be restored as much as practically feasible. A number of options for large-scale re-flooding was therefore designed, based on the experiences gained with the two pilot releases. It had not been possible, however, to reliably estimate the areas that would be re-flooded according to the different options, without proper modelling. Thus, the relationships between rainfall, flow, and flood extent and duration had to be established, in order to calculate the impact of the different release options.

| Release option (code) | Locations for additional water access to the floodplain (rivers, creeks and canals) | | | | | ***Total release*** |
|---|---|---|---|---|---|---|
| | Mayo Vrick | Areitekele | Petit Guruma | Zigla Kadoum | Mazra Canal | |
| 1A† | 0 | 10 | 25 | 0 | 0 | ***35*** |
| 1B | 0 | 30 | 55 | 15 | 0 | ***100*** |
| 1C | 0 | 30 | 55 | 15 | 30 | ***130*** |
| 1D | 0 | 40 | 80 | 30 | 0 | ***150*** |
| 2A | 100 | 10 | 25 | 0 | 0 | ***135*** |
| 2B | 50 | 30 | 55 | 15 | 0 | ***150*** |
| 2C | 50 | 40 | 80 | 30 | 0 | ***200*** |
| 2D | 100 | 30 | 55 | 15 | 0 | ***200*** |

† Existing situation since 1997, with two pilot schemes in place.

*Table 10.1. Floodwater peak flow ($m^3/s$) release options as specified by the Waza Logone project to restore the loss of flooded area by the Maga dam. The releases through Mayo Vrick, entering the rice scheme at Maga village, will be regulated via sluice gates connecting Lake Maga and Mayo Vrick. (Source: Mott MacDonald, 1999)*

The year 1994, when the first pilot release was created, was wetter than any year since the construction of the dam at Maga and the closure of the channels in 1980. This was as much a reason for the extra flooding as the pilot release itself, though this was not properly demonstrated until the model results were available several years later. The following years (1995 to 1997) were also wet in comparison with the years since 1980. Despite the fact that 1997 was the driest of these four years, the flooding had increased, and thus indicating the opening had been effective.

The hydrological model that was used to simulate the effects of the pilot releases had been developed for LCBD in 1993 (Mott MacDonald, 1993). This model was designed to simulate the hydrological behaviour of Lake Chad and its feeder rivers. It appeared that the model could be modified in such a way that the effects of the different re-flooding options in the Logone floodplain could be quantified under different rainfall and river flow conditions. The European Commission provided the necessary funds to adapt the model, which required additional data on the topography of the floodplain. This consisted of cross sections of the floodplain and channel section dimensions. The survey was carried out over two years by the project's survey teams, using GPS to determine the locations of the measuring points. Flow and rainfall records for sites throughout and beyond the Logone catchment area were collected from Cameroon, LCBC and ORSTOM sources. Satellite images were also obtained for the purposes of checking the extent of historical floods and for the calibration of the model. Hydrological data were also obtained from various rainfall stations and river flow gauges in the study area.

To simplify the model, only three different climatic scenarios were used in the study namely, '*good*', '*average*' and '*poor*' hydrological years. The hydrological conditions for these climatic scenarios were defined in terms of the maximum flows in the Logone River, while rainfall was kept constant for the different climatic scenarios. Rainfall figures for the 1975/1976 wet season were used because these figures closely approximated the long-term average rainfall amounts. The influence of varying flow levels of the Chari River, a much larger river than the Logone River, on the overland flow characteristics of water coming from the Logone river was not considered; these flows were kept constant in the model.

After the model was calibrated, a number of flood release options were modelled to determine the extent of the floods under the different climatic scenarios. Since the extra flooded area for each release option was an output of the model, the expected increase in production of the natural resources could be calculated. From there the next step was to assess the increase in benefits under different climatic scenarios, based on the results of the economic valuation of floodplain use.

For the calibration of the model, the model's prediction of the 1997/98 flood was compared with the actual situation. The model was also run with characteristics representing the physical conditions prior to the construction of the SEMRY earth works, and was calibrated against the 1975/76 flood. The model results were checked against the known extent of the flood, derived mainly from satellite imagery.

### *Results of model study and adoption of release proposals*

The first objective was to understand how the dam and the embankments, which were completed in 1979, had affected flooding. Therefore, the model was used to calculate the extent of flooding before and after the presence of the dam and the embankments for an "*average*" hydrological year. The difference in flooding amounted to a surface area of 965 km$^2$, which meant a reduction of nearly 30 percent of the total flooded area in the Waza Logone floodplain (Mott MacDonald, 1999).

Of greater interest for the future was to determine the impact of the two pilot releases on the extent of flooding under the three climatic scenarios. The model outcomes for the extent of the flooding before the pilot releases were therefore compared with those after the pilot releases, whereby comparisons were made for the same climatic conditions to eliminate the effects of rainfall on the outcome. For an "*average*" year, the additional flooded area resulting from the two pilot releases combined amounted to about 180 km$^2$ (Table 10.2).

| Release Option† | Flow (m$^3$/s) | Recuperation of pre-SEMRY flooding for 'average' conditions (%) | Additional area re-flooded including pilot releases km$^2$ | | |
|---|---|---|---|---|---|
| | | | good | Average | poor |
| 1A | 35 | 19 | 344 | 182 | 10 |
| 1D | 150 | 50 | 645 | 479 | 291 |
| 2C | 200 | 71 | 839 | 687 | 532 |
| 2D | 200 | 79 | 897 | 759 | 630 |

† (see Table 10.1)

*Table 10.2 Simulation results of various release options under three climatic scenarios. Release options 1 do not include additional water releases from Lake Maga through Mayo Vrick. Release options 2 include floodwater release from Lake Maga through Mayo Vrick.*

The model simulations for the largest release option indicated that under "*average*" conditions, nearly 80% of the lost area would be flooded again, while up to 93% of the lost area is restored under 'good' conditions, and up to 65% of the lost area is restored under "*poor*" conditions. For a given total release flow, which is the sum of each of the estimated release channel flows, e.g. Mayo Vrick, Areitekele, Zigla Kadoum etc, greater re-flooding is achieved if a higher proportion of the flow is derived from the lake via the Mayo Vrick (Options 2C and 2D in Table 10.2). Furthermore, the increase in flooding in "*poor*" years for the options releasing a greater proportion of flow from the Mayo Vrick is greater than that for 'good' years. The releases from the Lake would thus provide a greater security of floodplain productivity in drier years.

The model was used to predict the impact of the floodplain restoration measures on other parts of the ecosystems that extend beyond the limits of the Waza Logone floodplain. For example, the model was able to determine the changes in the volume and surface area of Lake Chad, resulting from the restoration measures. Reductions in flooding on the Logone right bank were estimated as a result of the restoration measures on its left bank. Furthermore, the model was able to predict the likelihood of low water levels that might impact on irrigation system operators on the River Logone downstream of Waza Logone. In the event of releases from the Maga reservoir for re-flooding of the floodplain, the model was able to predict water levels and volumes in the reservoir that would indicate a shortage of water for the irrigation of the rice crop. Finally, the model can be used to determine the rise in water levels immediately downstream of the SEMRY irrigated area that may result in interference in the drainage of rice fields.

The model results enabled the project to make approximate assessments of the impacts of the different flood release options on Lake Chad, water levels downstream, changes on the right bank etc. for each management option and under different climatic scenarios. Under all the climatic scenarios used in the simulations and irrespective of which release option was selected these impacts were not significant.

## 10.2 Consequences of re-flooding

*Ecological consequences*

The re-flooding of the pilot zone was a remarkable success from the pastoralists' point of view. Pastoralists unanimously agreed that the rangelands in the floodplain had improved since the first pilot releases, and that, as a consequence, their animals were in a better condition (Kari and Scholte, 2001). These changes were attributed to a recovery of the vegetation from annual grass species back to perennial species. The cover of annual species, especially *Sorghum arundinaceum* decreased in the impact zone from 58% to 34%, while the cover of perennial grasses, most notably *Echinochloa pyramidalis* and *Oryza longistaminata* increased from 41 to 61% (Scholte *et al.*, 2000b). Scientists expected that the impact zone would be fully rehabilitated into perennial grassland in 2003 (Scholte *et al.*, 2000b). An indicator of the rangelands' improvement was the increase of 260% in the number of cattle in the floodplain since 1994, without any sign of degradation to the grasslands (Kari and Scholte, 2001). Several factors caused this increase in livestock numbers in the pilot zone. First, the reproduction rate increased, which led to a larger number of animals per herd. Second, the number of herds in the floodplain increased by 130%, due to a recent influx of pastoralists from Nigeria. Third, transhumance patterns changed; after the pilot release pastoralists spent 60% more time in the pilot zone before they continued to the northern floodplain of Mukak near Zimado (Kari and Scholte, 2001). The changes in pastures are very drastic and visible; the tall annual species, *Sorghum arundinaceum*, had almost completely disappeared and one could again see for miles. The only negative impact was that pastoral women had far more difficulty finding additional fuel for cooking now that sorghum stalks were no longer available.

The increased extent of the floods meant that some of the natural waterholes were refilled and more surface water became available.  Both livestock and wildlife benefited in the re-flooded areas from the smaller distances to drinking water.

The increase in flooded area also provided additional habitat for water birds and fish. Based on surveys carried out by the project, IUCN (2002) calculated that fishers caught 1,777 tonnes of fish in the additional 200 $km^2$ of flooded area. This fish production is 1.5 to 2 times higher than is usually estimated for inland floodplains per hectare of flooded area (Benech and Quensiere, 1982; Welcomme, 1979).

The re-inundated areas became suitable for traditional floating rice and flood-fed sorghum cultivation, as was practiced before. Rain fed millet, however, was no longer possible to grow in the re-flooded areas (IUCN, 2002).

*The economic impact*

The economic impact of the re-flooding was important for pastoralists. Because animals were in a better condition, their reproductive rates increased, and, as a result, herd sizes increased accordingly. Improved pastures meant higher milk yields and, thus, higher incomes for the pastoral families in the floodplain. In the dry season, milk yields and reproductive rates are generally higher in the floodplain than in other parts of the province due to the excellent pasture conditions. Unfortunately, the population densities are low in the floodplain, which limits the marketing options of pastoral women in charge of dairy marketing. However, in recent years, businessmen from Maroua, the main urban centre in the Far North Province, have been buying milk by the gallon at the local markets of Guirvidig, Pouss, and even Mazera during the month of Ramadan. The main obstacles in dairy marketing are the large distances and the lack of good roads between the local markets of the floodplain and the urban consumers in Maroua; travel from Maroua to Mazera takes at least four hours.

The steadily growing demand for meat in the urban centres of Nigeria, and, to a lesser extent, in Cameroon, Benin, Togo, and Ghana, led to higher prices for livestock in the Far North Province. Livestock buyers from Cameroon and Nigeria started to come more frequently to the Logone floodplain to buy animals from pastoralists in the floodplain at the livestock markets in Zimado, Pouss, Kaykay Bourkoumandje and in particular, Mazera. The number of animals sold every week in the floodplain was significant (about 200) and supplies the markets of Bogo, Maroua, and Banki (Nigeria). In the year 2000, cattle prices ranged from € 210 to € 420 at the local livestock markets. This turned pastoralism in one of the most profitable sectors of the Far North Province; especially in the floodplain where natural pasture is free and abundant and animals are not fed expensive supplementary cottonseed cakes. The cattle trade raised the incomes of both pastoral families and traders and intermediaries, who were associated with the trans-continental livestock trade.

Besides restoring part of the floodplain's integrity by the pilot releases, the interventions of the Waza Logone project had also direct effects on the way the different ethnic groups shared the floodplain. The Waza Logone project mediated in security problems and assisted both in the creation of protected corridors along the major transhumance routes into the floodplain and in the establishment of semi-controlled grazing zones and water holes for watering animals in Fadaré. The project also facilitated the procedures to acquire permits for bush fires, and made arrangements to keep livestock out of the Waza National Park.

In general, pastoralists were very content with these activities of the project. Re-flooding of the pilot zone was welcomed by the pastoralists, and created much goodwill for the project and its activities among them. The economic consequences for fisheries, agriculture and other uses of the floodplain after the pilot releases are detailed in Chapter 11.

### *Addressing insecurity*

Most nomadic herders graze their cattle at night when they are in the floodplain. The advantage of night grazing is that cattle suffer less from heat loss and can increase their forage intake. Animals that graze at night have a better condition, but night grazing is very labour demanding. The main disadvantage of night grazing in the Logone floodplain is insecurity; herders always run the risk of cattle theft. Over the last thirty years insecurity has always been the main reason for herders not to return to the Logone floodplain.

In the first contacts of the Waza Logone project with herdsmen in the floodplain, they unanimously mentioned that insecurity and cattle thefts was a more serious problem for them than the degradation of the grasslands caused by the construction of the Maga Dam (Scholte *et al.*, 1996). Cattle thieves come from all ethnic groups and nationalities, including Fulbe and Shuwa herders. However, the main problems were caused by cattle raids of the Musgum, who traditionally appropriate animals for their dowry through theft from nomadic herdsmen in the floodplain. The raids were often accompanied by violence and every year herdsmen and thieves were killed in the clashes (Moritz *et al.*, 2002).

Insecurity is not a new problem in the Logone floodplain. The problem was, however, aggravated by traditional and governmental authorities through their active support of the thieves, negligence, and/or extortion of the victims (Moritz 1995; Scholte *et al.*, 1996). Insecurity is not limited to the floodplain. Animals and sometimes even entire herds are stolen elsewhere in the province. In the floodplain cattle theft also results in the loss of human lives.

The project's first direct intervention was to organise a roundtable discussion with herders, primarily nomads, at the project's headquarters in Maroua (Scholte *et al.*, 1996). This meeting was the start of a concerted effort of the project and the herders to bring the problem of insecurity in the Logone floodplain under the attention of the highest authorities. The intervention resulted in a positive attitude between the pastoralists and the project, and also the insecurity problem lessened, although it could not be proven that the latter was a direct result of the project's intervention. The security problem was not really solved until paramilitary units came to the Far North Province in 1998 after a number of serious incidents, and cracked down on suspected thieves (Moritz *et al.*, 2002).

**Protecting transhumance routes**

The Waza Logone project was successful in designating pastoral and agricultural zones in the floodplain area, and a transhumance entry route to the Logone floodplain (Kari and Scholte, 2001). The Waza Logone project motivated and organised herdsmen, farmers, and local traditional and government authorities to designate, mark, and protect through consensus transhumance routes, overnight camp sites, and areas reserved for grazing. These activities were limited to an important bottleneck in the pastoral infrastructure of the province: the southern entrance to the Logone floodplain just north of Guirvidig. In order to support a sustainable pastoral economy, transhumance routes and grazing areas had to be designated beyond the local level that incorporated all levels of decision makers of the Far North Province. The number of conflicts between fishers and pastoralists has diminished significantly as a result.

**Keeping pastoralists out of the Waza National Park**

In 1995, the Waza Logone project initiated contacts with nomadic herdsmen from Fadaré in order to convince them to stop using the Waza National Park as a grazing area. The leader, a prominent pastoralist, made an oral commitment that their herds would no longer enter the park. In 1997, this was formalised in a written contract with park authorities (Scholte, 2000). In exchange, the project assisted in establishing a formal pastoral group and provided technical and administrative support for a cattle-fattening project for which the Dutch embassy allocated financial support. In addition, the project installed a watering point (foot pump well) to facilitate watering of cattle in the dry season and initiated a monitoring and semi-controlled grazing program in the area of Abouli to aid pastoralists in preventing overgrazing and rangeland degradation (Van der Jagt and Abatcha, 1997).

**The use of fire to improve the quality of pastures**

Fire has been used in African savannahs as a tool for pasture management for centuries. Fire enhances the quality of forage because after burning, the grasses start to grow afresh. The re-growing grasses have higher concentrations of mineral nutrients, can be better digested and also the structure of the vegetation after burning is generally better. Burning the vegetation also kills the parasites that remain behind in the vegetation. The timing of burning is, however, crucial; when the vegetation is still very wet, fires may not be effective, while when the vegetation is really dry, the fires may be too hot and can destroy the vegetation. The Waza Logone project attempted to facilitate the legal procedure to obtain a permit to use bush fires in the Logone floodplain beyond the stipulated period for bush fires. In the period in which bush fires were allowed, right after the rainy season, the grasslands were still flooded and consequently burning was impossible. Bush fires in the dry season are illegal, unless one requests a permit from the prefect in Kousseri or Yagoua. The project succeeded in changing the procedures, so that burning grasslands in the floodplain is allowed in the dry season. More important, thanks to the intervention of the project, herders learnt which procedures they had to follow to obtain permits, and also, that they could send a representative to obtain a permit for them all at once. However, collective action is not one of their strongest points and nobody has yet obtained a permit independently from the Waza Logone project.

## 10.3 Participatory conflict management

The engagement of the Waza Logone project in the agro-pastoral conflict management was progressive. The first contact with conflicting parties was when the project surveyed the floodplain. From interviews and surveys, the project concluded that the methods to settle conflicts favoured the settled and the owners of fishing canals, at the expense of the pastoralists. This conclusion, which was based on a participatory approach, aroused among sedentary agriculturists and nomadic pastoralists the need of mediation in order to serve all the social groups of the plain equally well. Between 1997 and 1998 the Waza Logone project received from the pastoralists three requests to facilitate conflict management in the area. To satisfy these requests the project decided to intervene through the existing conflict settling institutions, in particular the commission for settling agro-pastoral conflicts. This commission prepared and convened the meetings. The project's role was to persuade the organisers to hold meetings, and to give logistical support to the Commission. The project also tried to implement another approach of conflict solving: the no-looser approach. Two techniques were used: facilitating and conciliating. These were adopted from analysis that there is a will for the conflicting parties to reach acceptable solutions for all.

*Photo 10.2 A participatory meeting of project staff with women (Photo Waza Logone project).*

The results of negotiations led to the demarcation of two transhumance corridors: the Boko-Massa corridor and the one passing through the Mereo, Blamako and Siaou villages up to the Masa-Masa grazing field. Despite the lack of formal training of the members of the commission, the project opted for dialogue, negotiation and consensus during the meetings. Thus, the Waza Logone project supported the president of the commission for the drafting of the conflicts settling procedures. This included diagnostics (analysis of the conflict), negotiation and implementation of resolutions.

The diagnosis was performed in two ways, during the meeting and during a visit to the conflict site. The aim was to hear the views of conflicting parties on the matters in dispute and their claims. During the diagnostic meetings, the project always ensured that room was given to pastoralists and agriculturists to voice out their point of view. The project also played the role of facilitator by reminding the participants of the key points of the meeting, such as the cause of the conflict, the common interests of the conflicting parties and consensus reached during the meeting.

Negotiation was introduced from the different agreements reached during the diagnostic meetings, before asking the participants to keep in mind that each group has a legitimate interest. This was essential in order to bring the protagonists to abandon their initial positions. Following this, there was need to stress the available options to satisfy the legitimate interest of the groups. The exercise involved asking each of the conflicting parties to propose a solution to the problem. The different options given were discussed within the group until consensus was reached. The final decision was to demarcate a corridor of a suitable width.

Mediation followed by arbitration was used during the negotiation meetings for the deviation of the livestock corridor passing through a village called Alvakaye 1. The reason for the conflict was that a livestock corridor passed through rice and sorghum farms, in front of the residence of the village head. The complaints of the farmers were that livestock caused damages to the crops. Furthermore, the people feared that the palace of their chief would be threatened by floodwater, now that the animals demolished the riverbanks when they passed the village. The nomadic pastoralists did not want to accept any deviation of the corridor, arguing that this corridor was there long before the village was established. They further mentioned that they could not send their herds on a new corridor because they did not have any information about it, and they feared that it would be a source of bad luck.

The project was confronted with a situation where the conflicting sides were holding onto their initial positions. The suitable approach in this case is reconciliation. The project investigated why the conflicting parties took these extreme stances. It was found that the situation was linked to the behaviour of the chiefs of the groups - the chief of the Shuwa-Arab pastoralists and the chief of Alvakaye 1 village, who transposed an existing conflict between them onto the corridor dispute. With this in mind the project started a new round of discussions with both parties.

The project first evaluated the possible consequences of the crisis for each group, and proposed suitable actions. Together with the pastoralists the project developed a scenario to turn the conflict into a win-win situation. Although the people of Alvakaye accepted the proposed actions, the pastoralists could not agree on one point. Some of them proposed to use a new corridor not far from the village, while others insisted to maintain the old corridor that was used for decades. The same approach was used with the farmers. They found that the actual itinerary of the corridor was a prejudice to their farms and the riverbanks. Consequently, the best solution was to divert the route to the peripheral zone of the village.

Only after this mediation was concluded, the commission to settle agro-pastoral conflict called a meeting to examine the case. The meeting was held at Alvakaye 1. The participants concluded that the existing corridor, which crossed though the centre of the village, was not a suitable passage because it caused problems between the two groups. Based on this view, the sedentary villagers, and some of the nomadic pastoralists, agreed that the corridor should pass at the periphery of the village. However, the solution was not accepted by two groups of Shuwa Arab pastoralists. To make an end to this deadlock, the commission proposed as solution that the commission's final verdict was binding to all. Thus, the commissions decision that passage of the corridor would be along the periphery of the village was accepted by all parties.

The agreement was written in a document that was signed by the representatives of the different groups, as well as by the members of the commission. The report was presented as a hand-written document to avoid subsequent protests. Following this, it was typed, signed again by all, and distributed to the different parties. After each agreement, the mandate was given to the Waza Logone project to help the nomadic pastoralists and the farmers to mark the transhumance corridor. This marking started by painting in red trees or tufts of grasses alongside the corridor. After that, the transhumance corridor was perpetuated with lasting concrete boundary marks. The project assisted in the marking of the boundary.

## 10.4 The new institutional linkages

Key to the project's success in achieving its objectives was its pursuit to ensure the full participation of the people of the floodplain, while enabling them to determine their own development paths. This required the involvement of the target groups at all levels of decision-making. Furthermore it was necessary to establish institutional structures with representations from all levels (communities, traditional chiefs and administration) for the implementation of both the management plan for the sustainable use of the resources of the floodplain resource, and the management plans for the national parks. Consequently, the project developed these plans in co-operation with all the stakeholders, from the grass roots up to provincial level.

*Co-operation with villages and nomadic communities*

The project's relationships with the local communities in the floodplain evolved as the project itself was developing its field activities. The first contacts were mainly through the traditional leaders at the more senior levels, either directly or through the Permanent Committee, of which these senior leaders were members.

Effective co-operation was also established with the village heads, first during the fieldwork associated with the feasibility study for the pilot releases, and later during the development of various income generating micro-projects. Nomadic communities and those villages that were likely to be affected by the hydrological rehabilitation of the floodplain were intensively consulted before the programme was executed. Similarly, people who would benefit from the micro-projects were also consulted. For this purpose, local management committees were formed with representatives of all concerned communities. This participatory approach to gather information and to plan the project's programme resulted in the definition of the strategy for institutional development as is detailed below.

*Co-management as an instrument*

The project used co-management, or participatory management, as an instrument to make local populations responsible for the sustainable use of the natural resources in the Waza Logone region, and to perpetuate the project achievements. Before co-management could be invoked in the floodplain, a number of conditions needed to be fulfilled. First of all it was necessary that the people living in the floodplain gave their consent for the re-flooding of the floodplain, since this was one of the project's main objectives. Secondly, the local communities should be committed to the sustainable use of the natural resources in the floodplain. This was important because different stakeholders claimed their right of access to the same resources. Lastly, another important prerequisite for the successful introduction of co-management is a positive attitude of the government to share the responsibilities for the management of natural resources with its citizens. Fortunately, the political will was there to involve local communities in the management of natural resources. On 20 July 1995 the government implemented the new forestry law N° 94 /01 promulgated on 20 January 1994, by signing decree N° 95/466/PM. This law gave the opportunity to implement participatory management in forests and in the vicinity of protected areas.

Other prerequisites for the successful introduction of co-management related to relationships of the project with its target groups. Essential was that the local communities trusted the project. In the Logone floodplain they appreciated the project after the sensitization and explanation meetings that were held to explain the project objectives. One of the project specific objectives was the hydrological rehabilitation of the floodplain, and the realisation of this objective matched the expectations of the local people. The project team could furthermore build on community-based resource management that traditionally existed in the floodplain.

Finally, the whole process of implementing some form of participatory management required a lot of time. Since the Dutch Government decided in 1995 to fund the (third phase of the) project for another five years, the project team had sufficient time. Three major stages were distinguished in the process, leading to co-management, namely environmental studies, stakeholder analysis, and the management process itself.

- The *environmental studies* consisted of the gathering of relevant information on the natural resources in the floodplain, the existing management systems, the users groups and the conflicts amongst them. The project team used various tools such as participatory rural appraisal (PRA), surveys, censuses, workshops and technical meetings to collect data on wildlife, the carrying capacity of the floodplain pasture, the floodplain fish production, the demography of the region, the origin of pressures on the natural resources, the location and nature of existing conflicts amongst user groups, and the procedures that should be followed to access these natural resources. The knowledge of the environment that the local communities had was indispensable in the gathering of all this information. In the end a hydrodynamic model could be developed thanks to all the information that became available.

  During this stage the project initiated a dialogue between the different local communities involving both resident and nomadic populations on the one hand, and traditional and administrative authorities, including the Park authorities, on the other. The stakeholders were encouraged to express their viewpoints on what they considered threats, and what their opinion was on the way the natural resources in the area were managed, and should be managed. This work ultimately led to a consensus on the way the pilot releases should be carried out, and on the status of the surroundings of the Waza National Park.

**Box 1: Management Plan for Waza National Park**

*A latent situation of conflicts had developed between Waza National Park authorities and the people living around the Park. The people claimed that the resources within the park's perimeter were essential for their livelihoods, while the park authorities had insufficient game guards to control the 170,000 ha of the park. It was thus necessary to involve the local communities in the protection of the park.*

*The structuring of the stakeholder groups and the interaction with each of them enabled the project to gather ideas, concerns, and suggestions to draft a management plan for the park. The project then facilitated the first stakeholders meeting to discuss the draft plan. As a result, a peripheral zone around the park was preferred above a buffer zone, because in the peripheral zone people could continue their usual activities. Also other key points were discussed, such as the procedure to validate the management plan, and the role and the composition of the management institution. The outcome was that the management institution would decide which activities were allowed in the peripheral zone and it would advise the park authorities on which activities could be allowed inside the park. The management institution would consist of three bodies: a scientific committee, an advisory committee and an executive committee. The conclusions of this meeting were included in the management plan, which was finally approved by the Ministry of Environment and Forestry in September 1997.*

*After the management plan received ministerial approval, the project called a second stakeholder's meeting, during which the procedures for the management institution, now called the Park Committee, were adopted.*

*The third stakeholders meeting was held in July 1998 during which the management committee planned the activities for the period July 1998 - June 1999. The project facilitated three other meetings where discussions focused on the procedure to inform the warden about poachers and those who illegally exploit resources within the park. During these meetings, discussions also focused on the content of specific agreements related to the exploitation of thatching grasses, fish and bee keeping inside the park. At the end of 2002, these agreements had not yet been finalised.*

- Through a *stakeholder analysis* the stakeholder groups in the floodplain were identified. The first group of stakeholders consisted of those who had legal rights to land or to the natural resources, or who depended on the natural resources of the floodplain for their subsistence. The second group was composed of those who were mandated by the central government: Waza National Park authorities, administrative authorities, *etc*. The third group consisted of those who were mandated by the local population: the traditional authorities and the mayors. The Waza Logone project was mandated by the State to play the role of facilitator.

  The next step was to investigate how well the stakeholder groups were organised. One important issue was who would represent the stakeholder groups in the process of decision-making. The project team assisted the stakeholders to organise themselves. In the case of the Waza National Park for instance, the area was divided into four sub-zones and for each zone representatives, five men and five women, were elected. In addition, two representatives (male and female) of the nomadic herdsmen and one representative of the semi-settled agro-pastoralists who exploit pasture in the vicinity of the park were elected.

- The development of *management agreements* and their implementation were carried out in a learning-by-doing process. This was applied in four instances, namely the management plan for the Waza National Park and its surrounding, a specific management agreement for a 3,200 ha dry season pasture located south of the park, a special agreement for pilot releases, and three specific agreements for conflict management related to transhumance corridors in the floodplain. For all these cases, the Waza Logone project played its role of facilitator. Two cases are presented in below.

**Box 2: Management agreement for a 3,200 ha dry season pasture in Abouli**

*Serious pasture degradation took place in Abouli, in part as a result of the drought period in the 1980s. The stakeholders in this particular area, who are all semi-settled agro-pastoralists, were concerned that the degradation of this area was aggravated by the exploitation of the pastures by outsiders from Nigeria, and by fire wood collectors from Maroua. The resident people suggested developing a management agreement for the sustainable use of dry season pastures in Abouli. They asked the project to facilitate the process.*

*The first thing the project did was to secure funds to establish water pumps. The Dutch government provided the funds to drill a borehole and to construct a reservoir and livestock watering places. Dairy cows thus could be supplied with drinking water. The project also facilitated the dialogue between the stakeholders, and in a number of stakeholder meetings the management agreement was defined. The stakeholders agreed who would represent them and what would be their role in the management institution, their functions and responsibilities, their rights and benefits, the procedures for conflict management, etc. The senior divisional officer of the Diamaré division in the Far North Province of Cameroon approved the final version of the agreement.*

*Two significant points can be mentioned as important factors that contributed to the successful outcome:*
- *The recognition that the traditional chief, "the Lamido of Petté", was ultimately responsible for the management of the area;*
- *The nomadic pastoralists coming from Nigeria were not considered as stakeholders. There was, however, a clause in the management agreement that allowed these users to spend two or three days in Abouli while moving to the floodplain dry pastures.*

*Provincial institutions*

The project recognised the need for close co-operation between the project and the ministries and their technical services, as well as with the communities of the floodplain. A series of agreements were therefore signed between the project and the provincial head offices of the various line ministries. Hence, the technical programmes were all carried out with major participation from the provincial offices of various ministries (Table 10.3).

| Line ministry | Services provided |
|---|---|
| Environment and Forests | Environment Service, Wildlife and Protected Areas |
| Planning and Regional Development | Censuses and Surveys |
| Agriculture | Agricultural Statistics, Community Development, and Crop Protection |
| Livestock and Fisheries | Livestock, Fisheries |
| Mines, Water and Energy | Water Engineering |
| Urban Development and Land Registry | Surveys |

*Table 10.3. Provincial offices of line ministries participating in project activities and their main contributions.*

**Provincial Management Committee for the Waza Logone region**

After preliminary environmental studies had been carried out by the project, it became evident that some issues would go beyond the mandate of the local management committees. The trans-boundary use of water and pastures, which are shared by users from the Lac Chad Basin, is but one example. For this reason the project set up the Provincial Management Committee that was in charge of the management of issues at a scale larger than the Waza Logone region. This committee functioned for three years and approved various activities that were related to the pilot releases. The committee also examined the problem of cattle theft that was reported by nomadic and semi-settled pastoralists. Although the members of the Committee were committed to monitor the rehabilitation process, the committee lost its momentum when a new governor was appointed as the head of the Far North Province. Apparently the new governor did not give the Committee the priority it deserved. Beyond that, the committee faced structural financial problems. At the beginning of the process, everything was funded by the project, but a strategy for internal fund raising was not defined.

*Co-operating Institutions*

The Lake Chad Basin Commission (LCBC), which is responsible for co-ordinating the management of rivers flowing into the lake, showed interest in the project as a possible model for future floodplain management in other countries of the Chad basin. The project was therefore listed in the LCBC's strategic plan for 1995-2000. The project retained regular contact with the LCBC and assisted practically in its collection of climatic data from the project area. In the future, the LCBC could become increasingly important in providing the forum to discuss the impacts of water release in the floodplain on both sides of the Logone River.

The project also co-operated with several organisations that fall under the umbrella of the Ministry of Higher Education, Computer Services and Scientific Research (MESIRES). Staff members of the *Institut de Recherche Zootechnique* (IRZ) and the *Institut de Recherche Agronomique* (IRA) played an important role in the development of the ecological programme. Most notably, the *Institut de Recherche Géologique et Minière* (IRGM) provided the backbone of the hydrological programme, working with the technical guidance of a consultant from Delft Hydraulics from The Netherlands.

The project maintained relations with almost all of the non-governmental organisations operating in the Extreme North Province, mainly for consultation and the exchange of information. These included: *the Organisation Canédienne pour Ia Solidarité et le Développement* (OCSD), the Catholic Mission, Enviro Protect, *Service d'Appui aux Initiatives Locales de Développement* (SAILD), Save the Children, the African Institute for Economic and Social Development (INADES) and CARE. The African Training Centre of INADES also provided training courses on participatory approaches for field research for the project. On a national level, the project took part in regular consultative meetings of international NGOs concerned with environmental matters.

The parastatal *Société d'Expansion et de Modernisation de Ia Riziculture de Yagoua* (SEMRY) consistently co-operated in the most practical terms with the project, notably in the execution of the pilot release. This co-operation, which was governed by an Agreement signed in December 1992, will continue to be essential to the success of the efforts made to restore the floodplain, since SEMRY will ensure the control of the Djafga canal and the waters of Lake Maga.

The *Ecole pour la Formation de Spécialistes de Ia Faune*, the international wildlife school based in Garoua, participated in the organisation and execution of wildlife counts and in the ecological monitoring. In addition teaching staff from the University of Dschang was heavily involved in the EIA programme (and have since formed a Cameroonian chapter of the International Association for Impact Assessment), while others were involved in the ecological programme.

Co-operation with the Centre for Environment and Development Studies in Cameroon (CEDC), which is administered jointly by the University of Dschang and the University of Leiden, included participation in CEDC's specialist training courses by supporting participants, by providing professional expertise, and by commissioning specific courses. The project was also invited by CEDC to participate in its own long-term programming.

## 10.5 Conclusions

The restoration of the floodplain began with two pilot releases, which coincided with above average rainfall during the period 1994 to1997. In these years a larger surface area was flooded than during the years immediately following the SEMRY interventions. The ecological monitoring programme initiated by the project showed that as a result of re-flooding, perennial grasses returned, and since grazers prefer perennial grasses, the number of wild herbivores had increased. Socio-economic data showed improvements in fishing yields and livestock production as a result of increased flooding.

A hydrological model was used to determine the feasibility of additional flood releases on a much larger scale. In this model man-made changes were treated as independent variables from climatic effects (increased rainfall and/or channel flow). The expected extent of flooding under a number of release options was calculated for a number of different climatic scenarios. This was achieved through a programme of hydrological monitoring and the development of a hydrodynamic model. The model required a large amount of topographical and hydrological information for it to provide dependable results that can take years to accumulate. In the case of the Waza Logone project four years of local hydrological data were collected and regional data over more than forty years utilised. Topographical surveys took place mainly over a two year period.

The model resulted in an estimate of the extent of flooded areas, which, in conjunction with other information, allowed an assessment to be made of the effectiveness of the releases in achieving the restoration objectives. Assessment tools such as Cost Benefit Analysis (CBA) formed part of this process, leading to the recommendation of three possible options for the large-scale release (IUCN, 1999b).

The actual measures that were taken in relation to the restoration objectives consist to date solely of the pilot releases. The effectiveness of these pilot releases was, however, clearly demonstrated by the model results, which confirmed 180 $km^2$ of additional flooding in an "*average*" year (Mott MacDonald, 1999). The outcomes of the model also confirmed that only 10 $km^2$ would be additionally flooded in a "*poor*" year (Mott MacDonald, 1999). This corresponds to a return to the drier conditions of the 1980s, and would result in a similar collapse in the natural resource base of that period, unless substantial additional re-flooding is undertaken. The results of the modelling showed that the most effective and efficient releases will take place from the outlet of Maga dam into the Mayo Vrick.

The European Commission not only funded the development of the hydrological model, but had also indicated that it would consider funding the measures that are needed to achieve large-scale re-flooding. The negotiations with the EC were a slow process, which finally, in mid-2002 resulted in the EC declining to make the necessary funds available. With the benefit of hindsight, it is clear that other sources of funding should have been pursued more vigorously at the same time. It is important that the dialogue with potential donors is continued with redoubled efforts, in order to implement the large-scale re-flooding of the Waza Logone floodplain. So far (mid 2003), only the Global Environment Facility has indicated a willingness to support the restoration (through its Lake Chad Basin project GEF/UNDP/World Bank, in co-operation with the Lake Chad Basin Commission and the Government of Cameroon). The project also hopes to be in a position to further support local livelihoods through a specific project submitted to the Government of Cameroon, as part of the Highly-Indebted-Poor-Country (HIPC) programme for Cameroon.

The Waza Logone project is a clear example how a participatory approach can be successfully used in conflict mediation. It should be stressed, however, that the project did not consider the negotiated agreements as merely conflict solving, but saw this aspect of the project in a wider context, as natural resource management. The new transhumance corridor is now part of the Waza Logone Plan. Natural resource management projects should not overlook conflicts that arise between the users of the natural resources. If there is need to establish a base for sustainable natural resource management, projects should allocate for conflict management in their strategies.

# 11 Economic Justification of Additional Floodplain Re-inundation

By Lucy Emerton

## 11.1 Introduction

The hydrological and ecological rehabilitation of the Waza Logone floodplain, through re-inundation, is an important element of the Waza Logone project. To date the project has already accomplished two pilot flood releases, which have led to demonstrable recoveries in floodplain flora and fauna. The local people welcomed the pilot flood releases, because they profited from the increased productivity of the floodplain.

A number of different release options had been worked out by the project. It was intended that further restoration of the previously inundated area would be achieved by constructing engineering works that allow flood releases from Lake Maga and its associated water courses. The implementation of any of these options requires a considerable financial input. A study was therefore carried out to estimate the economic returns of additional floodplain re-inundation to justify investments in flood release measures in order to safeguard the hydrological, ecological, biodiversity and socio-economic benefits of the Waza Logone floodplain. This implied that only those benefits were valued that were believed to be sustainable. The study excluded unsustainable resource utilisation activities, even where these are made possible (over the short-term) by flood release. It also did not value illegal resource utilisation, e.g. hunting and grazing in the Waza National Park. The study focused on valuing the so-called *on-site* benefits and costs of flooding that would accrue inside the floodplain region and would be received by the floodplain population. Although re-inundation may result in a number of off-site economic impacts, such externalities were not the primary focus of this study. Finally, the study concentrated on the incremental values of re-inundation over the current situation of reduced flooding. It therefore looked at the additional economic values that will result from flood release - it is concerned with changes in floodplain economic benefits and costs that are directly caused by re-inundation.

It should be emphasised that figures reached are a preliminary indication of the broad magnitude of the benefits and costs of flood release, and should not be taken as exact or indisputable values. They relied on very limited original data collection and on the information and reports available at the time within the Waza Logone project. Much of this data was approximate or incomplete.

## 11.2 Options for re-inundation

Building on work originally carried out in 1983, four options for flood release in the Waza Logone region were identified in 1994: a pilot release, an almost complete restoration, and two intermediate options (Wesseling *et al.*, 1994). A preliminary cost-benefit analysis concluded that the pilot release and large-scale re-flooding options could be profitable, whereas small-scale re-flooding was not economically attractive.

Pilot releases of floodwater from the Logone River were subsequently implemented in 1994 and 1997. These modified and opened the channels of two watercourses that connected the Logone to the Logomatya, and that had been blocked by the SEMRY works: the Petit Guruma in 1994, and the Areitekele in 1997. These pilot releases resulted in an annual increase in the area flooded of around 200 km$^2$ (see Chapter 10). The return of the water led to a marked recovery in the number of water birds and certain mammals, increase in fish production, improvement and extension of pasture, and changed agricultural opportunities (the replacement of rain fed millet with flood-fed rice and sorghum).

In 1999 a revised proposal for re-inundation was made, which updated the three options first presented in 1994 (IUCN, 1999b). This proposal focused on two main zones for release, one from Lake Maga, which usually has excess water in August and September; and a second zone from the area immediately to the north of the rice cultivation area of the irrigation scheme. The proposal consisted of three different components: Options X, Y and Z, each allowing a different level of additional flows and level of floodplain restoration (Table 11.1; Figure 11.1). It should be noted that none of these re-inundation options would reduce the surface area of irrigated fields that are actually cultivated in the SEMRY scheme (Wesseling *et al.*, 1994).

| Option | Additional flow ($m^3/s$) | Total flow ($m^3$) | % restoration in average year | Total area reflooded, including pilot areas ($km^2$) | | |
|---|---|---|---|---|---|---|
| | | | | Good year | Average year | Poor year |
| X | 215 | 250 | 90 | 916 | 867 | 646 |
| Y | 165 | 200 | 71 | 839 | 687 | 532 |
| Z | 115 | 150 | 50 | 645 | 479 | 291 |

*Table 11.1 Reinundation options.*

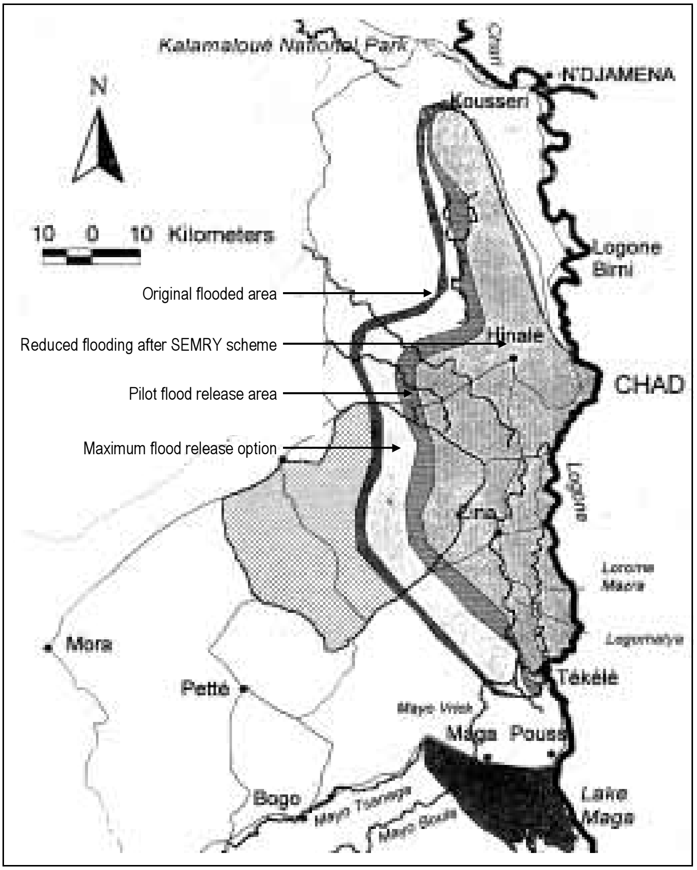


*Figure 11.1 Extent of proposed flood releases. From IUCN, 2002.*

Although it is impossible to effect a return to the exact flooding patterns that were found before the construction of SEMRY, the release of water from the Logone River and from Lake Maga can make a significant contribution towards rehabilitating the hydrology, ecology and biodiversity of the floodplain and to restoring the human production systems that depend on it. Re-inundation measures were intended to lead to the following changes (Wesseling *et al.*, 1994):

- Increased volume of water passing through, and larger recession zone around Lake Maga.
- Larger and earlier inundation from the Logomatya.
- Rehabilitation of September and October inundation of Gourgoule plain, the Waza National Park borders and floodplain.
- Slight increase in inundation of *Acacia seyal* forest belt, to the south-west of the floodplain.
- Increase of discharges of El Beid River, and increased inundation along seasonal creeks and associated depressions.
- Slight increase in inundation of the western section of the Northern Floodplain and decrease in inundation of the eastern section.

In turn, it was anticipated that re-inundation would have the following positive impacts on floodplain goods and services (IUCN, 1999b; Mott MacDonald, 1999; De Iongh *et al.*, 1998; Wesseling *et al.*, 1994):

- Restoration of *fisheries*, including an improved fishery in Lake Maga and higher fish migration. There will also be an increase in the productivity and extent of canals, lagoons and barrages used for fishing around Gourgoule and the Logomatya and El Beid Rivers.
- Rehabilitation of *dry-season pasture* around Lake Maga, Logomatya and Gourgoule, through an increase in both the area and quality of grasslands.
- Improvement of *crop agriculture* possibilities, including an increase in the area available for dry season millet cultivation around Lake Maga and the SEMRY scheme, an increase in land area for floating sorghum around Gourgoule, and the return of flood-fed rice around the Logomatya, El Beid and the Waza National Park borders.
- Recovery of *wildlife populations*, through the restoration of grazing and watering areas in and around Waza NP, and an increase in fish and waterfowl populations in the wider floodplain.
- Replenishment of *surface water* through increased storage and availability of water, especially in dry seasons.
- Protection of *agriculture lands, infrastructure and human settlements* in and downstream from the SEMRY scheme. Controlled water release and widening of the Mayo Vrick canal will protect crops, houses, roads and other infrastructures in and downstream from the SEMRY scheme from the overflow or breaching of Lake Maga during extreme rainy seasons.

## 11.3 Valuation methods

*Economic benefits of re-inundation*

The total economic benefit of wetland resources is conventionally defined as the sum of their direct values, indirect values, option values and non-use values. *Direct values* are composed of the raw materials and physical products that are used directly for production, consumption and sale. *Indirect values* are the ecological functions that maintain and protect natural and human systems through its functions and services. *Option values* are the premium placed on maintaining a pool of wetlands species and genetic resources for future possible uses. *Non-use values* or *existence values* are the intrinsic value of wetland areas and species, regardless of their current or future use. The most important economic benefits that depend directly on the re-inundation of Waza Logone floodplain are summarised in Figure 11.2.

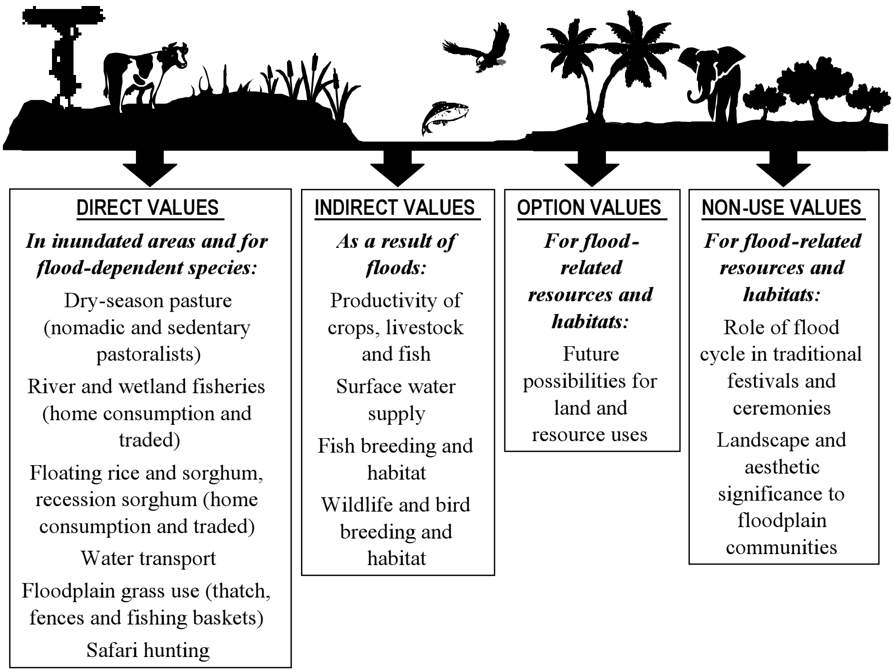


*Figure 11.2 Economic benefits of re-inundation of the Waza Logone floodplain. From IUCN, 2002.*

### *Economic costs of re-inundation*

The total economic cost for re-inundation of wetlands can be defined as the sum of their direct management costs, opportunity costs and costs to other economic activities (Figure 11.3). *Management costs* include investment and recurrent costs of the infrastructure required to re-inundate the floodplain, and of monitoring its effects. *Opportunity costs* refer to the alternative uses of time, land, money and other resources required for wetland conservation. These efforts could have generated income and profits had they been used differently or allocated elsewhere. *Costs to other activities* include the damage and interference to human and economic systems caused by wetland resources and species.

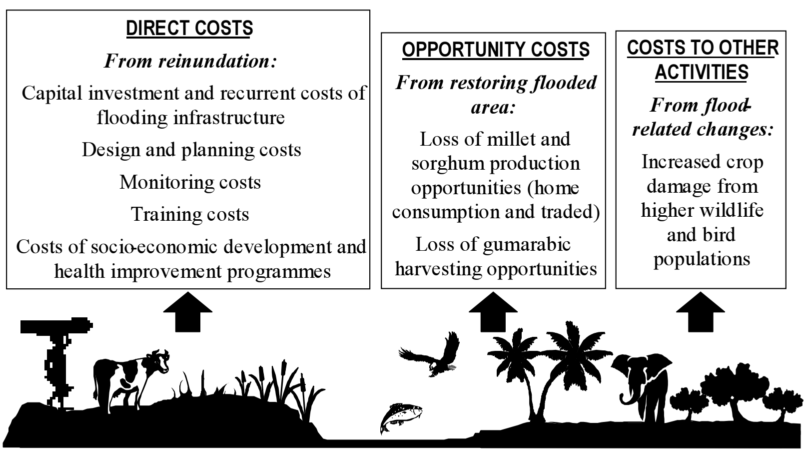


*Figure 11.3 Economic costs of re-inundation of the Waza Logone floodplain. From IUCN, 2002.*

*Techniques used to value floodplain re-inundation*

Because of the limited information, time and other resources available for this study, it was impossible to value every economic benefit and cost arising from re-inundation of the Waza Logone floodplain. For these reasons, option and non-use values associated with flood release were excluded.

Valuation of the other flood-related economic benefits and costs used a variety of techniques and methods (Table 11.2). The simplest and most straightforward way of valuing wetland goods and services is to look at their market prices — what they cost to buy or what they are worth to sell. Although this method can be useful, in many cases the goods and services associated with flood release had no market in the Waza Logone region, or were subject to prices that are highly distorted. In this study, market price techniques were only found to be applicable to fish and rice trading, water transport, and grass used for fishing baskets.

| Economic Benefit/Cost | Coverage of study |
|---|---|
| Pasture | Valued using effect on production techniques for sedentary and nomadic pastoralists using flooded pasture |
| Fishing | Valued using effect on production techniques for fishing households using re-flooded areas |
| Fish trading | Valued at market prices for traders selling fish from re-flooded areas |
| Rice cultivation | Valued using effect on production techniques for rice cultivators using re-flooded areas |
| Rice trading | Valued at market prices for traders selling rice from re-flooded areas |
| Thatching grass | Valued at replacement cost for house thatch harvested from re-flooded grassland areas |
| Grass used for fish baskets | Valued at market prices for construction of fishing baskets from grass harvested from re-flooded grassland areas |
| Beekeeping | Valued at market prices of honey producers using re-flooded areas |
| Surface water supply within Waza National Park | Valued using mitigative expenditure techniques for waterholes depending on re-flooding |
| Surface water supply for domestic use | Valued using mitigative expenditure techniques for domestic water supplies in re-flooded areas |
| Surface water supply for water transport | Valued at market prices for boat operators using newly opened/deepened channels and watercourses |
| Surface water supply for livestock | Reflected in effect on production of pasture (to avoid double counting) |
| Fish breeding and habitat | Reflected in effect on production of fisheries (to avoid double counting) |
| Wildlife breeding and habitat | Partially reflected in mitigative cost of waterholes in Waza NP |
| Land productivity | Reflected in the valuation of agriculture and pasture (to avoid double counting) |
| Option values | Not valued due to lack of time and data |
| Non-use values | Not valued due to lack of time and data |
| Infrastructure investment and maintenance costs | Valued using direct costs figures prepared for reinundation proposal (IUCN 1999b) |
| Crop losses | Valued using effect on production techniques for households losing red millet to re-flooding |
| Arabic gum losses | Valued using effect on production techniques for Arabic gum production lost to re-flooding |
| Wildlife crop damage costs | Valued using avertive expenditures for households suffering increased wildlife crop damage after re-flooding |

*Table 11.2 Valuation techniques used in this study (IUCN, 2002).*

For the benefits and costs that could not easily be valued through the application of market prices, three additional techniques had been used to value flood benefits. In the first place, the *effect on production* elsewhere was determined. Economic processes beyond floodplains often rely on wetland resources as inputs, or on the essential life support provided by wetland services. Where they have a market, it is possible to value wetland goods and services in terms of their contribution to the output or income of these other production and consumption opportunities. In this study, effect on production techniques were used to value pasture and fishing benefits, floodplain productivity for fisheries, agriculture and livestock production, and crop and gum arabic losses. A second technique is to use *replacement costs*. Even where wetland goods and services have no market themselves, they often have alternatives or substitutes that can be bought and sold. In this study, replacement costs were used to value grass used for thatching. Thirdly, *mitigative or avertive expenditure techniques* can be used.

It is almost always necessary to take action to mitigate or avert the negative effects of the loss of wetland goods and services, so as to avoid economic costs. These mitigative or avertive costs can be used as indicators of the value of conserving wetland resources in terms of expenditures avoided. In this study, mitigative expenditures had been used to value surface water supply benefits for the Waza National Park and for domestic supplies, and avertive techniques were applied to wildlife damage costs.

*Cost Benefit Analysis*

The cost-benefit analysis included consideration of both flood-related benefits and costs and of the direct physical costs of flood release measures. It calculated the net incremental benefits and costs of different re-inundation options, as compared to the existing situation of reduced floods. Benefits and costs were expressed as net values - the costs of labour and other inputs used to generate products had been excluded. This presented a more accurate assessment of the economic value of benefits and costs, made them more directly comparable, and helped to avoid the problem of double counting - especially where value is simultaneously or consecutively added to the same floodplain good or service by different groups.

Pilot flood release areas were included in additional flooded areas. Costs and benefits were analysed over a period of 25 years at a base discount rate of 10%, representing the opportunity cost of capital in Cameroon. "*Good*" years were assumed to correspond with hydrological conditions that are met or exceed the 75% probability of the annual maximum flow in the Logone River. An average flood represented the 50% probability of the annual maximum flow, and "*poor*" years meet or are below the 25% probability of the annual maximum flow (Mott MacDonald, 1999). In reality a sequence of "*good*" or "*average*" years will not occur – instead there will be average, dry and very dry years. The benefits of re-inundation will only occur in wet years. In dry years inundation will not occur at all.

**Assumptions used in the valuation**

Unless otherwise stated, survey data from the 33 villages affected by the pilot flood release had been used to calculate the costs and/or benefits of various uses. These values were extrapolated to the 41 additional villages that will be affected under the maximum re-inundation options and 31 villages affected by the minimum option. The estimated effects of three re-flooding options on flood related production in the Waza Logone floodplain are summarised in Table 11.3.

**Livestock production**

Livestock production was calculated by looking at the contribution of floodplain dry-season pasture to annual livestock output, comprised of the value of milk consumption and sales[1], sales off take and recruitment. The costs of livestock production (labour, veterinary, and mortality) were deducted from these benefits in order to give an estimate of the net value of dry season pasture.

Herds spend approximately 6 months of the year in the floodplain, and a conversion factor of 0.5 was applied to this annual sum to account for the contribution of the floodplain to livestock production.

For comparative purposes, estimates of the replacement cost of dry-season pasture made by previous studies (Wesseling *et al.,* 1994; De Iongh *et al.*, 1998) were updated, looking at expenditures on artificial feed saved. These updated figures gave a value € 2,285 per km$^2$ (based on 11,750 Tropical Livestock Units (TLU) days per km$^2$, above the original average of 11,137 TLU days/km$^2$ between 1993-1997. A TLU of one is equal to a 250-kg animal and other animals are compared with it using weight to the power 0.75). This is just over one quarter higher than the equivalent gross value of the effect on production approach per km$^2$, or approximately equivalent to the net value of the effect on

[1] Milk production was far in excess of actual consumption, and a large proportion of milk remained unconsumed and unsold - this value was not included in calculations, as it is not a realised value, even though it represented some two thirds of the total milk production.

production approach per km². It was however decided that this study would use effect on production techniques, as the purchase of artificial feed was considered an unrealistic scenario, especially for nomadic and semi-nomadic pastoralists.

| Parameter | Option X | Option Y | Option Z | Flood loss (costs) |
|---|---|---|---|---|
| Flood coverage and frequency | Good year 916 km², average year 867 km², bad year 646 km² | Good year 839 km², average year 687 km², bad year 532 km² | Good year 645 km², average year 479 km², bad year 291 km² | Based on actual figures: a decline of 964 km² to an annual flooded area of 2,418 km² |
| | Include pilot release areas. All good bad and average years flood areas from IUCN 1999b. Good year occurs 1 year in 6, bad year occurs 1 year in 10. Flooding commences at 50% area in Year 5, and then stabilises. | | | |
| Pasture benefits | Increases steadily over 5 years and then stabilises, based on area of previous year's floods. | | | Decreases evenly until stabilises at minimum after 8 years |
| Fisheries benefits | Increases steadily over 5 years and then stabilises. No adjustment of value in good and bad years, as price fluctuations compensate for variation in catch | | | Decreases based on figures extrapolated from data collected before and after pilot release |
| Agriculture benefits | Increases steadily over 3 years and then stabilises. No adjustment of value in good and bad years, as price fluctuations compensate for variation in yield | | | Decreases evenly until stabilises after 5 years |
| Water transport benefits | Returns after 1 year and then stabilises, does not depend on flooded area | | | Immediate loss after 1 year |
| Grass benefits | Returns after 1 year, based on area of previous year's floods | | | Immediate loss after 1 year |
| Beekeeping benefits | Increases evenly over 3 years and then stabilises, does not depend on flooded area | | | Full loss after 2 years |
| Surface water supply benefits | Returns after 1 year, does not depend on flooded area | | | Immediate loss after 1 year |
| Crop losses | Incurred after 1 year, does not depend on flooded area | | | Immediate decrease in cost (benefit realised) after 1 year |
| Gum arabic losses | Incurred after 1 year, does not depend on flooded area | | | Cost decreases (benefit increases) evenly until stabilises after 8 years |
| Wildlife crop damages | Incurred after 1 year, does not depend on flooded area | | | Cost decreases (benefit increases) evenly until stabilises after 5 years |
| Physical costs of flood release measures | All expenditures from IUCN 1999b. Preparation and design costs incurred Years 1-2, construction costs incurred Years 3-4, modification costs incurred Year 6, maintenance costs incurred Year 7 and every 5 years onwards | | | |

*Table 11.3 Assumptions of change in flood benefits over time (IUCN, 2002).*

## Fisheries

After the construction of the SEMRY scheme, just over 7,000 fishing households remained in the floodplain, catching an average of 15 sacks of wet fish a year from flood-dependent wetland areas. This increased to 10,400 households catching 29 sacks after pilot flood release, and based on the outcome of surveys that were carried out in the floodplain it was estimated that this number will rise to nearly 12,000 households and 32 sacks once floods are restored. This corresponds to between 12,000-15,000 tonnes a year for the whole flooded area or 42-46 kg/ha, consistent with estimates of floodplain productivity of between 40-60 kg/ha flooded (De Iongh *et al.*, 1998).

This study valued this production using local fish prices that had been weighted according to species composition and the costs of transport to market. The costs of labour, and of the depreciation and maintenance of fishing gear were deducted from this figure in order to estimate net returns to flood-dependent fishing. It was known that on average just under 6 sacks of wet fish equivalent were consumed annually by each fishing household. The value added by traders to fish sales was calculated by deducting trading costs (purchase price of fish, transport, loading, storage, sacks, and accommodation) from Maroua market prices.

## Agriculture

In the re-flooded pilot area, floating rice cultivation was practised for just under half of households. Between 0.67 and 0.91 ha or an average of 0.7 ha was cultivated by each household, yielding between

27 and 30 bags, which equals an average of 2.3 tonnes per ha. An average of 49% of households will actually cultivate new rice. Using floodplain farm gate prices, production costs (labour and other inputs) were deducted to give a net value for flood-related rice production.

**Roof thatching, fish baskets**

Houses in floodplain villages are re-thatched every two years, with an average of 5 houses per compound using an estimated 400 bundles of grass. The costs of replacing grass obtained from flooded areas around villages with purchased grass, less harvesting costs, were used to estimate the net value of thatching grass. Approximately 70% of households were engaged in fishing, using an average of 130 baskets and traps each, which have a lifetime of 2 years. The market price of fishing baskets and traps, less the costs of labour to harvest grass and construct baskets, had been used to estimate the net value of grass used for fishing baskets.

**Bee keeping**

After the pilot flood release, 20 households took up bee keeping as a result of the increased availability of water and pollen-producing vegetation. It was predicted that an additional 80 households would take up bee keeping under re-inundation Option X, 50 under Option Y, and 20 under Option Z. Bee keeping in the floodplain produces an average of 20 litres of honey a year, sold at € 3 per litre. Annual costs were deducted from this figure in order to estimate the net economic benefit of bee keeping for honey production.

**Water points**

The drying out of the floodplain resulted in the loss of waterholes in the Waza National Park (Wesseling *et al.*, 1994). These had to be dug again and filled from a borehole. The benefits of re-inundation in terms of avoided expenditures to mitigate the effects of loss of naturally fed waterholes were calculated from the costs of installing and maintaining waterholes. This included the costs of sinking a borehole, and of filling and maintaining the nine waterholes that had been affected by the loss of flooding.

The loss of dry-season and permanent water sources for domestic use was valued by looking at the mitigative expenditures of digging two additional wells to provide water. As wells must be re-dug once a year, these costs represent mitigative expenditures that can be avoided by re-inundation. Additional water available for livestock production was not valued separately, so as to avoid double counting with the figures calculated for the value of dry-season pasture.

**Transport**

The pilot release re-enabled water transport along parts of the Petit Guruma and Logomatya that had previously been closed off or made shallower as a result of flood reduction. After the pilot releases three boats made a total of about 60 trips during the flood season using these re-opened routes, carrying between 8 and 72 passengers on each trip as well as a variety of livestock and other goods. Water transport possibilities were assumed to stay the same for all re-inundation options, and were valued by deducting boat operation costs (fuel, labour, equipment, and depreciation) from total income earned from fares.

*Costs of implementing re-inundation measures*

Detailed costs had been provided in the proposal for re-inundation (IUCN, 1999b) for each of options X, Y and Z. These included the capital and maintenance cost of flood release infrastructure; associated preparation, design and planning costs; monitoring, training and research; and expenditures on work to mitigate negative health impacts of flood release. This study took these estimates as the direct costs of implementing re-inundation measures in the floodplain.

### Crop losses

Approximately 84% of households cultivated an average of 1.6 ha each of red millet, yielding 17 bags per hectare. An estimated 33% of millet fields would be lost to floods. The farm gate prices of red millet, less costs of production, were used to calculate the cost of re-inundation in terms of millet losses.

### Crop damage costs

After the pilot release re-inundation there was a negligible increase in the level of wildlife crop damage around the Waza National Park, and wildlife crop losses could even decline after further re-inundation due to the increased provision of pasture and water within the park's boundaries.

There was, however, evidence that bird damage to crops had risen with re-inundation. Surveys carried out in areas of the floodplain affected by pilot flood release suggested that an additional 21 days labour were required by each farming household each year after flooding to minimise bird damage to crops.

### Gum arabic losses

An estimated half of the existing area used for gum arabic harvesting would be lost to flooding. According to surveys undertaken in the project area, the value of this loss was estimated at € 40,400 a year.

### The opportunity cost of labour

The prevailing unskilled rural wage rate in the floodplain was € 0.75 per day, and the prevailing urban casual wage rate was € 2.30 per day in Maroua. Forty per cent of these wage rates were assumed to represent the opportunity cost of labour for floodplain activities. For crop cultivation costs, where a single figure was given to cover all inputs to production, it was assumed that labour accounted for three-quarters of the costs.

This factor of 0.4 had been used for several reasons. Firstly, most of the floodplain population engaged in particular resource utilisation activities as a way of life, and because alternative opportunities for employment were unavailable or unattractive to them. There were also other non-economic reasons for carrying out floodplain resource utilisation activities including risk aversion, self-sufficiency and livelihood security. The fact that high rates of unemployment prevailed in the floodplain area, where employment opportunities were scarce, also meant that paid wage rates represented an overestimate of the opportunity cost of labour. Many floodplain activities were carried out part-time, or fitted in around other productive activities as part of multiple livelihood strategies. Finally, floodplain labour is diverse, encompassing adults, children, old people, men and women, not all of whom can command full wage rates and not all of whom were able to engage in such employment opportunities.

### Floodplain population

In 1999, a demographic survey was carried out in the Waza Logone region. This found that in rural areas of the floodplain there were 555 villages, each with an average of 41 households, and that each household was occupied by an average of 6 persons. The floodplain urban population was estimated at 60,000 persons, and the population growth rate 2.8%. By extrapolating these figures approximately 36,000 households or 219,000 persons would be living in the floodplain in 2002 (Table 11.4).

| | Households | People |
|---|---|---|
| Urban population | 11,769 | 70,614 |
| Rural population | 24,720 | 148,323 |
| Total | 36,489 | 218,937 |

*Table 11.4 Estimated floodplain population in 2002, extrapolated from a demographic survey carried out by the Waza Logone project in 1999.*

## 11.4 Valuation results: the economic benefit of re-inundation

*The economic benefits of flooding before 1979*

The economic value of flooding in the Waza Logone region before the construction of the Maga dam in 1979 (Table 11.5) refers to the original flooded area. These values had been extrapolated from per km$^2$ figures for re-inundation options, but excluded bee keeping benefits (this was only introduced after pilot flood release), and losses to millet and gum arabic production (these were not lost to original flooding).

Annual flooding originally inundated an area of 3,382 km$^2$, which is half of the entire Waza Logone floodplain. It was estimated that, pre-1979, the annual economic value contributed by this flooding was € 10,7 million a year, or € 3,160 per km$^2$ of flooded area (Table 11.5, Figure 11.4).

| | Total value (€ *1,000) | Value per unit area (€/km$^2$) |
|---|---|---|
| Pasture benefits | 6,075.1 | 1,800 |
| Fisheries benefits | 3,425.6 | 1,005 |
| Agriculture benefits | 705.9 | 215 |
| Grass benefits | 779.0 | 230 |
| Surface water supply benefits | 21.4 | 15 |
| Net benefit | 11,007.0 | 3,265 |

*Table 11.5 Economic value of flooding in the Waza Logone region (IUCN, 2002).*

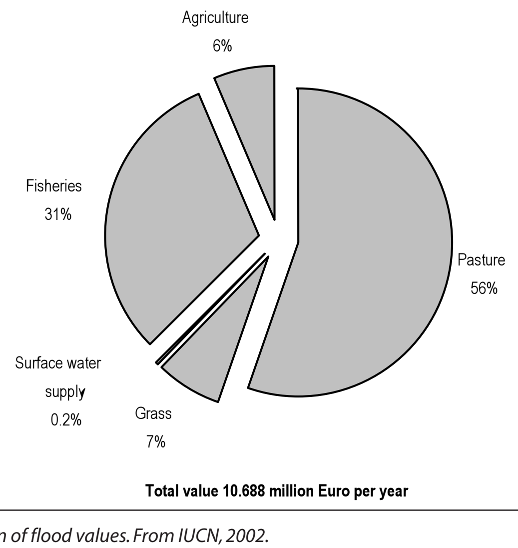


*Figure 11.4 Composition of flood values. From IUCN, 2002.*

This value is comprised of:

- *Pasture benefits.* Floodplain pastures, locally known are yaérés, provide important dry-season grazing resources in an otherwise dry area. From December onwards, when floodwaters have receded, the floodplain is used for pasture both by sedentary farmers and by nomadic and semi-nomadic pastoralists from other parts of the Extreme North Province of Cameroon and from neighbouring Nigeria and Chad. Prior to the loss of floods, it is estimated that some 200,000-300,000 head of cattle and 20,000-50,000 sheep and goats spent the long dry season in the floodplain (Wesseling *et al.*, 1994).
- *Fisheries benefits.* The Waza Logone floodplain supports a large fishery, both in its main river channels and permanent lakes, and in flood-fed and seasonal creeks, ponds, depressions

and wetlands. The Grande Pêche commences at the height of the flood and lasts until January. As waters begin to rise and spread onto the floodplain in July, catfish are caught in shallow waters as they leave the rivers and pools where they have spent the dry season. By September, fishing camps have been set up in the floodplain and traps are set for the now widely dispersed fish. When floodwaters start receding, migrant fishermen from neighbouring areas join the fishery. Fishermen leave the floodplain just as the flood turns, for a short period of sardine (*Alestes sp.*) fishing in the main river channels, before returning to the floodplain again to set nets, barriers, traps and hooks for fish left in natural depressions and water courses isolated by the receding floodwaters. Once the full flood has receded, and most migrant fishermen have left, fish trapped in drying-up depressions are caught using dragnets and baskets. From February until the flood returns, the primarily subsistence-based Petit Pêche uses set nets, throw nets and hooks to catch fish remaining in the natural and artificial depressions that hold their water throughout the dry season (from De Iongh *et al.*, 1998).

- *Agriculture benefits.* A wide variety of crops are grown in the floodplain, including rainfed, irrigated and flood recession crops. Prior to the loss of floods, floating rice and floating sorghum, and flood recession sorghum were cultivated, and farmers also depended on natural floods to provide water to their fields.
- *Grasses benefits.* A variety of perennial grasses, founded in flooded areas, are harvested from flooded areas and used for thatching houses and constructing fishing baskets.
- *Surface water supply benefits.* The almost total lack of relief in the Waza Logone region means that floodwaters are spread and retained over a large area. The coverage of the floods, and the length of their retention, makes a significant difference to the presence of watercourses, waterholes, flooded depressions and small streams. The floods feed, and leave water in, these water sources, some of which last the dry season and others of which provide year-round water sources for wildlife, human and livestock use.

### *The economic costs of flood loss*

Since the construction of the SEMRY scheme, the inundated area of the Waza Logone floodplain was reduced by almost 30%, to less than 2,500 km$^2$. Almost all flood-related benefits declined, and some are in danger of being lost irretrievably. Flood loss has had devastating impacts on biodiversity and ecology, and on the livelihoods of the population that depend on floodplain resources. It was estimated that, since 1979, the annual economic costs incurred by flood loss exceeded € 2.5 million a year (Table 11.6), or € 2,670 per km$^2$. For the period 1979-2003 this translates to a loss of € 56.4 million in total, with a net present cost of just over € 21 million.

| | Total Loss (€ *1,000/yr) |
|---|---|
| Pasture losses | 1,402.5 |
| Fisheries losses | 498.5 |
| Agriculture losses | 340.0 |
| Grass losses | 304.9 |
| Surface water supply losses | 19.8 |
| Net cost | 2,565.7 |

*Table 11.6 Economic costs of flood loss in the Waza Logone region (IUCN, 2002).*

These costs include:

- *Loss of pasture.* After the construction of the SEMRY scheme, the dry season herd had reduced to just under 80,000 TLUs, grazing an area of approximately 1,200 km$^2$. Most pastures in the formerly flooded area had lost their perennial grass cover, leaving degraded lands dominated by annual grasses of inferior quality and smaller area, which were unsuitable for sustained dry season grazing.

- *Loss of fisheries.* Loss of flooding had major impacts both on the Grande and Petit Pêches, and reduced the length of the fishing season, area utilised, total catch and productivity. It has also affected fish breeding and migration, further exacerbating the decline in fisheries. It has been estimated that, after the construction of the SEMRY scheme, fish yields in flooded wetlands declined by up to 90% (Wesseling *et al* 1994).
- *Loss of agriculture.* Much of the potential for floating rice and floating sorghum, and flood recession sorghum, was lost when flooding was reduced, as well as the use of water for various types of naturally irrigated crops.
- *Loss of grasses.* Since flood loss, perennial grasses have reduced substantially and are being replaced by annual grass species that are unsuitable for thatch and basket construction.
- *Loss of surface water supplies.* Loss of flooding has resulted in the disappearance of a number of permanent and temporary waterholes, ponds and watercourses (IUCN, 1999b). Water shortage has become especially acute in dry seasons.

### *The incremental benefit of floodplain re-inundation*

Pilot flood releases were effected in 1994 and 1997, and inundated an additional area of 200 km$^2$ of the floodplain (see above). These led to demonstrable recoveries in floodplain flora and fauna, and were welcomed by local populations. Data gathered after the pilot releases permitted the economic value added to the floodplain economy by these actions to be calculated. Pilot flood releases were estimated to have restored floodplain generated goods and services to a value of some € 872,000 a year more than those available under the reduced flood regime, and added a value of € 4,360/km$^2$ (Table 11.7).

| | **Incremental net benefit (€ *1,000 /yr)** |
|---|---|
| Pasture benefits | 291.2 |
| Fisheries benefits | 224.7 |
| Agriculture benefits | 151.8 |
| Grass benefits | 194.2 |
| Bee keeping | 0.9 |
| Surface water supply benefits | 8.7 |
| **Net benefit** | **871.5** |

*Table 11.7 Economic benefits of pilot flood releases (IUCN, 2002).*

It was intended that further restoration of the previously inundated area would be achieved by constructing engineering works which would allow flood release from Lake Maga and its associated water courses. The three re-inundation options identified for the Waza Logone floodplain (see above, Section 11.2) were predicted to generate additional economic benefits over the reduced flood regime of € 2.72 million for Option X - maximum flooding, € 2.15 million for Option Y - middle flooding and € 1.45 million for Option Z - minimum flooding. This equates to € 3,140/km$^2$, € 3,125 /km$^2$ and € 3,018 /km$^2$ respectively for the three re-inundation options (Table 11.8). Pasture, fisheries and agriculture accounted for the major proportion of value added in all three cases (Figure 11.5).

| | Incremental net benefit of re-inundation | |
|---|---|---|
| | Total (€*1,000/yr) | Per unit area (€/km$^2$/yr) |
| Option X | 2,723 | 3,140 |
| Option Y | 2,150 | 3,125 |
| Option Z | 1,447 | 3,018 |

*Table 11.8 Economic benefits of reinundation (IUCN, 2002).*

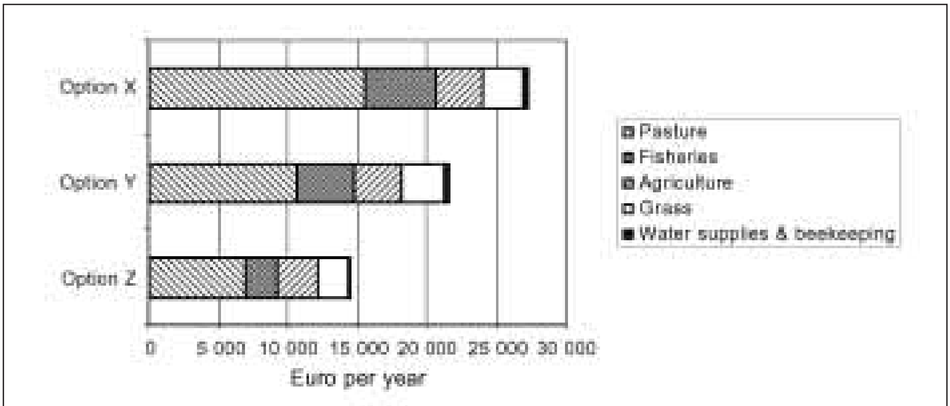


*Figure 11.5 Composition of incremental benefits of re-inundation (IUCN, 2002).*

### *Economic assessment of flood release measures*

Including the physical costs of implementing re-inundation measures as well as the additional economic costs associated with flooding, it was possible to assess the incremental costs and benefits of re-inundation. It was estimated that re-inundation measures will require initial investments of € 12 million (Option X), € 7.7 million (Option Y) and € 1.4 million (Option Z) to be incurred over the first five years (Table 11.9), and maintenance costs thereafter. Incremental flood-related benefits (and costs) will gradually increase as flooding is re-established and floodplain resources are restored (Figure 11.6), reaching full values in each "*average*" year of € 2.4 million (Option X), € 1.9 million (Option Y) and € 1.2 million (Option Z).

| | Physical costs of re-inundation (€ over 5 years) | | Incremental net benefits of re-inundation (€/yr) | |
|---|---|---|---|---|
| | Total (*1,000) | Per km$^2$ | Total (*1,000) | Per km$^2$ |
| Option X | -12,012 | -3,140 | 2,475 | 13,858 |
| Option Y | -7,719 | -3,125 | 1,901 | 11,235 |
| Option Z | -3,495 | -3,018 | 1,227 | 7,302 |

*Table 11.9 Incremental benefits and costs of reinundation options (IUCN, 2002).*

Option X - the maximum flooding option, would clearly result in the highest level of net benefits added to the floodplain economy, but also incurred the highest costs to implement. Option Z - the minimum flooding option, while the cheapest option to implement, would add a considerably lower level of net benefits to the floodplain economy. Option Y - the middle option, incurred costs and generated benefits at levels between these two extremes.

Discounting future streams of incremental benefits and costs over time indicated that all three options for re-inundation were economically desirable at a 10% discount rate, and all show a positive benefit:cost ratio. Option X had the highest net present value and benefit:cost ratio (€ 8.2 million and 10 million), followed by Option Y (€ 7.7 million and 9.3 million), and Option Z has the lowest net present value and benefit:cost ratio (€ 6 million and 7.1 million).

## 11.5 Sensitivity analysis and key assumptions

Valuation of the incremental economic benefits added from re-inundation was based on a large number of assumptions, and thus could only ever be partial and present rough estimates. In economic analysis, it is standard practice to test the robustness of results to changes in key variables, in order to present a more confident assessment of the desirability of a project. For this reason, the predicted benefits and costs of flood release measures had been subjected to sensitivity analysis, to assess how they would be affected by changes in discount rate, levels of benefits, flooding coverage and climatic conditions:

- *Changes in discount rate.* The application of a discount rate to bring future streams of costs and benefits to comparable present values has conventionally been a key element of economic cost-benefit analyses. It is however important to note that discounting gives relatively more weight to values that accrue in the early years of a project, and relatively less weight to values, which accrue further in the future. For the case of the re-inundation of the Waza Logone floodplain, all of the heavy investment costs of the project were incurred in the first five years, and flood-related environmental economic benefits accrued slowly over time. This is typical of environmental conservation projects.

  This phasing of benefits and costs meant that there was a danger that the results of conventional cost-benefit analysis would under-emphasise the (long-term) environmental benefits of flooding, and over-emphasise the (immediate) physical costs of re-inundation measures. Although it is generally agreed that environmental projects should be subject to the same types of economic analysis as any other project or sector of the economy, it is worth noting that applying a zero discount rate to the case of re-inundation of the Waza Logone floodplain generated both a much higher net present value, and showed a much greater differentiation in the net present values of different re-inundation options (Table 11.10).

| | NPV for incremental costs and benefits of re-inundation (€ million) | | | | | |
|---|---|---|---|---|---|---|
| | Discount rates | | | | | |
| | 0% | 5% | 6% | 10% | 12% | 15% |
| Option X | 34.67 | 16.75 | 14.54 | 8.28 | 6.22 | 3.99 |
| Option Y | 29.04 | 14.60 | 12.80 | 7.67 | 5.96 | 4.09 |
| Option Z | 20.47 | 10.75 | 9.51 | 5.99 | 4.80 | 4.08 |

*Table 11.10 Sensitiviy of results to change in discount rate (IUCN, 2002).*

  The base discount rate applied in this study was 10%, because this figure was thought to best represent the opportunity cost of capital in Cameroon. Analysis of the sensitivity of results to higher discount rates showed that all values were robust, and continued to display a net present value (Table 11.10). It is however notable that at much higher rates (15% and above), Option Y (rather than Option X) became a slightly more economically desirable re-inundation option, while Option Z consistently remained the least desirable.

- *Changes in the value of key benefits.* Although based on real data, recorded after pilot flood releases, valuation relies on a large number of assumptions and extrapolations. The bulk of the economic value of re-inundation - between 88% (Option X) and 84% (Option Z) of total benefits - is also accounted for by three benefit streams: pasture, fisheries and agriculture. Sensitivity analysis shows that results are however robust to changes in the value of these key benefits, showing little change in (and consistently positive) net present values, even when benefits are assumed to decline by a quarter (Table 11.11).

**Option X**

| | NPV @ 10% for incremental costs and benefits of re-inundation (€million) | | |
|---|---|---|---|
| | Pasture | Fish | Rice |
| Increase 25% (NPV 10%) | 17.21 | 15.41 | 15.20 |
| Increase 10% (NPV 10%) | 15.61 | 14.89 | 14.80 |
| Increase 5% (NPV 10%) | 15.08 | 14.73 | 14.68 |
| Decrease 5% (NPV 10%) | 14.01 | 14.38 | 14.41 |
| Decrease 10% (NPV 10%) | 13.48 | 14.19 | 14.28 |
| Decrease 25% (NPV 10%) | 11.88 | 13.67 | 13.89 |

**Option Y**

| | NPV @ 10% for incremental costs and benefits of re-inundation (€million) | | |
|---|---|---|---|
| | Pasture | Fish | Rice |
| Increase 25% (NPV 10%) | 14.67 | 13.52 | 13.46 |
| Increase 10% (NPV 10%) | 13.55 | 13.10 | 13.06 |
| Increase 5% (NPV 10%) | 13.17 | 12.94 | 12.93 |
| Decrease 5% (NPV 10%) | 12.42 | 12.65 | 12.67 |
| Decrease 10% (NPV 10%) | 12.06 | 12.52 | 12.53 |
| Decrease 25% (NPV 10%) | 10.93 | 12.07 | 12.13 |

**Option Z**

| | NPV @ 10% for incremental costs and benefits of re-inundation (€million) | | |
|---|---|---|---|
| | Pasture | Fish | Rice |
| Increase 25% (NPV 10%) | 10.75 | 9.91 | 10.09 |
| Increase 10% (NPV 10%) | 10.02 | 9.68 | 9.74 |
| Increase 5% (NPV 10%) | 9.77 | 9.60 | 9.63 |
| Decrease 5% (NPV 10%) | 9.27 | 9.44 | 9.41 |
| Decrease 10% (NPV 10%) | 9.02 | 9.36 | 9.28 |
| Decrease 25% (NPV 10%) | 8.29 | 9.13 | 8.95 |

*Table 11.11 Sensitivity of results to changes in key benefits (IUCN, 2002).*

- *Changes in flooding conditions.* The analysis was based on detailed studies carried out on estimates of flooded area, floodplain hydrology and climate (IUCN, 1999b; Mott MacDonald, 1999; Wesseling *et al.*, 1994). Future predictions of flood extent and impacts, and of climatic conditions, were only hypothetical. Analysis of the sensitivity of the outcomes to changes in the incidence of "good", "average" and "bad" years, to changes in the extent of flooding and to the level of floodplain benefits yielded, however showed that even for "worst case" scenarios (all years were "bad" in terms of flooded area, floods failed completely every 5 years, and key benefits decreased by 15% every year), results stayed positive (Table 11.12). It should be noted that for these worst case scenarios, Option Y (rather than Option X) became the most economically desirable re-inundation option, and in the absolutely worst case scenario Option X became the least desirable.

| | NPV @ 10% for incremental costs and benefits of re-inundation (€million) | | |
|---|---|---|---|
| | All bad years | All bad years and floods fail every 5 years | All bad years and floods fail every 5 years, and key benefits decrease by 15% |
| Option X | 4.97 | 3.54 | 1.60 |
| Option Y | 5.27 | 4.18 | 2.62 |
| Option Z | 3.26 | 2.70 | 1.74 |

*Table 11.12 Sensitivity results to changes in flooding conditions (IUCN, 2002).*

- *Other major unknown factors.* It is impossible to predict the future with absolute certainty. Many variables and conditions may change if re-inundation takes place, including those, which are unrelated to flooding and exogenous to the floodplain region itself. Two key assumptions could however prove critical to future cost and benefit flows, and to the economic desirability of re-inundation. One is the assumption that the use of floodplain resources is maintained within sustainable levels. Benefits estimated in this study had been cross-checked with available information, and all appeared to be within sustainable yields and carrying capacities. There is however a danger that as floodplain resources are restored, use may increase to unsustainable levels. The possible influence of re-inundation and floodplain restoration on population and demography was also unknown. Flood release may lead to an influx of population into the floodplain, or a concentration of the existing population. Although this would primarily affect the distribution, not the overall level, of flood-related benefits, it could have impacts on the sustainability of resource use.

A possible positive, but largely unknown, impact of re-inundation measures is their benefit in protecting areas downstream from the SEMRY scheme. Re-inundation involves widening the Mayo Vrick canal. This would help to protect crops, houses, roads and other infrastructures in and downstream from the SEMRY scheme from the overflow or breaching of Lake Maga during extreme rainy seasons. This was a major economic benefit from re-inundation, which had not been calculated in the valuation study. In theory it was possible to do this, using the damage avoided approach to valuation. This would require estimating the value of downstream agricultural production and infrastructure, and relating this to the frequency of high floods/extreme rainfall.

## 11.6 Conclusions: economic arguments for re-inundation

Flooding provides a vital source of support to the fragile ecology and economy of the Waza Logone region. The high and wide ranging economic costs associated with flood reduction that had been felt seriously eroded rural livelihoods and the regional economy. These are costs that neither the Government of Cameroon, nor the local population, can afford to bear over the long-term.

- Under full floods, the Waza Logone floodplain generated annual benefits worth about € 11 million, € 90 per capita, or more than € 3,250 per km$^2$ of flooded area. Since the construction of the SEMRY scheme, dry season pasture, fish catch and productivity, flood farming, surface water availability, wildlife and a wide range of plant resources utilised by the floodplain population had all been reduced. One third of the rural population, or almost 8,000 households, have suffered losses of nearly € 2.5 million a year or about € 60 per affected household.

Controlled flood release measures have the potential to restore at least partially the floodplain to its former state, and would lead to significant and quantifiable economic gains - at regional, local and household levels. All of the three proposed options for re-inundation were economically desirable over the current situation of reduced floods. All generated added economic benefits that are far in excess of their costs.

- Flood release measures would cost between € 3-12 million to implement over a period of 5 years, and would thereafter generate incremental benefits of between € 1.4-2.7 million a year or € 3,050 per km$^2$ of land re-flooded. All of the re-inundation options identified had positive net present values over a 25 year period, of between € 6-8.4 million.

- The livelihoods of up to a third of the rural floodplain population, or 8,000 households, would be improved after re-inundation. On a per capita basis, this translated into up to € 53 added economic value per floodplain-dependent member of the population.

The economic benefits of different flood release options were commensurate with the area flooded and the degree of floodplain restoration they achieve. All of the proposed re-inundation options were robust in the face of possible future changes in flooding, climatic and resource use conditions. Even under the worst conditions, they continued to yield net economic benefits.

- The maximum flood release option generated significantly higher economic benefits, net present value and added value than the middle and minimum options, even though it was the most expensive to implement. All of the three re-inundation options showed consistently positive economic values when discount rates were increased, projected benefits were decreased, or proposed flooded area was reduced. Even under the "worst case" scenario, where flood coverage continuously corresponded to a "bad" year, floods failed completely on a regular basis, and benefits were 15% lower than predicted, all options remained economically desirable.

In addition to the quantified economic value of flood release, there were important non-monetary economic arguments in favour of re-inundation. Flood release would strengthen, diversify and restore many elements of the socio-economy of the Waza Logone region, and helped to contribute towards key economic and development goals of the Government of Cameroon.

- *Poverty and vulnerable groups*. Some of the most vulnerable groups in the Waza Logone region (such as women, unemployed, and nomadic pastoralists) rely on floodplain goods and services for their economic survival. Many of the goods and services provided by the floodplain are unavailable elsewhere, or unaffordable, for these groups. If floodplain resources continue to be degraded and lost, these groups stand to suffer the most.

- *Food security*. The Waza Logone region has only limited production possibilities, contains a large rural poor population, and faces climatically uncertain conditions. It is chronically vulnerable to food insecurity. Through providing essential (and sometimes irreplaceable) support to livestock production, fisheries and agriculture, flooding makes a major contribution to local food security.

- *Sustainable, diverse and stable livelihoods.* Regular floods ensure the stability of ecological and economic systems. Floodplain resources provide a wide range of economic goods and services that help to diversify local people's production base and livelihoods, meaning that they have many sources of fallback and security when particular sources of income and subsistence fail. Flooding reduces risk in a climatically and economically uncertain region. Especially, the presence of floods helps to reduce the impacts and severity of drought.

- *Future economic growth and prosperity.* Floods generate benefits that can be maintained over the long-term and used to provide for a range of future developments and sources of growth. This potential for sustained future economic prosperity has been reduced by flood loss, and some goods and services which are sources of possible future growth have been diminished or lost irretrievably.

- *Multiplier effects*. Every economic activity in the floodplain has a multiplier effect — for example income earned through fish supports many people in addition to the trader himself, tourism in the Waza National Park supports employment, hotels, restaurants and transport industries, livestock herds are used as a source of investment and a coping mechanism, and redistributed between pastoralist households in times of stress. The total economic benefit of floodplain resources, and the ultimate beneficiary population, is many times greater than that expressed in the valuation study.

The overall conclusion of this study was that the economic analysis provided strong support for investing in flood release measures in the Waza Logone region. Implementation of any of the proposed re-inundation options would lead to significant net economic benefits, and could be considered to be economically desirable over the current situation of reduced floods. On purely economic grounds, it was recommended that either Option X (generating the highest economic benefits, overall and relative to costs) or Option Y (the most robust option in the face of risk and uncertainty) should be implemented.

# Part VI
# Guidelines for Floodplain Management

# 12 Tools and Practices for Floodplain Restoration

By Mike Acreman and Jean-Yves Pirot

An important aspect of any development project is that the most successful practices are made into generic guidelines that can be implemented by other, similar projects. The Waza Logone project has not only generated substantial benefits for local communities and the regional economy, but it has also guided and further enhanced the restoration and management of floodplain wetland ecosystems throughout Africa and the developing world. In particular, the Waza Logone project has been instrumental in refining four sets of tools and practices: 1) principles of the ecosystem approach endorsed by the Convention on Biological Diversity; 2) key steps for ecosystem restoration; 3) managed flood releases, as recommended by the World Commission on Dams and the World Bank; and 4) guidelines for the sustainable management of Sahelian floodplains. These are described further below.

## 12.1 Implementing the ecosystem approach

The principles of the ecosystem approach have been endorsed by the Convention on Biological Diversity (CBD) in 2000 to provide guidelines for implementing integrated conservation and development projects. Practitioners have supplemented the principles with a series of steps allowing a better interpretation and implementation of these guidelines. Pirot *et al.* (2000) and Smith and Maltby (2003) have provided examples how the most important CBD principles can be implemented. The purpose of this section is to illustrate how the Waza Logone project in particular has practically applied some of the key CBD principles.

*The ecosystem approach: definition and principles*

*The **ecosystem approach** (as endorsed by CBD) is "**a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way**" (the three objectives of the Convention of Biological Diversity).*

*The ecosystem approach seeks to sustain the functioning of ecosystems and maintain ecological integrity. It requires recognition that the complexity and function of any particular ecosystem is heavily influenced by the surrounding systems. It recognises the heterogeneity of social and cultural factors affecting resource use. It also recognises that these will change over time. Thus management has to be flexible and adaptive. The ecosystem approach values the active role of humans in achieving sustainable management goals; therefore management needs to focus on the human as much as the physical influences on ecosystem functioning.*

*According to IUCN, this approach supports participatory planning guided by adaptive management to respond to the dynamic nature of ecosystems. In doing so, all stakeholders will be involved and local interests will be balanced against the wider public interest. It advocates the decentralization of management to the lowest appropriate level, to achieve greater efficiency, effectiveness and equity. Implementation also requires trans-boundary and cross-sectoral co-operation to achieve sustainable results.*

*The 12 following CBD principles support this strategy:*

1. *The objectives of management of land, water and living resources are a matter of societal choice.*
2. *Management should be decentralized to the lowest appropriate level.*

3. *Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.*
4. *Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context.*
5. *Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.*
6. *Ecosystems must be managed within the limits of their functioning.*
7. *The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.*
8. *Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.*
9. *Management must recognise that change is inevitable.*
10. *The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.*
11. *The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.*
12. *The ecosystem approach should involve all relevant sectors of society and scientific disciplines.*

The principles of the ecosystem approach put forward by CBD were never intended to become strict binding guidelines for management, and remain concepts promoting different ways of achieving the integrated management of land, water and living resources. The principles can be used as a flexible framework to ease decision making and management actions taking place in highly complex systems, and to challenge proactively the sectoral (conservation and/or development) approaches which have not delivered intended results. Therefore, it falls upon project managers to interpret the definition of the ecosystem approach in the light of regional, national or local circumstances, and apply the principles that seem to fit best with the context. Thus, the Waza Logone project has paid special attention to applying the following seven principles.

- **Management should be decentralized to the lowest appropriate level (2).**

From the outset the project has endeavoured to work with the natural resource users, their traditional leaders (as described earlier in this book) and professional organisations (fishers, herders, etc.). Municipalities were also involved in the planning and execution of the project. The production of the management plan for the Waza National Park and the planning and execution of the pilot floods required special exchange mechanisms leading to detailed consultations with (e.g.) target villages, affected people and user groups.

- **Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context (4).**

Disregarding this principle has allowed the construction of SEMRY II (and many other such schemes in Africa). The true economic costs of completely altering the hydrological regime of the entire floodplain had never been documented prior to building the dam. As reported in this book, the economic valuation of the traditional floodplain activities justify the maintenance and strengthening of traditional uses, and does not support full conversion of the ecological, social and economic systems. Had this study been available in the 1970s, an integrated approach would have been adopted to allow the construction of a smaller dam with much less impact on the functions and services of the floodplain (Braund, 2000).

The economic cost of flood loss since closure of the Maga dam in 1979-1981 has been estimated at € 2.4 million per year (Chapter 11). This valuation study underlined the positive economic impact of the 1994 and 1997 pilot flood releases. The study estimated this impact to be at a value of over € 800,000 per year due to the partial restoration of goods and services in the floodplain. Further recovery of the floodplain (from 115 to 215 $m^3$/sec) using the re-inundation options described in this book would generate an economic benefit of € 1.1 - 2.3 million per year. This translates into net present values of € 5.6 - 7.8 million, when investment and operation costs were taken into account.

Thus, knowledge of the economic context justifies further increases in the quantity of floodwaters. Should donors pursue this option, further analysis should seek to assess whether operational and maintenance costs can be internalised. The internalisation of the costs can be achieved by generating revenues from user groups, municipalities etc. who benefit from the floods. Most of these costs should, however, be borne by SEMRY as a compensatory measure for disrupting a highly productive system. Given the economic importance of the floodplain, at the very least at provincial level (if not at national level), one can only hope that regional and international development institutions will use this data to pursue a strong poverty alleviation and biodiversity conservation programme in the Extreme-North Province of Cameroon.

- **Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach (5).**

The intervention as a whole was initiated to restore ecosystem structure and functioning. The results achieved in only a few years of pilot floods proved that the initial, very ambitious project objectives were achievable. Those areas that remained without floods for almost 15 years, had regained its vegetation (especially the high value perennial grasses), the biodiversity in the floodplain improved and the quality of life of floodplain people is higher than before, after the pilot flood release brought back the floods to these areas.

- **Management must recognise that change is inevitable (9).**

The Waza Logone project is a restoration project; therefore the need to adapt management actions to ecological change, local perceptions and project capacity was clearly apparent from the outset. Project documents requested project implementers to follow a "*process approach*" to stress the fact that the project's logical framework should not be considered as a blueprint. To detect and discuss changes, a careful monitoring system was set in place, first and foremost in the field through establishment of a sampling grid to assess the changes in vegetation composition and cover in the floodplain. Second, detailed surveys and regular consultations were held with user groups of all kinds. Third, from a more strategic point of view, the project was guided through discussions held with, and decisions made by the stakeholders involved in the Provincial Project Steering Committee (headed by the Governor of the Extreme-North Province), through annual meetings with the project partners (headed by IUCN) and by triennial external evaluations commissioned by the donor; the latter two types of meetings both provided pertinent technical advice.

- **The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity (10).**

The project has initiated a process to upgrade the management of the Waza National Park and reduce conflicts in its entire buffer zone. Co-management agreements have been signed with communities in villages around the Park, and resource use activities such as fishing, honey gathering have been authorised. In return, local communities work with the Park authorities to make Park resources more secure from poaching.

The project also proposed management agreements that had been agreed upon by the user groups in the entire floodplain. Under these, farmers, fishers and cattle herders have agreed to contribute to planning, implementation and monitoring of development activities, as well as to protect resources from outsiders. Municipal authorities are responsible for the production of local development plans, which must respect the management agreements, while higher administrative authorities have agreed to monitor implementation of agreements and solve conflicts (Ngantou and Kouokam, 2000).

- **The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices (11).**

Substantial efforts have been invested in establishing close working relationships with user groups, traditional leaders at all levels, village elders and elected representatives of local communities. These have provided invaluable information on the floodplain ecology, hydrology, sociology etc., and resource use patterns, prior to the construction of the dam and immediately thereafter. Multiple partnerships with institutes and universities in Cameroon and abroad have allowed a large number of experts and students to contribute data to the knowledge base. This effort by the Waza Logone project to implement a detailed participatory research programme and learn from indigenous and local knowledge is in extremely sharp contrast with the minimum investments made in data collection by the proponents of the Maga dam and SEMRY II.

- **The ecosystem approach should involve all relevant sectors of society and scientific disciplines (12).**

Over the years, countless meetings took place in the field, in Maroua (the provincial capital), in Yaoundé (the capital city) or in Europe, to report on progress, discuss options and implementation processes, solve conflicts and strengthen existing or establish new partnerships. This has contributed to the building of a very strong coalition of project partners. Special social events have also been organised on a regular basis in the floodplain to celebrate the successful completion of some important activities, or the launch of a specific programme component. For example, the opening of the embankments along the Logone River in 1994, further enlarged in 1997, was celebrated with traditional boat races on the river. Capacity building, in all relevant fields and disciplines of ecosystem restoration and resource management, was provided to all partners, including local people, members of municipal councils and representatives of decentralised administrations.

An ambitious communication and environmental education strategy supported this wide-ranging coalition for floodplain rehabilitation, involving the production of a diverse range of material, for example newsletters, brochures, posters, video films and glossy picture books. This enabled the project to reach out to most segments of its constituency locally, regionally, nationally and internationally.

For its innovative communication approach and the positive impact on the people's livelihoods and the biodiversity of the floodplain, as clearly described for the public in the high-quality glossy picture book produced by Noray (2002), the project has received several international awards. The most prestigious award was the UNDP Equator Prize that was received at the occasion of the UN World Summit for Sustainable Development (held in Johannesburg 26 August – 4 September, 2002).

## 12.2 Key steps for ecosystem restoration

For further consideration by interested managers, this section provides a summary of the most important implementation steps followed by the Waza Logone project.

*Building the knowledge base*

The project made important investments in setting the scope and analyzing the situation prior to the initiation of the second project phase in 1992. This was followed by baseline studies to define the ecological and social niches of the project. In addition, the project has carried out a detailed environmental impact assessment of the dam and other development schemes established in the sub-catchment. To support the establishment of the monitoring scheme for the entire floodplain, the project has also produced indicator assessments. Several databases were established. In addition to the most recent and best available ecological, social and economic data, the project has gathered non-scientific forms of knowledge from indigenous and local communities.

### *Adopting an adaptive management approach*

Investments in the knowledge base has allowed the project to consider the impacts of previous development actions, thus allowing managers to consider flexibility and uncertainty as important parameters, and to seek reversible ways to adapt to change rather than to implement rigidly the agreed logical framework. Management was based on long-term objectives, but efforts were made to adopt indicators *i.e.* the "*floodplain grid*" for ecological parameters, which allowed analysis short-term changes due to the dynamic nature of floodplain ecosystems.

The project has also produced a Research Master Plan (Mvondo Awono, 2003) to drive new research investments. The project has also designed participatory planning in co-operation with local, user group committees, the Provincial Project Management Committee and the Scientific Committee for the Park. A detailed decision making process involving monthly, annual and triennial partner meetings and evaluations, has promoted in-depth discussions about what activities were needed to attain the project's objectives.

Last but not least, the project has adopted an ambitious communication programme to provide clear messages on conservation management and sustainable socio-economic benefits, to link partners and inform stakeholders of all project issues and strategies.

### *Working with stakeholders, partners and people*

The project has endeavoured to involve all relevant sectors of resource use in the floodplain (Kouokam and Ngantou, 2000; Sherbinin and Claridge, 2000). Users have guided the project through all the feasibility studies undertaken, further helping the understanding of the project on key issues such as the change in the vegetation cover, the reasons for the disappearance of floating rice, the migration routes of pastoralists. Most communities have been involved in project implementation. For example, the production of detailed topographic and hydrographical maps of the floodplain, the economic valuation studies and the planning and execution of pilot releases of water were carried out in close co-operation with the local communities. Local communities were involved in development activities as early as 1992, such as rain-fed rice improvement, installing grain mills and digging wells. Special efforts were made to initiate a detailed discussion process on co-management issues and practices, to strengthen sustainable use in the floodplain, as well as to solve acute conflicts between National Park authorities and local communities living in villages on the eastern boundary of the park (Kouokam and Ngantou, 2000). Local populations have also been included in all management committees, while all stakeholders, from grass root groups to the highest traditional authorities, have been part of the Provincial Committee for the restoration of the Waza Logone region. This sort of decentralisation of power to encourage stakeholder involvement and responsibility was from the outset a key feature of the project.

### *Promoting multi-sectoral and institutional co-operation*

Co-operation was established with a range of local, provincial, national and international partners, from both the development and conservation fields, to bring together both technical (ecosystem restoration) and political (poverty alleviation) agendas, and establishing a dialogue between communities and sectoral interest groups. A fruitful co-operation was established with the Lake Chad Basin Commission, the World Bank and the Global Environment Facility (GEF), which supported the project at international level.

*Solving conflicts*

From the outset, solving conflicts was an important goal of the project, given the tensions surrounding the management and law enforcement issues of the Waza National Park. A large number of conflict mitigation meetings took place in the floodplain to build stakeholder involvement in the project, to allow opposing parties to agree on principles for co-management, and to provide accurate and adequate information to stakeholders. Traditional leaders have played a key role in helping the project mitigate these conflicts and reach agreement on new management practices.

## 12.3 Managing flood releases

As exemplified by the Waza Logone project, many wetlands have been degraded and the livelihoods of local communities ruined by the construction and operation of dams that have prevented the periodic inundation necessary to sustain the ecosystem. In such cases floodplain restoration must involve some revitalisation of the hydrological regime. This issue was addressed by the World Commission on Dams that was established in 1998, to arbitrate in the increasingly acrimonious debate between the pro- and anti-dam lobbies that had raged over the previous 30 years. The Commission's report (WCD, 2000) concluded that dams have made an important and significant contribution to human development, but the social and environmental costs have, in too many cases, been unacceptable and often unnecessary. The WCD report also proposed the mitigation of negative impacts of existing dams, by implementing operating rules that reflect social and environmental concerns. The report includes recommendations to consider managed flood releases from dams to restore and maintain downstream wetland ecosystems and their dependent livelihoods. This was based on the results of a major study funded by DFID as part of the Commissions work programme (Acreman *et al.,* 2000) that paid particular attention to lessons learnt from the Waza Logone project. This work recognised the trade-off between using water for reservoirs or flood dependent livelihoods (Figure 12.1).

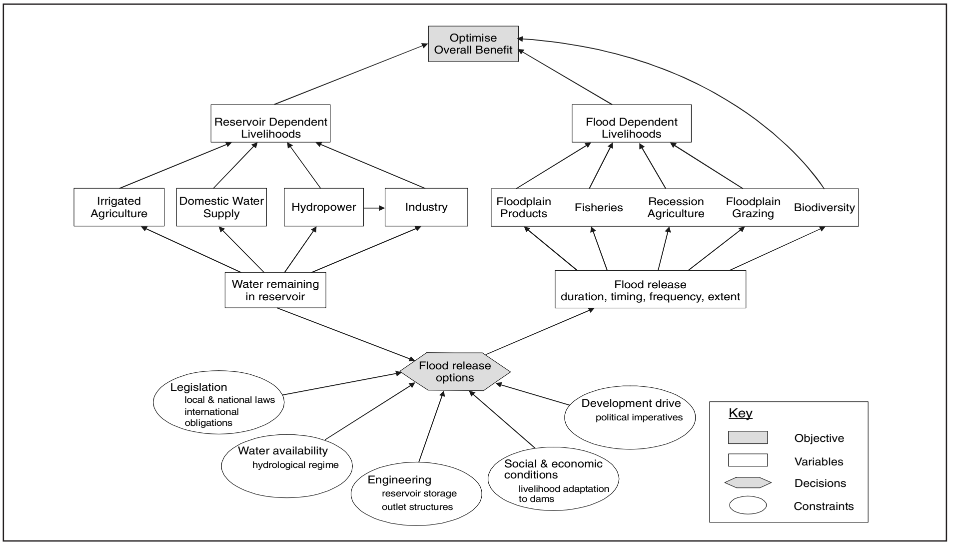


*Figure 12.1 Flow chart showing the trade-off between using water for managed flood releases and for reservoir based activities.*

A major output from the study was a set of guidelines for managed flood releases; designed as 10 steps within a strategic approach to the planning, design and implementation phases of a project cycle (Figure 12.2).

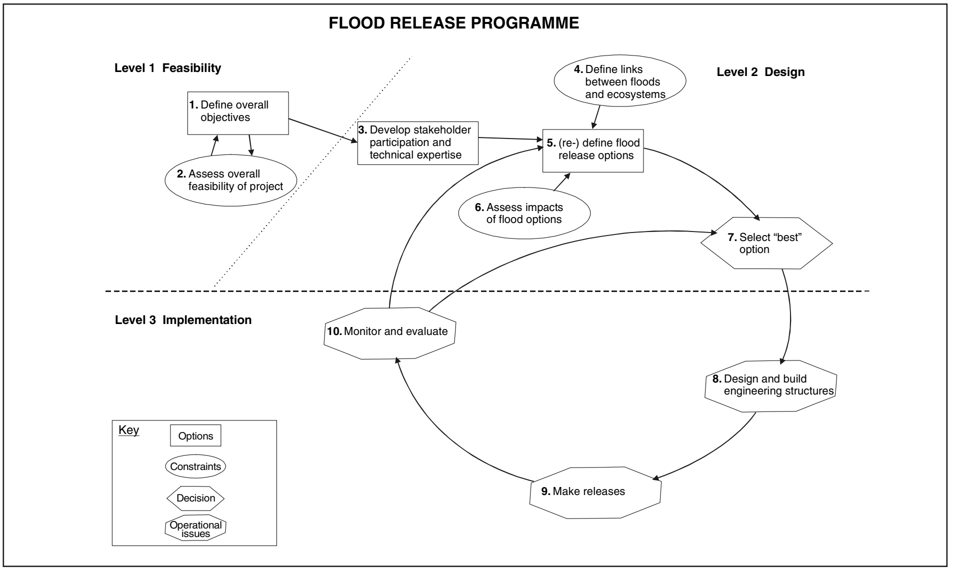


*Figure 12.2 A planning framework for managed flood releases.*

**Level 1 –** *Planning and feasibility*
**Step 1.** **Define overall objectives for flood releases.**
**Step 2.** **Assess overall feasibility.**

**Level 2 –** *Design*
**Step 3.** **Develop full stakeholder participation and technical expertise.**
**Step 4.** **Define links between floods and the ecosystem.**
**Step 5.** **Define flood release options.**
**Step 6.** **Assess impacts of flood options.**
**Step 7.** **Select the best flood option.**

**Level 3 –** *Implementation*
**Step 8.** **Design and build engineering structures.**
**Step 9.** **Implement releases.**
**Step 10.** **Monitor, evaluate and adapt release programme.**

These guidelines were adopted by the World Bank as good practice in dam management (Acreman, 2003). Within the guidelines, the Waza Logone project was adopted as one of the world's best examples of developing a flood release regime. The project included all of the 10 steps, although they were not necessarily carried out in the same order. Project activities have thus been used to exemplify the 10 steps to managed flood releases, as follows.

**Step 1. Define project objectives.**
The objectives were to restore the biodiversity and the livelihoods of communities who benefit from the natural resources of the floodplain through managed flood releases, whilst retaining sufficient water in the reservoir for intensive rice irrigation. These were defined through broad-level analysis of the degradation of the floodplain ecosystem and of the efficiency of the SEMRY irrigation scheme.

**Step 2. Assess overall project feasibility.**
Technical studies were undertaken to assess the capacity of the outlet structures of the dam, the channels leading from it and the river embankments. As the reservoir is shallow, thermal and chemical stratification was not a problem. In addition, the reservoir is "off-line" thus it does not control the entire flow of the river while sediment release was not an issue. Natural inundation of the floodplain resulted from a series of processes: (1) rain falling directly onto the floodplain; (2) runoff from local streams; and (3) flows in the River Logone exceeding the capacity of its channel.

**Step 3. Developing stakeholder participation and technical expertise.**
A participatory process was established with relevant national and local authorities, floodplain communities (using Participatory Rural Appraisal) and SEMRY management. Local interest groups, for example, on fisheries and small-scale rice farming were established within local communities. The intention was to establish a water committee with local community representatives, the SEMRY rice scheme managers, Waza National Park staff and local authorities. Technical expertise was developed in local institutions through involvement in the work of the project.

**Step 4. Define links between floods and the ecosystem.**
Detailed studies of the interaction between vegetation and flooding were undertaken. These showed the change from annual to perennial grasses with inundation over a three-year period. The surveys were continued as part of the pilot releases.

**Step 5. Define flood release scenarios/options.**
A hydrological model of the reservoir, the floodplain, the Logone River and local tributaries was constructed and used in conjunction with ecological and socio-economic models to define flooding options under dry, wet and very wet conditions

**Step 6. Assess impacts of flood options.**
A preliminary Environmental Impact Assessment of all flood options was undertaken. Studies of water-related diseases led to water supply (wells), sanitation (latrines) and hygiene awareness programmes, which led to reduced incidences of diarrhoea diseases. An assessment of the impact of re-flooding on the operation of SEMRY rice scheme was undertaken. Further studies of the health and environmental impacts of full flood options are planned.

**Step 7. Selection of the best flood option.**
Economic analysis was undertaken of various flooding options. The economic costs per year of flood loss were € 1,310,000 for loss of pasture, € 470,000 for loss of fishing and € 320,000 loss of agriculture. The maximum re-flooding option for the 867 $km^2$ of floodplain would yield annual benefits of € 2,300,000, which translates to a net present value of € 7.8 million when investment and operation costs are taken into account.

**Step 8. Design and build engineering structures.**
Changes to the embankments along the main river and channels feeding the floodplain with water were planned and implemented in collaboration with local communities. Modifications to the outlet structures of the dam were not required. No embankments were necessary to protect the SEMRY rice scheme from flooding.

**Step 9. Implement releases.**
Pilot flood releases were started in 1994. After three years of studies of the responses of the ecosystems and many discussions with local communities on the impact of pilot floods, the releases were enhanced in 1997. This level of flood release is being maintained today, whilst financing is being sought for the full flood release option.

**Step 10. Monitor, evaluate and adapt release programme.**
For the pilot releases, hydrological, ecological, sociological and economic monitoring was established to assess the impacts of flood. Results were used to refine the models and flooding options. Monitoring is being continued.

*Photo12.1 Opening of the dyke along the Logone in November 1997 by the Waza Logone project to implement managed flood releases (Photo IUCN).*

## 12.4 Guidelines on Sahelian floodplain management

The Waza Logone floodplain is typical of the floodplains of Sahelian West Africa, both from a biophysical perspective and with regard to the issues faced by the people who live there. The Waza Logone project thus provides an excellent example of the problems and solutions to the sustainable management of Sahelian floodplains.

Over the past 20 years there has been increasing recognition of the need for improved and sustainable management of water and other natural resources, through integrated planning of river basins and their floodplains. In Sahelian West Africa, experience of fully integrated planning and management has been limited. Whilst expertise exists in many sectors, most specialists had undergone only specialist training and had little interaction with other sectors. Consequently, few have acquired the breadth of knowledge over a wide range of issues needed for a truly integrated approach.

To build the capacity of institutions in the region, to plan and manage floodplain resources sustainably, IUCN established the Sahelian Wetlands Expert Group (SAWEG) in 1992 with financial support from the Government of the Netherlands (Acreman, 1996a). This network brings together floodplain specialists including hydrologists, water engineers, biologists, pedologists, planners, human and animal health experts, ecologists, sociologists and legal experts from Mauritania, Senegal, Mali, Niger, Chad, Burkina Faso, Gambia, Nigeria and Cameroon. Many organisations are represented including universities, research institutions, government departments and river basin development authorities, such as the Niger Basin Authority (ABN), the Organisation pour la Mise en Valeur du fleuve Sénégal (OMVS), the organisation pour le Mise en Valeur du fleuve Gambie (OMVG), the Lake Chad Basin Commission (LCBC) and the Hadejia-Jama'are River Basin Development Authority.

It was agreed that SAWEG would be action-oriented and that different sub-groups would be selected to undertake different projects in the form of task forces, which could be disbanded, if necessary, when the product was complete (Acreman, 1996b). In the early days of the network, it was felt that there was a need to produce guidelines for the sustainable management of Sahelian floodplains (SAWEG, 1999). This publication brings together wide experience of the issues, problems and solutions to floodplain management. The experience gained in the Waza Logone project became a central part of the guidelines.

The information below provides a summary of the guidelines presented in the publication "*Towards the sustainable management of Sahelian floodplains*" prepared by the IUCN Sahelian Wetlands Expert Group (GEPIS, 2000). These guidelines constitute a mechanism for effective international co-operation to share information and experience on how to use water and aquatic ecosystems sustainably. They are also intended to help contracting parties to the Ramsar Convention implement Article 5, which requires them to: *"... co-ordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna... especially in the case of a wetland extending over the territories of more than one Contracting Party"*.

It is not intended that these guidelines provide an unambiguous recipe for successful management. Rather they aim to provide a framework within which the issues of individual river basins and their floodplains can be set. The following section highlights in a concise way the major principles and actions from the guidelines that are related to activities in the Waza Logone project. In many cases, the guidelines were developed from the experience of the project. The guidelines cover five areas of management: A. Planning a sustainable management programme for Sahelian floodplains; B. Implementation; C. Awareness building, institution strengthening and training; D. Financing of floodplain development; E. Policy.

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## A. Planning a sustainable management programme for Sahelian floodplains.

Planning provides a structured way of solving problems and achieving objectives. It involves viewing the floodplain and its catchment as a single system, which has economic, social and environmental components that interact. The steps involved in planning are:

**1. Bring together key stakeholders.**

- Bring together all stakeholders and develop a process of participation, not just consultation.
- Have each stakeholder define his/her core interest rather than a rigid viewpoint.

**2. Collate available information.**

- Develop a data collection strategy and collect information *e.g.* hydrology, vegetation, soils.
- Identify traditional floodplain uses, e.g. recession agriculture, grazing.
- Establish a data management strategy and set up databases.
- Involve local communities in data collection, especially on local traditional knowledge.
- Publish summary information and circulate copies widely.

**3. Analyse information.**

- Quantify floodplain ecosystem functions.
- Determine health status of people and animals, hot spots and trends.
- Prepare results that are comprehensible to non-specialists.
- Establish research programmes to address unanswered questions.

**4. Define a range of development options.**

- Involve all stakeholders.
- Define a range of development options.
- Promote restoration of sites whose value has been degraded.

**5. Assess the impacts of options.**

- Establish compatibility of proposed activities.
- Undertake environmental impact assessments on all options.
- Assess health and social implications.

**6. Make decisions.**

- Consider who benefits and who loses from an option.
- Favour multiple uses against single sector projects.
- Favour projects that permit sustainable use of floodplains.

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## B. Implementation

Preferred development options should be implemented through the following principles and guidelines.

**1. Principles for implementation**

- Incorporate the various elements of the river basin's ecosystems into the implementation.
- Underpin decisions with the best science and technical advice.
- Include representatives of community groups, especially women in project implementation.

**2. Guidelines for implementation**

- Develop an adaptable and flexible management style.
- Establish an effective monitoring and evaluation framework to track the progress of projects.
- Develop indicators of progress and of environmental change in the project area.
- Define clearly the responsibilities of involved institutions.

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## C. Awareness building, institution strengthening and training

**1. Building awareness for integrated floodplain management.**

- Promote the building of awareness at all levels.
- Develop and implement clear communications strategies.

**2. Strengthening institutions' capacity in integrated floodplain planning and management.**

- Develop NGO capacity to contribute to effective decision making and project development.
- Establish stakeholder groups to permit input to policy development, planning and implementation.
- Ensure adequate resources for agencies and other institutions for wetland conservation.

**3. Training and educating for effective floodplain planning and management.**

- Develop technical expertise.
- Train staff in functions and values of floodplains

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## D. Financing of floodplain development

**1. The financial strategy**

- Diversify sources of income so as to reduce risk.
- Develop alternate financial strategies in the planning phase of the process.

**2. Financing from foreign and domestic sources.**

- Maintain awareness of international guidelines, such as OECD, that influence investment.
- Work with donors and recipient governments on debt-relief arrangements in support of sustainable floodplain management programmes.
- Develop innovative funding mechanisms, such as debt-for-nature swaps.

**3. Financing from the private sector.**

- Develop partnerships between the private sector and government institutions to ensure that foreign, domestic and private investments in floodplain or wetland resources management are sustainable.

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## E. Policy

**1. Integrated Wetlands and Water Resources Management**

- Implement the Dublin principles[1] and Chapter 18 of Agenda 21 of the "Earth Summit", the United Nations Conference on Environment and Development, Rio de Janeiro, 1992.
- Further develop the process of Integrated Water Resources Management (IWRM).

**2. National Wetland (or Floodplain) Policies**

- Implement the wise-use concept promoted by the Ramsar Convention.

## 12.5 Conclusion

This chapter illustrates that the Waza Logone project not only provided substantial benefits to the local communities and the regional economy, but the experience of the project has also significantly contributed to move the global development forward. The project provided an example of the sound practice to integrate ecosystem conservation and sustainable development. In particular the project has guided the thinking within global institutions including the World Bank, the Convention of Biological Diversity, the World Commission on Dams and IUCN itself. This project found a mechanism for effective international co-operation and the transfer of knowledge and experience to other projects, by influencing politics, academic thinking and on-the-ground practice concerning the integrated and sustainable use of water and aquatic ecosystems. In this way, the Waza-Logone project has had an important impact beyond the floodplain, beyond Cameroon and beyond Africa.

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[1] Four principles were provided in 1992 in Dublin. They were the basis for the Rio Agenda 21 and for the millenium Vision-to-Action. The four principles are:

[1] Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment. i.e. one resource, to be holistically managed.

[2] Water development and management should be based on a participatory approach, involving users, planners, and policy-makers at all levels i.e. manage water with people - and close to people.

[3] Women play a central role in the provision, management and safeguarding of water.

[4] Water has an economic value in all its competing uses and should be recognised as an economic good, i.e. having ensured basic human needs, allocate water to its highest value, and move towards full cost pricing rational use, and recover costs.

# 13 Towards Sustainability

By Jean-Yves Pirot and Mike Acreman

Over the past ten to twelve years the Waza Logone project has brought about major improvements in the biodiversity of the floodplain and, hence, ameliorated in the livelihoods of its inhabitants. As explained in Chapter 12, the experience gained by the project has also contributed to formulating guidelines for the restoration and management of floodplain ecosystems throughout Africa and the developing world. Whilst it is important to disseminate these achievements, we must not become complacent. To attain sustainable use of the floodplain in the future, there are many management actions than can still be developed or improved. Further research is needed to ensure that actions are based on information that has been collated according to sound scientific principles. This includes collecting more data on hydrology, ecology and socio-economic aspects of the floodplain. Capacity building of local institutions needs to continue and the government must remain committed to sustainable management. These proposals, and more, are expanded on below.

## 13.1 Management and research priorities

Many of the large-scale irrigation schemes undertaken in the 1960s used a "top-down" approach ignoring traditional knowledge that was acquired by local communities over several generations. Possibly some farmers supported the construction of the Maga dam in the 1970s, since the perception was that a dam always offered a more secure pattern of floods, which in turn makes floodplain farming more attractive. However, the long-term effectiveness of irrigated farming was grossly overestimated, while the impact of the Maga dam on downstream ecosystems, water resources and livelihoods was hardly taken into account.

Many studies have highlighted the poor performance of large-scale irrigation schemes in Africa, and in the Lake Chad Basin in particular (see Barbier *et al.* 1991, for their analysis or the nearby Komadugu-Yobe Basin, northern Nigeria). This is mainly due to the low rates of internal return upon investments and large (often-unplanned) operating costs. Fortunately, the poor performance of many large-scale irrigation schemes and their many environmental, economic and social problems has been countered by the growing recognition of the importance of floodplains. A re-evaluation of the most appropriate strategies for the development of Africa's water resources and floodplains is now required.

Since environmentally sound and sustainable water resource management must be achieved, a new approach to water resource development must influence future management scenarios for the Waza Logone floodplain. However, the development of strategies for the sustainable management of the floodplain will require the continued commitment from governments, as well as on-going co-operation with a wide range of specialists for additional scientific knowledge, and, ultimately, financial support to implement decisions and management strategies.

### *Improving knowledge*

Future management decisions require further research on the responses of flora and fauna to changes in the flooding regime. Further research is also needed into the social and institutional dimensions of floodplain management. The Biosphere Reserve status given to the Waza National Park also requires that research must be carried out inside this protected area.

From this premise the Waza Logone partners, led by the Centre for Environment and Development in Cameroon (CEDC), have drafted a comprehensive research master plan (RMP) for the floodplain (Mvondo Awono, 2003) in the period 2000-2003. The RMP was developed to reach agreement on the strategy to follow to both strengthen and diversify the research carried out in the area. Key priorities for research is:

- **Hydrology**
  Of paramount importance is to predict the responses of flora and fauna on the different hydrological scenarios, both natural and man-induced; to assess the sedimentation rate of Lake Maga; to study groundwater recharge in the floodplain; and to assess the size of environmental flows required for adequate ecosystem functioning.

- **Biodiversity and natural resources dynamics**
  Biodiversity is high in the restored floodplain. Therefore, a better knowledge of natural resources dynamics in relation to hydrology and exploitation by communities is obligatory. This will require research on the ecology of flagship species, on key parameters governing wildlife productivity and population dynamics, and on optimum stocking and grazing rates in the most important areas of the floodplain.

- **Economic development, social dynamics and governance**
  Floodplain users also have highly diverse cultural characteristics, origins and socio-economic "niches", which makes social research a challenging endeavour. Subjects for scrutiny include the study of social dynamics and the understanding of lifestyles and practices of the different user groups (farmers, fishers, and pastoralists). Further detailed floodplain valuation studies are needed. Indicators for poverty alleviation must be produced. Adequate mechanisms for improved governance should also be established.

- **Environmental impacts**
  The impacts on the floodplain of human activities in the basin outside of the project area need to be understood. Studies on industrial pollution and pollution resulting from local chemical use (*i.e.* fishers using pesticides and other lethal chemicals as part of their processing practices) are also urgently needed.

- **National Park management**
  The National Parks (Waza and Kalamalue) are special land use entities that offer a broad spectrum of subjects for research and education. Promising areas for research include defining biodiversity monitoring methodologies and understanding key characteristics of important wildlife habitats and the impact of human activities on some important park resources (e.g. fish, gum arabic, straw). The main factors responsible for conflicts between people and wildlife, and people and park authorities, must be clarified.

For these five research areas the RMP provides detailed information on the short, mid- and longer-term research priorities. Short-term priorities are targeted at solving urgent conservation issues, mid-term priorities at strengthening conservation and development planning, while longer-term research will aim at furthering our understanding of ecosystem processes.

This research programme needs a collaborative effort of local and international scientists, authorities, institutions and the people of the floodplain. If achieved, the results will provide a sound scientific foundation for future decision-making and actions in the floodplain, on which to build a sustainable environment for people and wildlife.

*Strengthening management and planning*

Managers need to be adequately informed in order to make appropriate decisions. A major problem in many basins in sub-Saharan Africa is the lack of effective hydrometric networks, while at the same time huge investments are made in infrastructure for irrigation (which, according to World Bank statistics, sometimes exceed a capital investment of 15,000 per hectare). Management and planning capacities are strengthened by:

- **Up-grading data collection.**
  Given that in the past, collection of hydrological data in the area has been inadequate (and to a large extent continues to be so), the hydrometric network on the Logone River should be maintained or rehabilitated, and the relevant hydrological data collected, managed in appropriate databases and analysed. To expand further the area under flooding, and to allow for proper development planning, suitable topographic maps should be made available. Ground-based information needs to be complemented by data from remote sensing by aircraft and satellite, so that data from particular sites can be scaled up to the size of the Waza Logone floodplain. This will enable detailed maps to be made of, for example, the extent, volume and depth of floodwater and resulting vegetation patterns. This information will provide the basis for sound planning and management of the area.

- **Strengthening hydrological management.**
  There is great potential for intensifying the land use in the Waza Logone floodplain through the implementation of relatively low-level irrigation projects. Such projects can produce over five times more per hectare, and infinitely more per unit of water used, than the formal irrigation schemes (Barbier, 1993). There is also scope for traditional floating rice or sorghum cultivation in flood-prone areas, support towards traditional flood-recession agriculture, and implementation of sustainable small-scale fisheries activities.

  Given the fact that the Maga reservoir is grossly oversized, the floodplain could sustain much larger floods than those currently implemented through the openings made in the Logone River levees. This would ensure maximum spread of available water over the largest possible area. However, apart from widening existing breaks in these levees, more water could only be made available through the rehabilitated sluice-gates on the Vrick channel (see Chapter 10), to ensure that managed flood releases would coincide with high in-flows from the Logone River. Such a strategy would provide for a more equitable distribution of water resources over a large area, by providing more water each year, and would result in a larger flow of water into the Waza National Park.

  The project has carried out initial studies indicating that the provision of additional, artificial, sustained flooding through restoration of the main sluice gate on the dam and the Vrick channel would be both feasible and cost-effective in the long term.

- **Designing communal and village management plans.**
  Clearly, pilot releases implemented from 1994 onwards have brought significant benefits to both floodplain communities and wildlife. They have also triggered a regional process of immigration (Pires, 1998; Scholte, 2003) whose impact upon natural resources could be both important and insoluble, if people continue to move onto the restored floodplain. This phenomenon is poorly documented, and research must be carried out to gain a better understanding of the likely impact of an increased population upon limited water resources and upon wildlife, especially the wild animals that live in and around the Waza National Park. Immigration could have highly detrimental impacts upon biodiversity in the floodplain and beyond.

One of the most promising options to mitigate the impact of immigration, together with implementation of the new management plan for the Park, is to improve the management of village or communal lands ("*terroirs*") with a view to strengthen household economies and control unsustainable resource use. Resource users in the restored areas, as well as in the buffer zone around the Park, can design and implement both development and conservation activities on their traditional lands, within the context of a carefully zoned scheme. This would contribute to relieving human pressures on the greater floodplain (for example in the area covered by the communes of Maga, Waza and Zina) and serve as a model to upgrade the efficiency of farmers, pastoralists and fishers.

One of the most visible successes of restoration is the (re-)development of floodplain fishing activities. However, over-fishing may soon lead to depletion of fish stocks while dangerous processing practices, such as using chemicals imported from nearby countries, will jeopardise the overall viability of the whole fisheries sector. Funding for improving small-scale fisheries management must be secured as soon as possible. It should be recognised that livelihood strategies for floodplain fishers does not involve fixing a sustainable yield level, because fish stocks in a floodplain system are a function of climate and/or water quantities, and rigid access rights, given that fishers often need to migrate to track these mobile resources.

The existing migration corridors, or cattle routes, for nomadic and semi-nomadic herders must be reviewed, re-organised, better demarcated, maintained and adequately managed. This is an important issue for the relevant Ministry, to avoid the type of conflicts between farmers and pastoralists that have plagued other floodplains in the Lake Chad Basin. The establishment of grazing reserves might also be considered by those responsible for communal management plans.

Last, but certainly not least, management planning at the local level will allow traditional leaders, user groups and communities to have an audible voice in the debate over future flooding scenarios and development options for the floodplain.

*Conserving biodiversity in the Waza National Park and beyond.*

The Waza National Park is an internationally recognised protected area and plays a key role in the overall maintenance of the biological diversity and the wealth of the floodplain. The new management plan has initiated a process of co-management agreements with populations living in villages around the park. Extractive activities, such as fishing and honey collecting in the park, have become legal, while local people work with Park authorities to prevent poaching. The revitalised Scientific Committee provides advice on resource use levels within the protected area.

These steps towards biodiversity conservation and wise use are further strengthened by management agreements in the nearby floodplain (Ngantou and Kouokam, 2000), whereby user groups have agreed to follow similar agreements and management guidelines, to protect resources from outsiders, and to contribute to planning, implementation and monitoring of development activities. Regional and municipal administrative authorities, extension services, project partners and research institutions support this.

*Increasing regional co-operation.*

Biodiversity conservation and water management decisions in the Waza Logone floodplain have a regional dimension. Therefore co-ordination for improved resource use and protection between riparian countries in the Lake Chad Basin must be increased. The advances made in northern Cameroon should logically trigger a process of wetland restoration in the basin, using the approach described in this book that provides options for legitimate development options for stakeholder and conservation needs. The forthcoming GEF Lake Chad Basin programme will endeavour to serve this purpose, and provide much needed support to the Lake Chad Basin Commission.

## 13.2 Restoring livelihoods

The links between poverty and the state of the environment, including those between poverty and the shortage of water, are receiving increasing recognition, but until recently little consideration was given to the fact that protecting ecosystems, directly or indirectly related to water, is an important prerequisite for sustainable development. The Waza Logone project is a practical case study illustrating that environmental restoration and poverty alleviation must always go hand in hand.

The land resources of the Far-North Province of Cameroon are finite, yet often over-exploited, and current evidence, as documented in this book, suggests that using the ecosystem approach to local water resources management is a viable option for sustainable development. Practically speaking, the application of the ecosystem approach to the restoration of the flood regime of this degraded floodplain has had clear, positive impacts on its functions and values, and consequently on its productivity and the livelihoods depending thereupon. In times of reduced rainfall, smaller floods or unexpected and sudden hardship, the project has offered floodplain communities access to a larger selection of foodstuffs and tradable material (cereal, fish, non-timber products etc.) crucial to overcome drought years in this part of the Sahel. As exemplified in Chapters 10 and 11, the project has given local people an opportunity both to increase and diversify their sources of income, which means that both livelihoods and food security have been strengthened by the project.

*Photo13.1 Inhabitants of the floodplain find a wider array of livelihood options, including fishing, following managed flood releases (Photo IUCN).*

The Waza Logone project has demonstrated that management scenarios using an adaptive and participatory approach can lead to effective (although still partial) floodplain restoration and create the opportunity for planned land-use management at the local scale. For more than 10 years, stakeholder groups have all worked together to implement jointly a project that has demonstrated the inadequacy of current development plans for the floodplain, and asserted the rights of downstream users for equitable sharing of water. Moreover, a case has been made for the reorganisation of the present water-management infrastructure, to increase further the equitable distribution of valuable water resources. Indeed, the economic contribution of the floodplain to the economy of the Extreme-North Province justifies further artificial flood releases from the Maga dam onto the floodplain.

*Photo 13.2 The provision of wells has dramatically reduced the incidence of water-borne diseases (Photo IUCN).*

The Waza Logone project has also demonstrated that the functions and values of this Sahelian floodplain can be restored very effectively. The project has also shown that participatory planning of water resources is a powerful and consensual tool and, above all, that options do exist for improved hydrological management and sustainable resource development in the Waza Logone floodplain.

To achieve these results, the project has:

- made it clear from the outset, using the scoping exercise that preceded the first phase of the project in 1992, that development issues would be considered on an equal footing with conservation issues;
- invested considerable time into the identification of key leaders, including representatives of user groups (farmers, pastoralists, fishers) and traditional authorities;
- endeavoured to gain confidence from user groups through practical action, *i.e.* the establishment of pilot floods in 1994 (enlarged in 1997), to respond to the peoples' need to resume traditional activities, while research into long-term options was carried out;
- facilitated interactions between local people and scientists, to ensure that both traditional and scientific knowledge would underpin the development of ecologically-effective and socially-acceptable re-flooding options;
- initiated many income-generating and wise use activities to assist target groups under economic stress. Digging a considerable number of wells in villages in the floodplain to fulfil immediate needs for clean drinking water, and eliminate water-borne diseases, has contributed to build confidence in the project;
- emphasised the need for the project to remain flexible, both in terms of objectives, activities and use of funds, to ensure that the project would respond rapidly to peoples' understanding of desired outcomes and to ecosystem change; and,
- designed an exit strategy, in which capacity was built gradually among the provincial administration and several NGOs established for this purpose.

The approach followed, and the results achieved, have considerable practical implications for the implementation of policies. When local communities participate in the management process and feel they may benefit, rather than just being on the receiving end of authority, rules and regulations are more readily accepted. Also crucial knowledge of what works and what does not, is more easily fed back into the debates and processes to improve policies for the future. This is the basis of adaptive management, whereby initial policies and management systems are assessed and improved on the basis of interactions with stakeholders. This requires trust between policy makers and resource users. But such an adaptive management approach can work at all scales from local to international.

The latest advance on policy includes the Plan of Implementation adopted at the Johannesburg World Summit on Sustainable Development, which calls for action to "*develop integrated water resources management and water efficiency plans by the year 2005"* (para. 25), this requiring, *inter alia*, to:

- develop strategies on integrated river basin and watershed management;
- improve the efficiency of water infrastructure;
- increase the efficiency of water use and promote allocation among competing uses to ensure a balance between human needs and the preservation of ecosystems; and,
- mitigate extreme water-related events.

The Waza Logone project has partially achieved these objectives and will hopefully complete them in the years to come. This would also be consistent with the recommendations produced by the World Commission on Dams (WCD, 2000), which strongly advocates the release of environmental flows from dams to support the livelihoods and biodiversity that depend on downstream ecosystems. In particular the WCD highlighted the importance of managed flood releases from dams to maintain and restore floodplain wetlands. This is also consistent with recommendations of the New Partnership for Africa's Development (NEPAD), which makes a strong plea for ecosystem restoration and integrated water resources management.

To achieve progress with the Johannesburg Plan of Implementation, the Government of Cameroon and its partners may thus use the following guidance on ecosystems, people and institutions:

*Improving the management of water resources and ecosystems.*

While ecosystem goods and services have been partially restored, and water availability for human needs and wildlife has been enhanced, we must ensure that water resources are managed as part of broader integrated land, forest and coastal zone management. This will require designing further sustainable catchment management strategies and ensuring that water resources management plans are in place. To achieve this, increased co-operation with additional partners within the Logone River and the broader Lake Chad basins will be required.

*Improving stakeholder participation and co-operation among partners.*

Information and awareness have supported a better understanding of the economic aspects of ecosystem management. Floodplain benefits are used in a more sustainable way and equitably, because of the local networks of resource users involved in participatory decision making. However, further efforts are needed to agree additional regulations, incentives and investments to foster sustainable management of water and other resources. Essential to this is the continuation of the research and information gathering effort undertaken by the project, to support planning, decision-making and negotiations over access and use of natural resources. The Research Master Plan (Mvondo Awono, 2003) produced by the project and its partners should thus be used to the full.

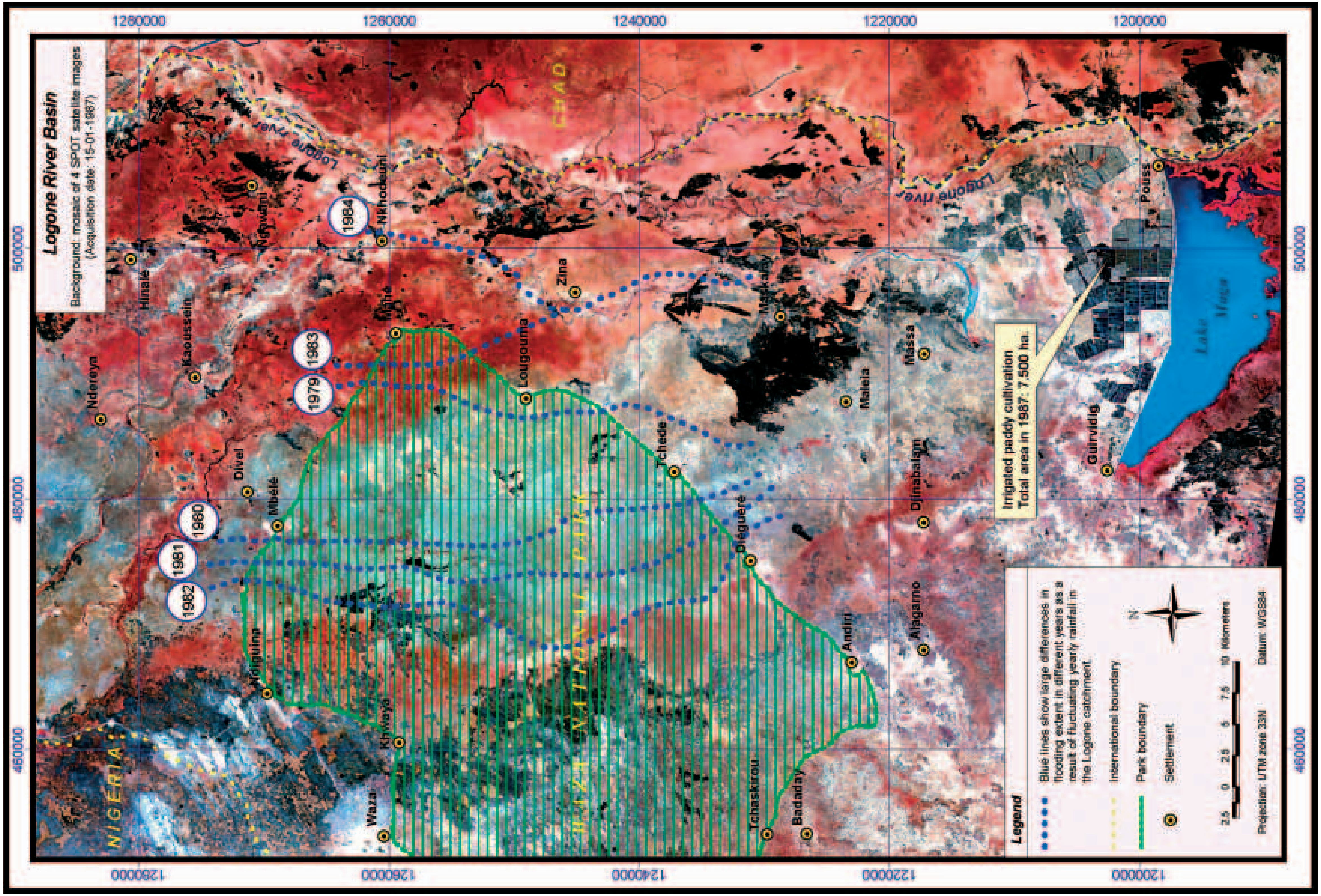
*Improving the effectiveness of institutions.*

Decision-makers are now aware of the value of the goods and services provided by a functioning floodplain, but this needs to be reflected in improved decision making. To foster improved governance, new legal and institutional frameworks and mechanisms for sustainable and equitable water allocation in the floodplain should be adopted. For example, in co-operation with stakeholders, especially floodplain users, financial and economic incentives should be identified and tested by partners (e.g. the provincial administration, municipalities, user groups and NGOs). At the same time adequate funding mechanisms with central government and bilateral and multilateral donors should be defined to support sustainable water allocation and resource use in the area until full restoration of the floodplain is achieved.

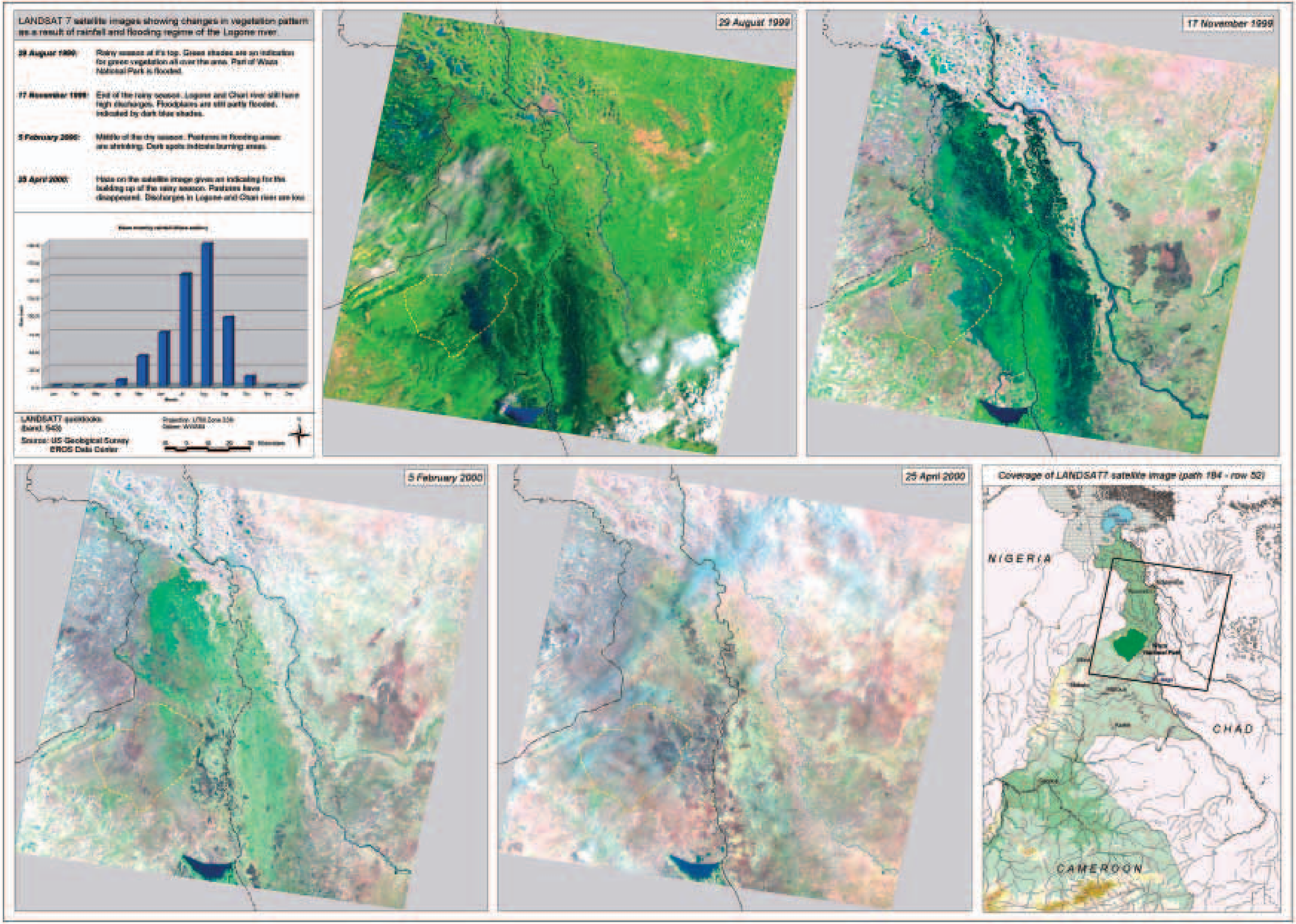
## 13.3 Conclusion

Planning and managing a floodplain for the future requires an integrated approach. This means integration across technical disciplines and integration between the various stakeholders. To provide the scientific foundations for future decisions and actions, information gathering, including traditional knowledge, is essential on the hydrological, ecological and socio-economic aspects of the floodplain. In parallel, awareness raising and capacity building of government, local institutions and communities is needed to allow these stakeholders to use the information available and participate in the decision-making process. All parties need to feel that policies and practices are workable and will address short-term needs, such as food security, mid-term issues including economic growth and long-term issues of sustainability. Integrating well-informed experts, decision-makers and the people of the floodplain in a flexible and adaptive framework is the key to sustainable management.

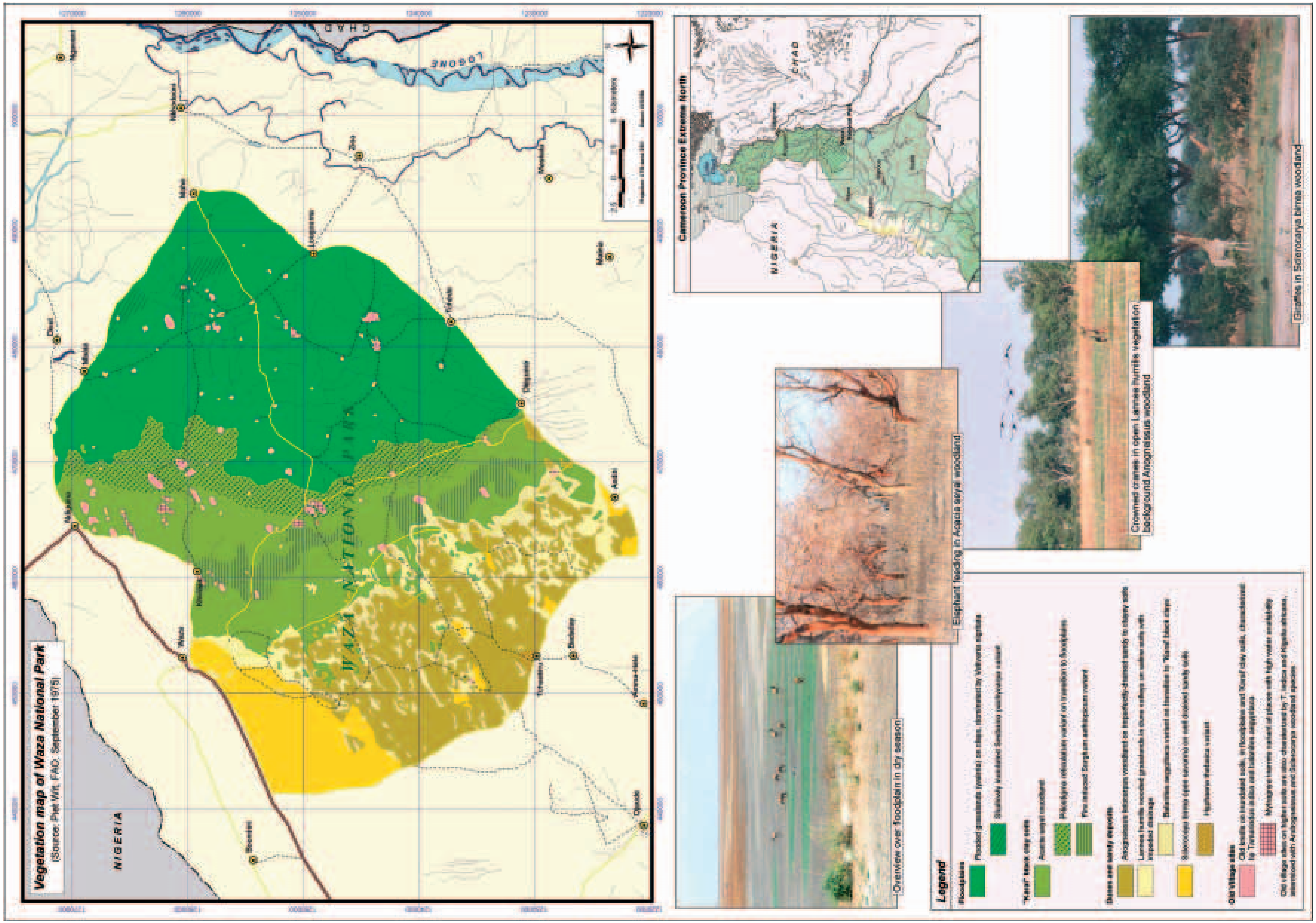
*Photo 13.2 The return of the waters has lead to a successful fishing season and restored livelihoods in the Logone floodplain (Photo IUCN).*



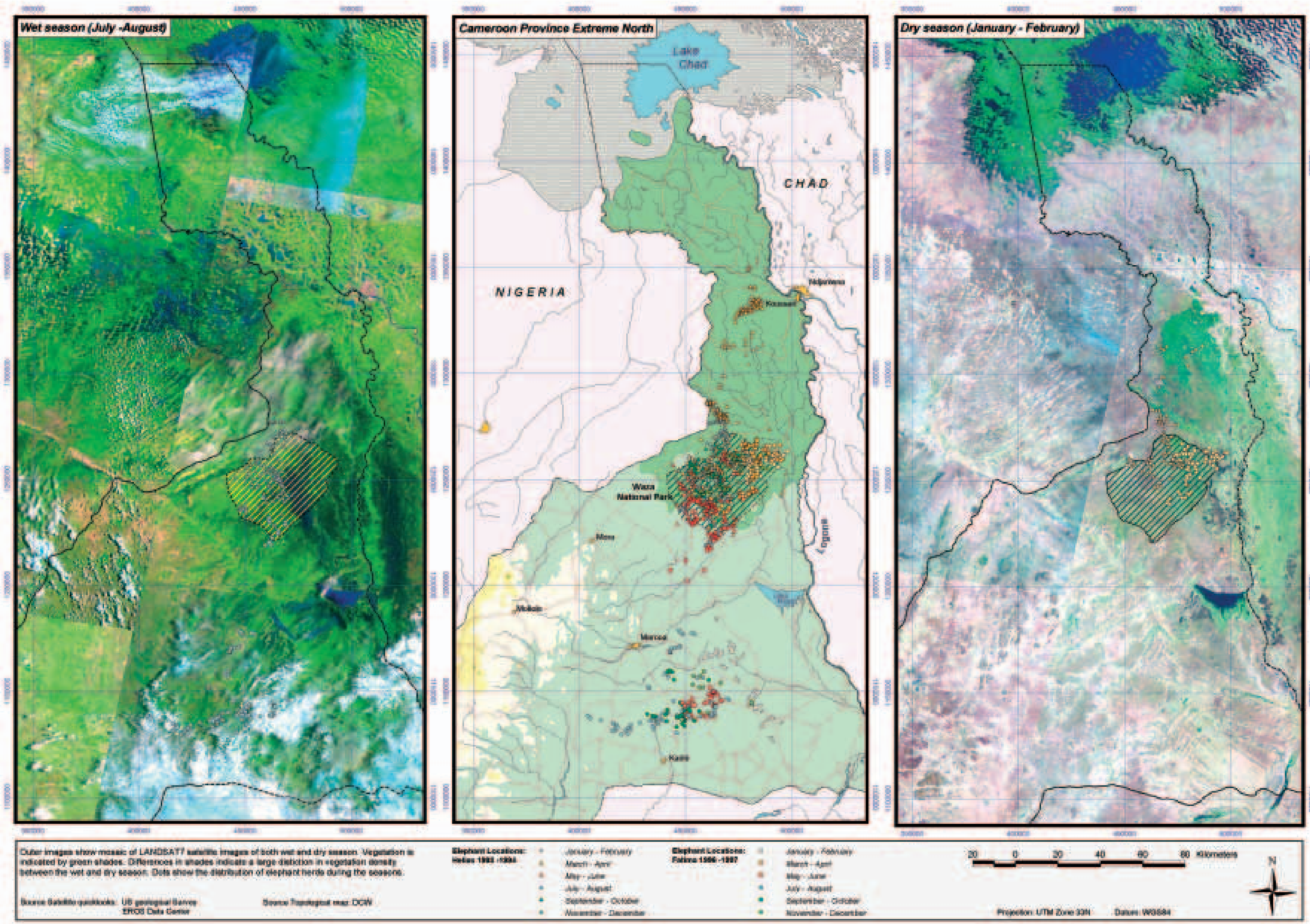

Map 3.1 The extent of the flooding in the Waza Logone floodplain varies from year to year, as a result of annual fluctuations in rainfall in the catchment of the Logone River.




*Map 6.1 Satellite images showing seasonal changes in vegetation in the Logone floodplain as a result of flooding by the Logone River.*




Map 6.2 Vegetation map of Waza National Park.




*Map 6.3 Positions of two elephants tagged with satellite collars in northern Cameroon in 1993 and 1994.*

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