CASE STUDIES IN WETLAND VALUATION #4: May 2003

WAZA LOGONE FLOODPLAIN, CAMEROON: economic benefits of wetland restoration

Irrigating Cameroon's drylands

More than 59% of Cameroon's freshwater resources, and 86% of freshwater surface area, is comprised of floodplains. Water shortage and inappropriate river and floodplain water management are cited as major threats to their ecology and biodiversity, especially in drier areas (Government of Cameroon 1999). Over the last 10-15 years the construction of dams and canals has been encouraged within and upstream of many of the country's floodplains, particularly by the Rice Development Authority, SEMRY, to encourage grain cultivation by the sedentary farming population. As well as having devastating impacts on floodplain hydrology and ecology, this has impacted heavily on the fisherfolk and pastoralists populations who traditionally rely on their freshwater resources and flooding regimes. Yet, for the most part, these values have not been taken into account when irrigation schemes are constructed.

This case study describes an exercise that was undertaken to assess the economic effects of floodplain degradation in the Waza Logone region, a semi-arid ecosystem in northern Cameroon that has been severely impacted by upstream water diversion for irrigation. By demonstrating the economic benefits of reinundation, and the high economic costs of flood loss to date, the study intended to present an economic justification for government and donor investment in flood release measures to restore the hydrology, ecology and biodiversity of the Waza Logone floodplain.

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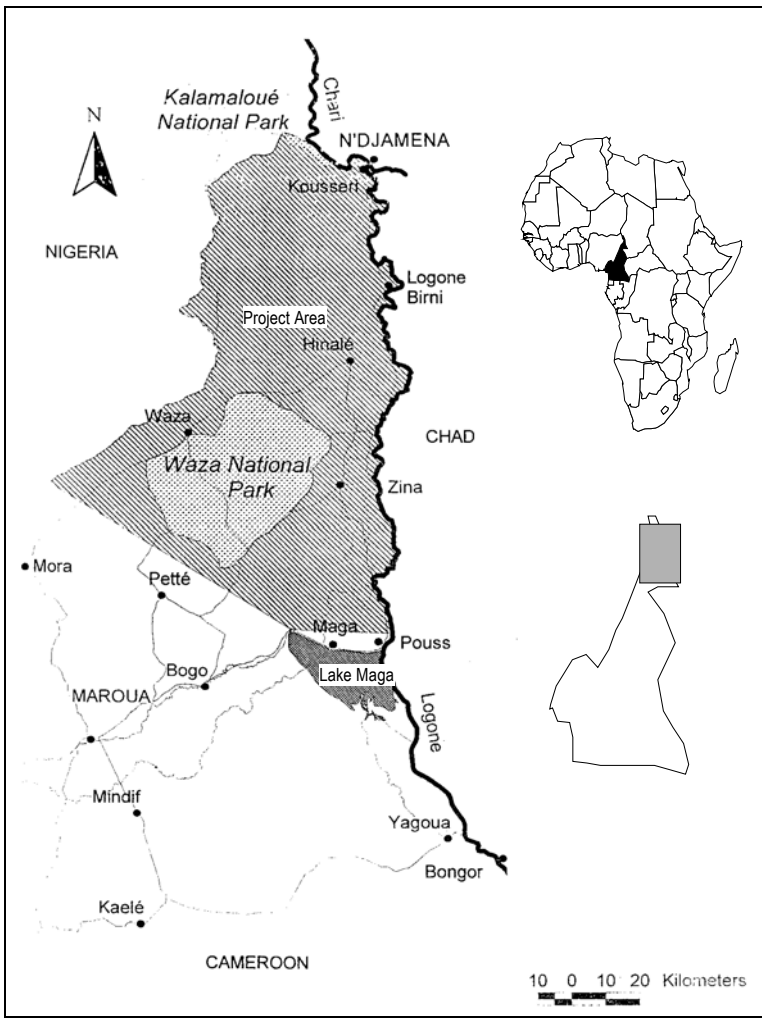
Integrating Wetland Economic Values into River Basin Management

The Waza Logone Floodplain

The Waza Logone floodplain covers an area of some 8,000 km². It is located in the Extreme North Province of Cameroon, bordered by Nigeria to the west and Chad to the east (Figure 1). The floodplain comprises about 10% of the total surface area of major riverine wetlands in the West African Sahel. It represents a critical area of biodiversity and high productivity in a dry area, where rainfall is uncertain and livelihoods are extremely insecure. Just under 220,000 people are estimated to live in the Waza Logone region, approximately 60% of whom (or 85% of the rural population) rely on floodplain and wetland resources for their basic income and subsistence. The 1,700 km² Waza National Park is also located in the floodplain, and is recognised as having one of the richest wildlife populations in the West African Sahel, including giraffes, elephants, lions and various species of ungulates (Wesseling *et al* 1994).

The high productivity of the Waza Logone region depends to a large extent on the overbank flooding of the Logone River and the seasonal rivers Mayo Tsanaga, Mayo Boula and Mayo Vrick. The flooding cycle begins with the first important rainfall in May, which saturates the soil and starts to fill the deepest depressions (Mott MacDonald 1999). The discharges of the Mayo Tsanaga and Mayo Boula reach the floodplain in August, and by September or October the area is inundated by overbank flow from the Logone River, lasting until November or December. The almost total lack of relief in the region means that the flood spreads over a large area: more than 3,000 km² of the 8,000 km² floodplain. By December, the residual floodwaters are drained back in to the Logone through the Logomatya River, and north to Lake Chad through the El Beid River.

Figure 1: Location of Waza Logone



Reversing the effects of flood loss

Since 1979 the inundated area of the Waza Logone floodplain has been reduced by approximately 964 km² or almost 30% of the original flooded area (Mott MacDonald 1999), due in large part to the construction of a rice irrigation scheme by SEMRY. The establishment of embankments blocked breaches of the Logone and entrances of the Mayo Aretékélé and Petit Goroma, and deprived the Logomatya of its main supply (Wesseling *et al* 1994). The Maga Dam sealed up water courses entering the Pouss depression, stored water originating from Mayo Tsanaga, Mayo Boula and Logomatya, and caused the Mayo Gourgoulay to dry up. In total, these construction works resulted in a 70% reduction of water supply to the floodplain from the Mandara Mountains, and an almost complete curtailment of the water supply from the Logone.

The reduction in inundated area has had a number of negative impacts on the ecology, biodiversity and socio-economy of the Waza Logone floodplain, including:

- Reduction in ***crop agriculture***: 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.

- Loss of ***fisheries***, including an estimated 90% decline in fish yields within flood-fed wetlands (Wesseling *et al* 1994), and reduction of the capacity of the area to provide nursery for fish stocks in the wider river systems of the Logone and Chari. The Waza Logone floodplain supports a large and complex fishery, both in its main river channels and permanent lakes, and in flood-fed and seasonal creeks, ponds, depressions and wetlands.

- Decrease in ***dry-season pasture***: 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). Most pastures in the formerly flooded area have now lost their perennial grass cover, leaving only degraded grasslands of inferior quality and smaller area.

- Loss of ***plant resources***, including grasses, shrubs and trees that are used for house construction, beekeeping, handicraft production, woodfuel, wild foods and medicines. A variety of perennial grasses, founded in flooded areas, are harvested from flooded areas and used for thatching houses and constructing fishing baskets.

- Decrease in ***wildlife populations***, including reductions in the number of kob, and the complete disappearance of buffalo, waterbuck, bushbuck and common duiker in Waza National Park (Wesseling *et al* 1994). Bird populations and migratory habitats outside the NP have also diminished. Wildlife supports a number of economic activities, such as tourism, sport and subsistence hunting.

- Reduction in ***surface water*** availability, affecting water holes and water courses that are used for domestic and livestock water supplies and for water transport, especially in dry seasons. 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.

Building on work carried out two decades ago, a number of options for setting in place engineering works to allow for flood re-release in the Waza Logone region were identified in the early 1990s. Pilot releases of floodwater from the Logone River were subsequently implemented in 1994 and 1997. These modified and opened the channels of two watercourses which connected the Logone to the Logomatya, and had been blocked by the SEMRY works: the Petit Goroma (1994) and the Aretékélé (1997). These resulted in an annual increase in the area flooded of around 200 km^2 and led to a marked recovery in the number of waterbirds and certain mammals, an increase in fish production, improvement and extension of pasture, and changed agricultural opportunities.

In 1999 a revised and updated proposal for reinundation was made. This focused on two main zones for release: from Lake Maga, which usually has excess water in August and

September; and from the zone immediately to the north of the rice cultivation area of the irrigation scheme. The proposal consists of three different options, each allowing a different level of additional flows and level of floodplain restoration. All of these reinundation options have the potential to make a significant contribution towards rehabilitating the hydrology, ecology and biodiversity of the Waza Logone floodplain and to restoring the human production systems that depend on it.

Valuing floodplain reinundation

The aim of the study was to estimate the economic value of reinundation, and economic costs of flood loss, with a view to justifying investment in flood release measures in the Waza Logone floodplain. It built on and updated three previous pieces of work: a preliminary cost-benefit analysis of reflooding options made by Delft Hydraulics and the Centre for Environmental Science of the University of Leyden in 1994 (Wesseling *et al* 1994); a study on the economic benefits of floodplain inundation carried out in 1998-99 by the Centre for Environmental Science (Centre for Environmental Science 1999); and a cost-benefit analysis of the proposed reinundation programme carried out in 1999 (IUCN 1999). The current study aimed to relate floodplain values specifically to the reinundation options that were being considered, so as to present to decision-makers and investors a measure of the economic desirability of investment in flood release works.

The study involved a number of steps, which together resulted in an economic assessment of flood-related benefits. First, the broad parameters and scope of the study were defined. It was decided that the study would focus on incremental values – in other words the additional values that would result from flood release over the current situation, considering only changes in floodplain economic benefits and costs that are directly caused by reinundation. The major focus of the study was on on-site benefits that accrue inside the floodplain region and are received by the floodplain population. Although reinundation may result in a number of off-site economic impacts, such externalities were not the primary focus of this study. All benefits and costs were to be calculated as net values, so as to avoid double counting, and the study valued only benefits that were believed to be sustainable in environmental terms.

A second step was to identify the economic values associated with the inundation of Waza Logone floodplain, and could be valued given available techniques and information. These focused mainly on direct values such as dry-season pasture, fisheries, flood-fed and flood-recession agriculture, use of floodplain grasses for thatch and basket making, beekeeping and honey production, water transport, and surface and sub-surface water supplies. Additionally, inundation gives rise to a number of flood-related economic costs, which were considered in the study. As well as direct expenditures on constructing and operating flood release infrastructure, there would be an opportunity cost to reinundation in terms of loss of crop cultivation and gum arabic harvesting areas, and additional crop damage resulting from increased populations of wildlife and birds.

A third step was to define the methods and data needs for floodplain valuation. Here, a variety of techniques and methods were used. Market price techniques were only found to be applicable to fish and rice trading, water transport, and grass used for fishing baskets. For the benefits and costs that could not easily be valued through the application of market prices, three additional methods were used to value flood benefits: effect on production techniques (for example pastoralists livestock production), the price of alternative or substitute resources (for example thatching grass), and mitigative or avertive expenditures avoided (for example loss of year-round surface water supplies).

Information was collected by carrying out a number of field surveys, as well as consulting with existing documents and reports – including those produced as part of earlier cost-benefit analyses. The resulting costs and benefits of flood release, and flood loss, were modelled over time, allowing for the gradual restoration of floodplain resources and benefits, and computed as single net present values for flood loss to date and for each scenario of reinundation. An additional cross-check on the robustness of the figures was provided by carrying out a sensitivity analysis

to see how the results would be affected by changes in discount rate, levels of benefits, flooding coverage and climatic conditions.

Using economic values to promote investment in flood release measures

Annual flooding originally inundated an area of 3,382 ha, or nearly half, of the Waza Logone floodplain. The study showed that, before the construction of the SEMRY scheme, the value contributed by this flooding to the regional economy was over $10 million a year, or more than $3,000/km^2 of flooded area. Since then, the inundated area of the Waza Logone floodplain has reduced by almost 30%, incurring annual economic costs to the local population of more than $2 million (Table 1).

The valuation study underlined the positive economic impact of the pilot flood releases of 1994 and 1997, showing that they had added a value of over $800,000 a year through restoring floodplain goods and services. Relating these changes to further recovery of floodplain ecology and biology showed that the reinundation options currently under consideration would generate incremental economic benefits of between $1.1 million and US $2.3 million a year over the current situation, translating into positive net present values of between $5.6 million and $7.8 million when investment and operation costs were taken into account (Table 2). On a per capita basis, this equates to $50 added economic value per floodplain-dependent member of the population.

A large amount of donor and government funding has recently been made available for projects to address poverty alleviation concerns in Cameroon. To date, proposals have been focused mainly on the provision of basic services, infrastructure and income-generating activities for the urban and rural poor, rather than on environmental conservation and restoration activities. The results of the valuation study both presented a convincing argument for investment in flood release measures in the Waza Logone floodplain as a mechanism for rural poverty alleviation and sustainable livelihood development, and also highlighted the high economic costs to poor rural populations of having failed to take environmental values into account when the original investment in the SEMRY irrigation scheme was made.

This case study is adapted from IUCN, 2001, Economic Value of Reinundation of the Waza Logone Floodplain, Cameroon, Projet de Conservation et de Développement de la Région de Waza-Logone, Maroua

Table 1: Economic costs of flood loss in the Waza Logone region

	Total Loss ($ mill/yr)
Pasture losses	-1.31
Fisheries losses	-0.47
Agriculture losses	-0.32
Grass losses	-0.29
Surface water supply losses	-0.02
NET COST	**-2.40**

Table 2: Incremental benefit of reinundation over current situation

	Additional flow (m3/s)	Reflooded area in average year (km^2)	Incremental net benefit of flooding ($ mill/year)	Net present value of investment ($ mill @ 10%)	Benefit:cost ratio of investment
Maximum flood release option	215	867	2.32	7.76	6.57
Middle flood release option	165	687	1.78	7.19	6.13
Minimum flood release option	115	479	1.15	5.61	4.66

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This project aims to develop, apply and demonstrate environmental economics techniques and measures for wetland, water resources and river basin management which will contribute to a more equitable, efficient and sustainable distribution of their economic benefits at the global level and in Africa, Asia and Latin America, especially for poorer and more vulnerable groups.

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