ECONOMIC ASSESSMENT STUDY
OF THE LOGONE FLOODPLAIN

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Consultancy for Waza Logone Project/IUCN
by Centre of Environmental Science

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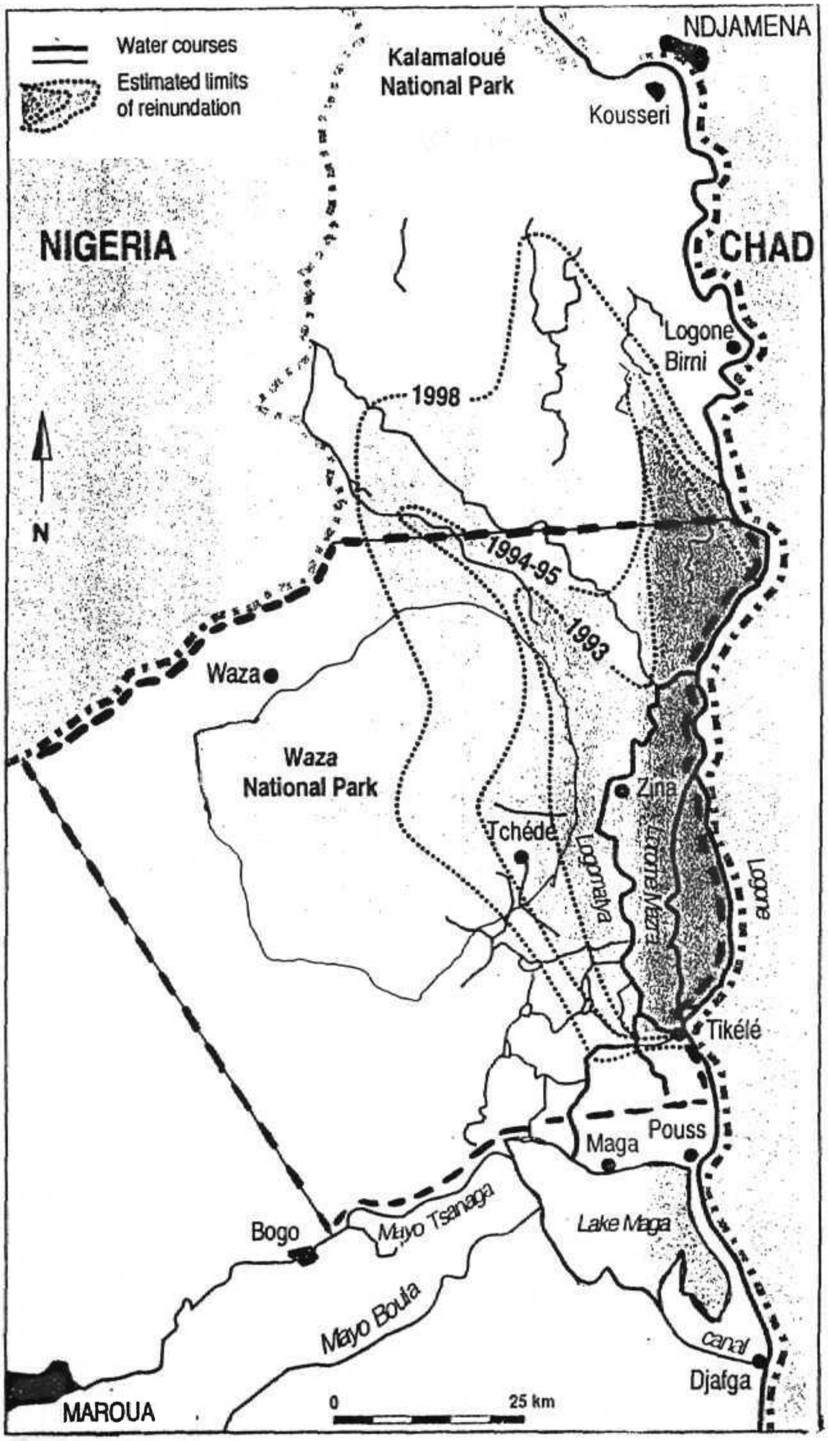


Figure 1.1

Map of the Project area

BOUNDARY PILOT ZONE

EXECUTIVE SUMMARY

About twenty year ago the Logone floodplain was among the most productive floodplains of Africa in terms of fish and pastures. Furthermore, it was at the base of the ecological viability of the Waza National Park, part of which is situated within the area regularly flooded. The creation of the SEMRY rice irrigation scheme, which involved the construction of the Maga dam and the Maga lake, in combination with recurrent droughts led to reduced flooding and the productive and ecological value of the floodplain declined rapidly. The Waza Logone Project (WLP) aims to rehabilitate the floodplain by way of reinundation. This report contains the preliminary results of an economic assessment of natural resources to be created by the reinundation of the Logone floodplain in North Cameroon, as proposed by the Waza Logone project. The study was based on data available at the Waza Logone Project and on limited data gathering by the study team, basically through the interviewing of key-informants.

Given the availability of data at WLP and the difficulties in valuing natural resources, which are still to be created, the study mainly focussed on putting monetary values on direct use values associated with reflooding. Indirect use values and non-use values were discussed, but no monetary values were put on them. The study team was asked by WLP to present a figure on total net benefits per square km of reflooded area per annum. We calculated it to be about FCFA 1,300,000. The study team was also asked to calculate the total net benefits per annum for a trial option, the "Model Reinundation", which was expected to reinundate an additional area of 1770 km^2 a surface which includes an area within the Waza national Park of 380 km^2. The total net benefits of the "Model Reinundation" turned out to be FCFA 2,261 million per annum.

As was expected benefits due to changes in the production of fish, to be caught by the Kotoko and Mousgoum fishermen and women, and to changes in the production of dry-season pastures, to be exploited by nomadic and semi-nomadic pastoralists, turned out to be the bulk (about 98%) of yearly total net benefits per km^2. Benefits associated with increased fish production in the floodplains were calculated to be FCFA 369,500 per km^2 per annum. These benefits are captured by fishermen, fish traders and the Cameroonian government in the form of taxes. In the figure of total net benefits calculated for the "Model Reinundation" the value of the fish produced within thé Waza part of the reinundated area is included, because this fish is thought to be captured anyway on its way back to the Logone river, at the time the floods recede. Benefits associated with increased forage production on the floodplain pastures were calculated to be FCFA 1,142,000 per km^2, per year. These benefits are captured by nomadic and semi-nomadic pastoralists, including nomads from Nigeria and Chad, like the Woila and the Arab-Choa. In the figure of total net benefits calculated for the "Model Reinundation the value of the pastures produced within the Waza part of the reinundated area is excluded, because pastoralists are officially not allowed to enter the park area. Direct use values associated with ecological rehabilitation (e.g. tourism, hunting and the harvesting of natural products) were found to be relatively low.

Some specific data are still needed to make the figures more accurate. Static figures do not do justice to the reality of a dynamic floodplain. The benefits calculated above are a reflection of the hydralogical conditions which occurred during the years 1994-1997. The hydrological significance of these years will have to be defined by others such that the economic benefits may be calculated for other periods having different hydrological conditions.

2 INTRODUCTION

The present study is carried out under responsibility of the Centre of Environmental Science/Leyden University by assignment of the Waza Logone Project. The Terms of Reference of the study have been included in Annex I. Main objectives of the study, as described in the TOR are;

- The estimation of the economic values of the changes attributable to the large- scale inundation of the floodplain;
- Presentation of the data, methodology and results in a format such that they may be used in a Cost-Benefit Analyses of the options for reflooding;
- Calculation of the Total Economic Value of the large-scale reindundation of the flood-plain for a trial option and for up to three other options for reinundation;
- Dissemination of information to project personnel through working groups and the holding of a one-day seminar in which the methodology and conclusions of the study will be presented.

The study team consisted of Hans de Iongh (team leader), Aad Zuiderwijk (socio-economist) and Peter Hamling (environmental economist), who worked in Cameroun during February 1998 (see TOR). The team worked very closely with the Project staff Richard Braund, Maureen Roell, Bobo Kadiri, Saidou Kari, Saleh Adam and Roger Kouokam during data gathering and during processing of the available data. The Preliminary Report and results of the study were presented to and discussed with the WLP team during a seminar on 24 February 1998.

This Preliminary report also provides a short review of the first economic assessments carried out by Wesseling et al (1994) and by the Waza Logone Project (1996). Although in the TOR it was mentioned that data available at the Project or in the literature was expected to be sufficient for the purposes of the study, the team prepared ecommendations for obtaining further data for the achievement of satisfactory results. As a consequence this Preliminary Report provides the first stage results of the Economic Evaluation, the Cost Benefit Analyses will be carried out based on the outcome of the hydrological modelling.

Figure 1.1 provides an overview of the project area in the Extreme North Province of Cameroun and the boudaries of the pilot zone, where the Waza Lagone Project has focussed its activities. The figure also shows a projection of the flooded area before and after the pilot flooding, which was achieved by creating a gap in the protection dyke at Tekelé in 1994 and a projection of the major reflooding, the ultimate goal of WLP after 2000.

3 APPROACH

The construction of the Maga *Dam* interrupted the flood cycle of the Logone river. A large area of the Yaeres floodplain dried up. The economic benefits of this tropical wetland ecosystem were not taken into consideration. Partial re-flooding of the plain has been achieved by breaching the containment dykes in two places. The success in restoring the floodplain in these reflooded areas has led to the proposal that further civil works be considered in order to restore even greater areas of the plain. A full Cost Benefit Analysis of three engineering options is to be commissioned. Each option will have different construction costs and will result in different hydrological regimes and, consequently, areas of the plain being re-flooded. The final decision making process will be based on a dynamic hydrological model which will enable a CBA associating construction costs with the stream of future benefits accruing from the areas which will be newly inundated.

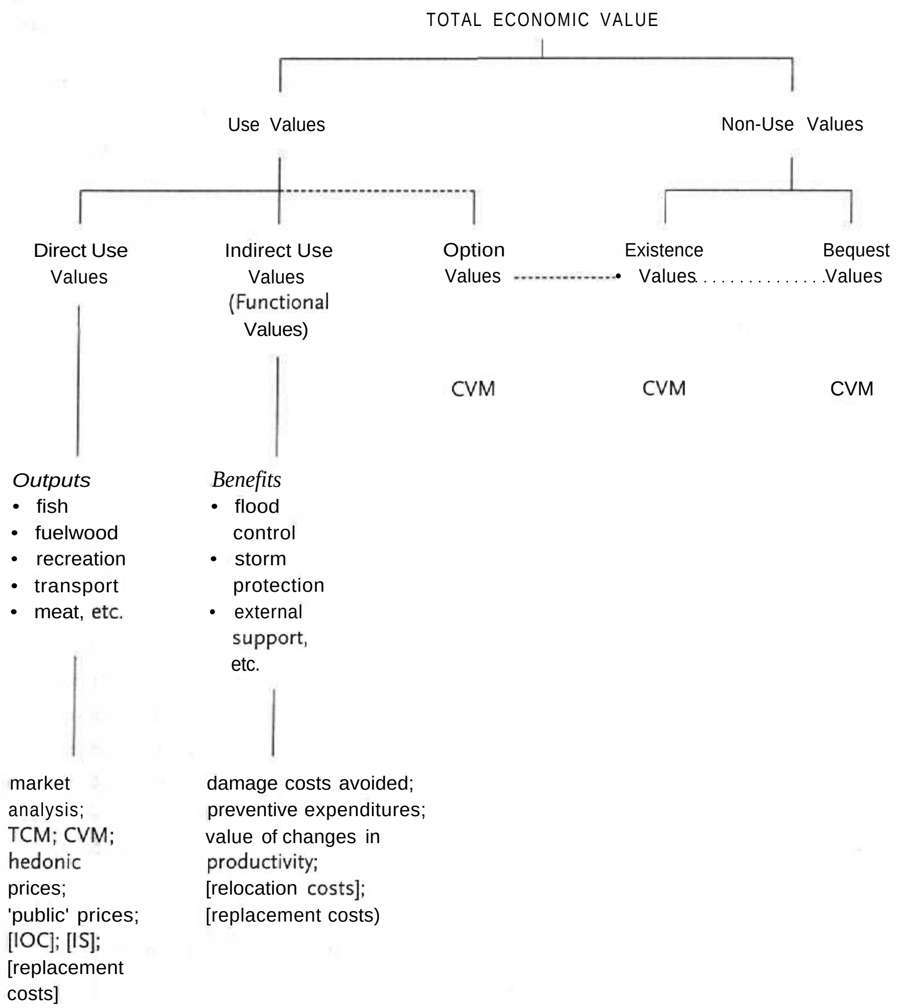
The objective of this study is to identify and quantify the benefits associated with the increased flooding of the plain. In order to facilitate the decision process the presentation of the anticipated benefits must be tailored to meet the requirements of the final CBA model.

The floodplain is a tropical wetland ecosystem. In order to identify and assess the benefits of the project the approach of the consultants has been to use the methodology proposed by the International Institute for Environment and Development (Barbier, 1989). Valuing a wetland essentially means valuing the characteristics of a system. The Total Economic Value (TEV) of an ecosystem is assessed by breaking it down into "Use values" and "Non-use values". "Use values" are subdivided into Direct-use values (outputs), Indirect-use values (benefits) and Option values."Non-use values" relate to the value of the physical existence of the floodplain. See Figure 3.1.

- Direct-use values are derived from the direct use or interaction with wetlands resources (eg. fishing, livestock, etc.).

- Indirect-use values are derived from the indirect support and protection provided to economic activity by the wetlands natural functions or regulatory environmental services (eg flood control). Included as an Indirect-use value is the concept of an "option value"; the value people attach to preserving the option to use the economic resources of the wetland in the future in a way not yet known.

- Non-use values are the intrinsic values of the wetland itself for its conservation of wildlife and bio-diversity and its uniqueness in cultural heritage.



Notes:
CVM = contingent valuation method; TCM = travel cost method; IOC = indirect opportunity cost approach; IS = indirect substitute approach; [ ] = valuation methodology to be used with care

Figure 3.1
Valuing Wetland

In ecology a distinction is made between the regulatory environmental functions of an ecosystem, its flows, (eg nutrient cycles, micro-climate, energy flows) and its structural components, its stocks, (eg biomass, species of flora and fauna etc). This distinction is useful from an economic perspective as it corresponds to the standard categories of functions or services (eg Croundwater recharge, tourism) and resource stocks or assets (structural components). In addition ecosystems have certain attributes (biological diversity) that have economic value because they induce economic uses or because they are vaiued in themselves.

Following this methodology the following wetland characteristics were identified and classified as in table 3.2 below:

Table 3.2
Use of Floodplain Characteristics

	Economic Values		
	Direct	Indirect	Non-use
Components / Assets			
1. Livestock	xxx		
2. Fisheries	xxx		
3. Agriculture	x		
4. Natural Products	x		
5. Tourism/Safari hunting	x		
6. Water supply	x		
Function/services			
1. Tourism	x		
2. Ground water replenishment		x	
3. Sediment retention		x	
4. Nutrient retention		x	
Diversityf attributes			
1. Biological diversity			xx
2. Cultural heritage/ way of life		xx	

Key:
x = low
xx = medium
xxx = high

Even in a temperate wetland where extensive data are available the techniques used to value indirect and non-use values are highly sophisticated and difficult to apply. In a tropical wetland situation a valuation of "only the primary direct uses of a tropical wetland and a few of its functions may be possible" (Barbier *et al.*, 1989). The marginal benefit in terms of improved accuracy in results should exceed the marginal costs of acquiring the information.

In this study the availability of data was assessed and possible methods of economic assessment were reviewed and discussed with Waza Logone project staff. It was decided to concentrate valuation efforts on direct use values and in particular livestock and fisheries which previous studies (Wesseling *et.al.*, 1994) have shown to produce by far the highest benefits. The availability review is presented in Table 3.3 below.

Table 3.2
Availability of Data and Methods of Economic Assessment

ACTIVITY	Data before 1994	Data 1994-1998	Data after 1998	METHOD
FISHERY	No data	Estimates Use averages	Predict for 30 years	1/ Change in productivity 2/ Productivity per hectare 3/ Benefits per km square
LIVESTOCK	Limited data Use avg TLU Use avg floods	Estimates Reliable data only for pilot zone. Prices from SODECOTON	Predict for 30 years	1/ CIP approach using surrogate market prices 2/ Based on estimates and predictions 3/ Benefits per km square
WAZA NATIONAL PARK	Tourist statistics	Tourist stats	Predict for 30 years	1/ Expenditure method 2/ Project benefit
SAFARI HUNTING	Quota	Quota Actual no's shot	Predict for 30 years	1/ Expenditure method 2/ Project benefit
AGRICULTURE	Limited data Estimates	Limited data Use avg.	Predict for 30 years	)/ Change in productivity 2/ Benefits per sq km
NATURAL PRODUCTS	Limited data	Limited data	Predict for 30 years	1/ Change in productivity 2/ Project benefits

The main effort of this study has been directed towards attaching values for fisheries and livestock to a single square kilometer of flooded land. The values will be factored to allow for the gradual build up of the benefits. In this way values can be simply attached to flooded areas suggested by the hydrological model. Attaching costs and other benefits of the total project, some of which are identified below, will facilitate the completion of the overall feasibility study.

Costs which should be included in the final CBA are:

1. Construction
2. Maintenance of the canal
3. Water Management Plan
4. Compensation for people displaced by construction works
5. Lake fishery losses should water be discharged from Maga Dam to flood the plain
6. Possible health effects; malaria and schistosomiasis.
7. Effect on Lake Chad.

The effect of reducing the water level in the Maga reservoir in order to add to excess flood waters on the plain was assessed using the Surface Area/Volume graph of the lake. The assumption was that the volume used would lower the water level 5ocm beiow spillway level. It was estimated that a 60 km2 reduction in lake surface (depth 50 cm) would inundate 288 km2 of the plain to a depth of 35cm. This water would evaporate in 2 months from the lake but would prolong the flood by 1.5 months on the plain.

An additional major benefit of the project must be considered when finalizing the CBA. The construction of the "Model Reinundation"; the widening of the "Mayo Vrik" canal will help protect the SEMRY II irrigation scheme, and all downstream inhabitants and structures, from the potential failure of the Maga Dam during high floods. This action has already been recommended (SOCREAH, Rapport Final Jan 1992). Coincidentally this wouid also give potentially the greatest quantity of water to the floodplain. It can be argued that the entire value of SEMRY II plus all downstream structures and inhabitants multiplied by the probability of dam breakage is the benefit of the Mayo Vrik canal. At least a proportion of the construction costs can be defrayed as a benefit. There is a strong argument that the floodplain benefits are actually an additional benefit of doing the Maga Dam protection works.

A cost benefit analysis always examines the "with" project and "without" project situation. The flood is a dynamic event. There is a variable area flooded each year even without the project. The CBA is concerned with the incremental benefits which are due to the project. Each hydrological model must enable the calculation of the incremental area flooded each year. It must be able to show the "without" project area flooded as well as the "with" project flooding area. In a bad flood year, for example, "newly" flooded area may actually be rormally flooded area which would not have flooded in a bad year under the old hydrological regime.

4 DATA AVAILABILITY AND RELIABILITY

4.1 Fisheries

Statistics on Fisheries production were provided through discussions with Project staff, and through a number of project reports, listed hereunder;

1. Bobo Kadiri Serge and Boukar Beladane (supervision Paul Schölte) (1997), Estimation de la Production Pechee dans la Plaine d'indondation du Logone
2. Bobo Kadiri and Boekar Beladane Didjatou (supervision Paul Scholte) (1996), Estimation des Stocks Résiduels de Poissons dans la Plaine d'indondation du Logone.
3. Aboukar Mahamat and Kouokam Roger (supervision Maureen Roell) (1997), Rapport suivi canaux de Peche(Campagne 1996/1997)

The report cited under 1) provides a summary of the other reports and gives total fisheries production for "Grande Peche" (which represents the production of the fishing channels) and "Petite Peche" (other fishing methods) for the Fishing Season 1996/97, with a total estimated production of 6190.5 t fresh weight, related to a flooded area of 2000 km^2. Based on these figures, it is concluded that fish stocks in the floodplain are *over-exploited.*

The report cited under 2) presents the results of experimental fishing in 9 natural depressions outside the Park and in the Logomatya and Lorome-Mazra, with the aim to assess the remaining stock of fish at the end of the dry season. Fishing took place during May-August 1996. The report concludes a remaining stock of 63.8 t, of which 50.4 t are *Protopterus.*

It is regretful, that the study has not covered the natural depressions inside the Park during the same period, because the data on remaining stocks can now hardly be related to total fisheries production in the floodplain. This type of study should be done both inside and outside the Park during the same year.

The study area of the study cited under 3) covers the fishing channels draining on the Mayo's Petit Goroma and Logomatya, between Tekele and Zina. From the table on page 6 we learn that the actual numbers of *exploited channels* are 172 in 1994, 166 in 1995, 227 in 1996 and 232 in 1997 for the zone between Tekele and Zina. According to the report, fisheries production has gone down to an average of 1.174 tons per canal (n=23, s.d.=0.956) during 1996/97 from 2.576 tons per canal in 1995/96 (n=19, s.d.=3.535). An extrapolation is made from the production of 23 fishing channels to the production of 166 fishing channels in 1995/1996 and 227 fishing channels in 1996/1997.

Since the variance of the production-per-canal data is much higher than the mean (when calculated in kilograms), data was logtransformed to obtain a normal distribution. This was done for the data of both seasons. New confidence intervals could be calculated using this logtransformed data. Standard errors of the logtransformed data were calculated, limits were calculated using t-values and d.f= n-l. Limits were backtransformed which gives the following results (note that the confidence intervals are skewed as a result of logtransformed, which is better representing the actual situation with some canals with outlying high production figures, but none with outlying low). Means and Standard deviations are those of non-transformed data.

Average fisheries production per canal in tonnes 1995/1996 and 1996/1997

	1995/1996	1996/1997
n	19	23
mean	2.576	1.174
standard deviation	3.535	0.956
confidence interval	1.562 - 4.246	0.8 - 1.722

Extrapolated values, Tekele - Zina

	1995/1996	1996/1997
canals	166	227
extrapolated total	427.58	266.49
confidence interval	259.36 - 704,91	181.69 - 390.88

The average production per canal was clearly higher in 1995/1996, unfortunately with a very high standard deviation, but the number of canals was lower so fishery yield could be spread over more canals in 1996/1997. Though, when comparing extrapolated total production, the production in 1995/1996 was higher compared to 1996/1997. When comparing confidence intervals, there is some overlap between the two seasons.

Extrapolated total production however is based on the area surveyed (Tekele - Zina), so this conclusion is at most statistically vulnerable since the production is calculated with an unsound mean. The important point made in the WLP report is that total fisheries productior with fishing canals had gone down during the period 1995 to 1997. At the same time, the number of canals had been increased. The average production per canal had diminished, indicating that the maximum of possible fisheries yields had been reached. Had the floodplain been under-fished, an increase in the number of canals could have led to an increase in total production and comparable average productions per canal. If the canal fishing system was already at its most efficient (draining all depressions), an increase in the number of canals would have led to a lower average production per canai but total production should have been comparable.

The average production per canal has however been reduced by 54% while the number of canals has increased by 37%. The reduction in average production is thus much higher than expected, that is, if it could be solely attributed to the increase of the number of canals.

The productions of the ten canals that were surveyed during both seasons were compared. Production in all the ten canals was much lower in 1996/1997 when compared to 1995/1996. The difference between the two seasons was highly significant (Wilcoxon Matched-pairs Signed Rank Test, $n=10$, $P=0.0051$).

Conclusion

in para 2, p. 7 (4.1), it is written that fish stocks in the floodplain are overexploited. In 5.1.4.1 it is written: *Statistically it is not proven that the floodplain is overfished.* In the other WLP fishery reports (Ecology), it is concluded that there is over fishing because the total yield is 31 kg/ha/an while 40-60 kg/ha/an is given as potential yield for tropical floodplains in literature. Indeed, this last conclusion is based on an assumption and is not supported by statistical facts (see also comments Bobo & Kouokam). Since total annual yield is, at present, calculated for only one year, it is even not clear if there is a progressing reduction of total yield.

The socio-economic study is the only one, at this moment, that compares two subsequent seasons. The comparison of the ten canals surveyed both seasons shows a clear reduction of average fishery yields per canal. Since total production is also lower, there is a strong indication that the quantities of catchable fish are reduced. With the results of the actually realised fishery studies, it is impossible to conclude that this reduction is caused by over fishing. Still, the data described and analysed above can be used in the Economic Assessment report as indicative of reduced yields, one possible reason being over fishing.

However, one has to realise that this analysis is based on a limited sample size, considers only fish canal production and that the study was confined to a limited area.

Production fishing canals 95/96 - 96/97. Socio-economic group Waza Logone Project
Production in tons, 95% confidence intervals (t-value and logtransformed, see note)

	95/96	96/97
n	19	23
mean	2.576	1.174
standard deviation	3.535	0.956
t-value int.	0.872 - 4.280	0.761 - 1.587
logtransformed int.	1.562 - 4.246	0.8 - 1.722
extrapolated Tekeie • Zina		
canals	166	227
extrap. total	427.58	266.49
t-value int.	144.76 - 710.40	172.65 - 360.34
logtransformed int.	259.36 - 704.91	181.69 - 390.88
717 *canals in* 96/97, *tekele-ivye, extrapolated*		
extrapol. total	841.758	
t-value int.	545.637 - 1137.879	
logtransf. int.	573.6 - 1234.674	

canals used for comparison between years (see graph), Wilcoxon matced-pairs signed ranks test n=10, P-0.0051, highly significant -> production in 96/97 significantly lower compared to 95/96

canal	code canal	prod sacs 95/96	prod kg 95/96	prod sacs 96/97	prod kg 96/97
varagan	19	123.06	4922.4	45.26	1810.4
alao afdadaye	17	45	1800	25	1000
basgar	16	397	15880	90	3600
bourai	15	135/3	5412	68.27	2730.8
mirli	H	67.27	2690.8	4.27	170.8
dilbafagas	13	23.51	940.4	17-45	698
malifou	12	39.6	1584	7	280
alhadji abladan	11	30.17	1206.8	25	1000
djibrine mamat	10	39	1560	27	1080
zawi	9	43-9	1756	22.99	919.6

Note:
In original report t-vaiue confidence intervals are used. logtransformed intervals represent better the actual situation since there is a skewed (not normalo distribution of production data. Both intervais are given above.

Production fishing canals 95/96 - 96/97 Socio-economic group Waza Logone Project
Production in tons, 95 % confidence mlervals (t-value and logtransformed see note)

	95/96	96/97
n	19	23
mean	2.576	1.174
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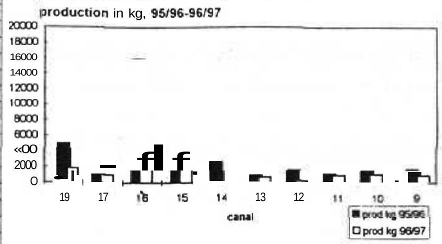

717 canals in **96/97**, **tekele-ivye,** extrapolated:

extrapol. total	841.758
t-value int.	545.637 - 1137.879
loglransf int	573.6 - 1234.674

canals used for comparison **between** years (see **graph), Wilcoxon** matched-pairs signed ranks test
n=10, P=0.0051, highly **significant -> production** in 36/97 **significantly** lower compared to **95/96**

canal	code canal	prod sacs 95/96	prod kg 95/96	prod sacs 96/97	prod fcg 96/97	Note in original report
varagan	19	12306	4922.4	45.26	1810.4	t-value confidence Intervals
alao afdadaye	17	45	1800	25	1000	are used. logtransformed
basgar	16	397	15880	90	3600	intervals represent belter
bourai	15	135.3	5412	68.27	2730.8	the actual situation since
mini	14	67.27	2690.8	4.27	170.8	there is 3 skewed (not
dilba fagas	13	23.51	940.4	17,45	698	normal) distribution of
malifou	12	39.6	1584	7	280	production data.
alhadji abladan	11	30.17	1206.8	25	1000	Both intervals are given
djibrine mamat	10	39	1560	27	1080	above.
zawi	9	439	1756	22.99	919.6	

Figure 4.1.1

Summary of all analysed data results of fisheries prodution and graph showing drop of production of the ten canals surveyed during both seasons.

4.2 Livestock

The economic assessment of pasture resources was complicated by a number of factors. First, no information was available (or accessible) within the project on the prices of straw and cotton cake as a possible substitute forage, and on the livestock, forage and pasture situation in the regions adjacent to the floodplain, the regions from which potential floodplain pastures users are expected to come from (including Nigeria and Chad).

Second, the person responsible for pastoral research (Paul Schölte) was not present anymore at the project, and it was not clear who had taken over his responsibilities. No reports were made available on livestock and pastoral herders. Other staff members clearly did not have access to Paul Scholtes research results on livestock. No person could provide the study team with a written research framework (i.e. the methodology) of the pastoral research. Later it turned out that the definition of the "pilot zone" differed between the hydrological research and the pastoral/ecological research.This problem was solved by using the boundaries of the pilot zone to calculate the inundated surface of the ecological pilot zone and stocking densities.

Third, data on stocking densities were obtainable only in an unprocessed form (i.e. only on paper). Furthermore, data on stocking densities in the floodplain in general and the pilot zone in particular contained a lot of shortcomings and missing data, which forced us to make assumptions and use averages of existing data for each ethnic group of nomads.

Fourth, aerial survey data on stocking densities were not (yet) available. They could have served to check or extrapolate on field research data.

However, Mr Roger Kouokam has done everything he could to assist the study team in getting the necessary data.

4.3 Agriculture

Data on Agriculture were obtained through the report of Wesseling et al (1994) and through interviews with project staff. Basically data were used for the changes in productivity and prices of Red millet, Mouskouari and Floating rice. In the project zone. Analyses of the data showed no major benefits to be expected after reinundation. However, disbenefits may be expected by the increase of crop damage by increased populations of species like geese, ducks, grane eating birds, and larger mammals like kob antelopes. These benefits could not be quantified during the present studies.

4.4 Tourism/Safari and Sport hunting

Statistics on numbers and prices for Tourism and Safari/Sport hunting in the project zone were obtained from the Conservateur of Waza National Park, the Provincial office of MINEV at Caroua and the report of Tchamba (1996). Since the Délègue of MINEV Maroua was not present during much of the period of the study, his data were not made available and should be gathered by project staff in the coming months.

The statistics of the number of tourists (divided into nationals, residents and non-residents), visiting the Waza National Park seemed consistent and reliable, although data on the 1992/93 and 1993/94 tourist seasons were missing, due to reasons unknown to the study team.

The data available were sufficient to calculate the benefits for the reinundation options, making assumptions on future increase of tourist numbers, as outlined in Chapter 5.4.

The only form of Safari hunting permitted in the Extreme North Province is the hunting of elephants. For the whole of Cameroun an annual quotum has been set of 80 elephants, of which a quotum of 20 elephants has been set for the North and Extreme North. According to MINEV Garoua, per annum an average of 50 hunting licenses are issued for elephants nation wide. The actual numbers shot in the Extreme North Province differed per source, as is summarised below;

Table 4.4.1
Average numbers of elephants shot per annum by trophy hunters during 1994-1997, according to different sources.

source	Tchamba, 1996	MINEF Garoua	Conservateur WNP
average number of elephants shot per annum	10 sporthunting and 10 culled	approx. 10 in North and Ext.N.	4-5

Apart from Safari hunting on elephants, Sport hunting takes place, mainly on ducks and goose. Census data on numbers of ducks and goose in the Waza area were provided by the results of a census in 1994 by de Kort and Van Weerd, while census data during 1995-1997 were provided by Bobo *et al.* (1997) The main species hunted are 1) Knobbill goose (*Sarkidiornis melanota*), 2) Spurwinged goose (*Plecopterus gambiensis*), 3) Egyptian goose (*Alopechen aegiptiaca*), 4) Cargany (*Anas querquedula*) and White faced tree duck (*Dendrocygna viduata*).

These data were gathered by experienced bird watchers and are considered reliable.

The fees of hunting permits and hunting and trophée tax were also obtained from MINEFCaroua and Maroua and the Conservateur of WNP and showed consistency.

4.5 Natural Products

In our study an attempt was done to assess the economic importance of "natural products" other than fish production enhanced by reinundation of the floodplain. IIED (1997) had implemented a study to assess the economic importance of the so called "Hidden Harvest" or wild resources in the Hadedjia-Nguru wetlands, Nigeria. Since information on the production and use of these wild resources was absent, a research team defined 76 different "wild products" with economic importance for local communities for food, medicine, cattle feed, spiritual purpose, construction purpose, craft, cultural purpose, agrochemical and industrial purpose. The use of these products was studied by participatory rural appraisals and transect methods in two selected villages.

For the Waza Logone area a similar list could be drafted, but a major research effort is needed to investigate the quantities extracted and the values associated with these products.

Only for three products some information could be obtained, which may allow an estimate of the economic benefits of reinundation; 1) Gum Arabic, 2) Bushmeat 3) Perennial grasses.

4.6 Indirect Use and Non Use Values

According to Barbier *et al.* (1991) Indirect Use Values cover *benefits* such as flood control, storm protection, groundwater recharge and can be valued as *damage costs avoided, preventive expenditures* and *values of changes in productivity.* Barbier stated that due to constraints on data limited the coverage of wetland benefits in the Hadejia-Jama'ra floodplain, to *direct use of key resources only* (Agriculture, Fishing and Fuelwood). *Indirect Use Values and Non Use Values* were not taken into account during the study of Barbier *et al.* (1991). Similar constraints are faced by the study team of the present study. Since the importance of the construction works proposed for the *Model Reinundation* for reducing the risk of collapse of the Maga dam is stressed by SEMRY, this additional benefit will be taken into account, but not further quantified.

5 METHODOLOGY AND VALUATIONS

5.1 Fisheries

5.1.1 *Introduction*

The Fishing

Floodplains are amongst the most productive fishery resources in Africa. The fishery production cycle begins with the rainy season. The river waters rise and the water spreads onto the floodplain. Fish leave the rivers or perennial water bodies where they have spent the dry season and migrate onto the floodplain where they feed and spawn. The adults, juveniles and newly hatched fry grow rapidly on the abundant food. When the flood waters recede the fish return to the river to await the next flood cycle. Productivity is usually estimated (Wellcome; 1974) to lie between 40 and 60 kg /hectare flooded.

The exact pattern of migration varies from species to species. The hardy African catfish (Clarias sp) is usually the first to move. Large catfish can be found in water barely covering their backs and have even been found at night moving in wet grass. Catfish are also the last to leave the plain as the flood recedes. The "sardines" (Alestes sp.), on the other hand, are very sensitive. They are the last onto the floodplain and will leave as soon as they sense the water beginning to recede.

The habits of the species and their biological requirements dictate the method of fishing employed in their capture. The fishing calendar (Figure 5.1) gives an idea of the timing of the flood and the types of fishing on the floodplain. Broadly two fishing seasons can be defined. The "Grande Peche" begins at the height of the flood. Although the rains begin sometime in June the waters only begin to rise and spread onto the plain in July. At this time large Catfish can be speared, or clubbed, in shallow water as they leave the river or pools where they have spent the dry season. The normally sedentary local fishermen move into camps, with their families, on the floodplain during September. Here they set baited traps in cleared areas for the widely dispersed fish. As the waters begin to recede migrant fishermen from adjoining 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 *et al.*, 1995).

There is a short concentrated period of "sardine", (*Alestes* sp.) fishing just as the flood turns and these species migrate en masse to the safety of the river. All the fishermen tem-

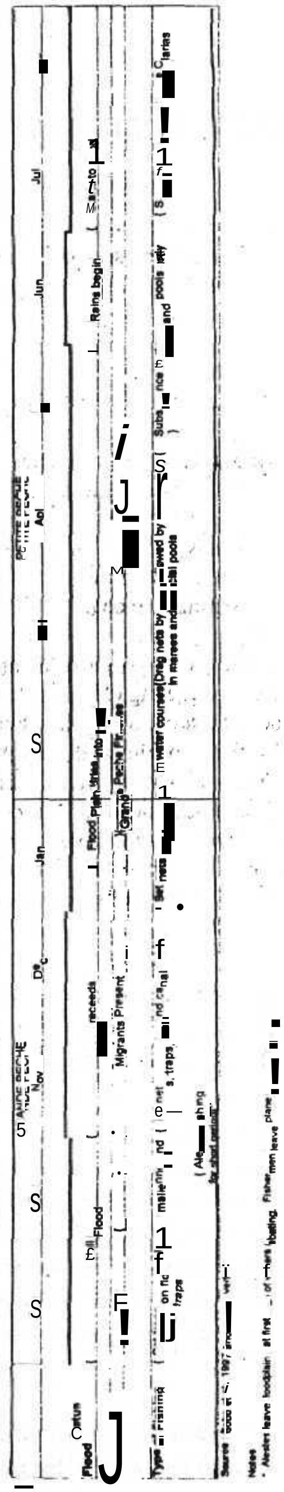

Figure 5.1
Fishing Calendar

porarily leave the floodplain to exploit this fishery along the Logone river, and other large watercourses, before returning to the floodplain.

The receding waters concentrate the fish into natural depressions and water courses where they are easily caught with set nets, grass barriers and traps and hooks. The fishermen have even dug many artificial 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 canal fishing is over the migrants leave the fishery. The flood plain is still, however, dotted with pools ("natural depressions") and water bodies full of trapped fish unable to reach the safety of the river.

The "natural depressions" gradually become swampy then dry up concentrating the trapped fish further. When the natural depressions are judged suitable for fishing the men will use seine nets to catch as many fish as they can. The woman and children then all join together 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.

Other natural and artificial depressions may hold their water throughout the dry season. These as well as the river itself are fished on a subsistence basis with set nets (filet dormant), throw nets (epervier) and hooks (Palangre). This is the period of the "Petite Peche".

Utilizing the Catch

The fishing is non selective and many undersized and unsuitable fish are caught. These are sorted from the catch and discarded. Almost 7% of the fish caught during the "Grande Peche" are discarded. Some are inedible but most are too small. About 2.75% of the fish caught during the "Petit Peche" are discarded. These are recorded as physical losses (Perte Physique) in the statistics. Out of the 6,190 tons caught in 1996/97 about 5,898 tons are utilized for home consumption or sales.

Not all the catch is marketed. A significant proportion is consumed by the fishermen and their families. Defined as "autoconsommation" in the statistics this amounts to 18% of the total catch before discards in "Grande Peche" and 10% in "Petite Peche". Out of 5,898 tons utilized in 1996/97 about 1,333 tons were consumed at home (1,114 tons in Grande Peche and 219 tons in Petite Peche). This left about 4,565 tons of wet fish weight to be sold.

Ninety five per cent of the catch is sun dried on tables constructed from branches and reeds. About 300 tons of *Lates* n. and *Heterotis* n. is smoked on open smoking tables. When sun dried the fresh fish lose weight as they dehydrate. This weight loss is 1 : 3 for all species except the tiny sardines (Alestes sp) where the loss is 1 : 4. After drying and smoking the 4,565 tons convert to a dry weight of about 1,482 tons.

Floodplain Productivity in 1996/97

The catch of 1996/97 amounting to 6,190 tons is estimated to accrue from a flood which covered 2,000 kilometers squared. The flood which produced these fish showed two distinct peaks. The first occurred in October 1996 and covered 1,700 km^2. The second peaked in November and covered an additional 300 km^2.

The yield of fish per hectare is therefore estimated at about 31 kg/ha. This is within sight of the range of yields suggested for African floodplains; (40-60kg/ha/annum) (Welcome *et al.*, 1970). Reasons for the shortfall in yield have been suggested by the project staff. (Bobo *et al.*, 1997a) These are:

- inaccurate data
- over exploitation; too many fishermen fishing on a much smaller floodplain destruction of juveniles by using too fine a mesh nets and not returning the juveniles to the water
- killing of fertile adults as the waters rise
- over exploitation of natural pools in the dry season
- construction of too many more fishing canals

With the restoration of the extent of the flood and the introduction of possible measures to manage the floodplain fishery this apparent over exploitation could be reduced and yields could rise to the levels of 40kg or more per hectare suggested for African floodplains.

Marketing the Catch

Fishermen bring their dried fish to various small markets such as Zimado, Holom, Yvie, Ngodeni, Bamgalo and Araynaba. The importance of these markets rises or falls depending on where the main fishing is concentrated. In turn the fishing concentration varies according to the dynamics of the flood cycle. A small amount of dried fish is sold in fishing camps to help fishermen in the purchasing of commodities.

From the small markets the product passes through three main transit points; Zimado, Te'Ko'le and Goromoi. From the transit points the product goes through the "distribution markets" of Pouss or Cuirvidag. Zimado is actually a local market and a distribution market serving Kousseri. From Pouss or Guirvidig the bulk of the fish goes to Maroua or Yagoua. Smaller final markets are Bogo, Banki and Mora. Some are transported as far as Lagdo.

Small merchants may buy as little as one sack to weighing 40 kg to sell in the next town. The biggest merchants may buy as many as 50 sacks and take them to Lagdo for resale.

A "typical" merchants buying trip would begin in Maroua. He or she would travel to Yvie. This would take the best part of a day. The evening of his arrival would be spent meeting people and perhaps selling some wares brought from Maroua. Buying the product could take one to two days depending on the competition for and availability of product. The sacks are then loaded onto a pickup for transport firstly to Pouss and then onwards to Maroua. The fish could actually be sold on from Pouss to another merchant. Upon the return to Maroua the product is sold on in sacks to individual market traders. Market traders break down the sacks into parcels for sale to consumers.

5.1.2 *Method of Economic Valuation of the Fishery*

The Fishermens Economic Value

In order to calculate the value of the 6,190 tons caught in 1996/97 it is necessary to differentiate between the "Grande" and "Petite Peche". This is because the species composition between these fishing periods alter as do prices. The tables (Annex 5.1 to 5.3) present the calculations of the economic values discussed here.

The estimation began by taking the quantities caught for each species in each period and subtracting the discards which have no value. The remaining utilized wet weight incorporates home consumption. Home consumption has an economic value to the consumers and is included in the valuation of the catch.

The utilized wet weight is converted into a dry weight using a conversion factor of 1 : 3 (except for Alestes at 1 : 4). The dry weight is divided by 40 kg to estimate the number of sacks. The number of sacs of each species is multiplied by the average seasonal price for a sack to yield the gross economic value to the fishermen. From this must be subtracted the economic cost of production.

The economic cost of production again depends on the type of fishing. The catch in the "Grande Peche" is divided by 6,800 fishermen whilst the catch in the "Petite Peche" is divided between 3,600 fishermen. The fishermen's costs are depreciation and maintenance of equipment, personal transport in the field as they pursue the fish, transport of the fish to a local market and an estimate of the opportunity cost of the fishermen's labour.

Estimating the fisherman's opportunity cost of labour in a traditional semi-subsistence fishery is subject to debate. Applying an opportunity cost equal to the full unskilled labour rate in agriculture to most floodplain fisheries would suggest the fishery is completely uneconomic; yet cannot explain why the vibrant fishery actually exists. There is some merit in suggesting that the opportunity cost of labour, in this situation, is zero; (Bobo and Kouokam, 1998) effectively suggesting that the fisherman has no alternative opportunity for earning a living during the height of the flood. There is a "quality of life" factor in this approach. A floodplain fisherman will have pursued this occupation for generations and may know no other way of life. He might value his way of life and may not want to migrate to the city and compete with the unskilled unemployed. A fisherman often considers agricultural labour to be "woman's work". The sensitivity of the model to the opportunity cost of labour complicates the decision. Clearly there is an opportunity cost of labour but a full market rate is not justified. The opportunity cost could range between a minimum of zero and a maximum of FCFA 500 per day. A compromise sum of FCFA 300 per day has been chosen in this model. During the "Grande Peche" the opportunity cost of the labour of the fisherman's wife and children is assumed to be zero.

The return to the fisherman's labour is another way of examining the fishing family economics whilst circumventing the opportunity cost debate. A migrant fisherman earns the about FCFA 84,000 during the "Grande Peche". A local fisherman, pursuing the fisheryl year, earns about FCFA 162,000. Subtracting the opportunity cost of labour as discussed above reduces the economic value to about FCFA 44,600 for a migrant and FCFA 96,225 for a local (Annex 5.4.9).

This methodology suggests that the cost of production is about 64% of gross value during the "Grande Peche" and 54% of gross value during the "Petite Peche". This broadly agrees with the factor suggested in previous studies (Wesseling et al. 1994) of 62% for costs of fishing. Accordingly the factors of 64% for "Grande" and 54% for "Petit Peche" are used in this model.

Economic costs of production of each species are subtracted from the gross value to yield the economic value for each season. The seasons are then summed (Annex 5.1.1) to estimate the value added by fishermen in both seasons to be approximately FCFA 490 million and for traders FCFA 249 million for the 1996/97 season.

The Merchants Economic Value

The fishermen sell what they have not eaten themselves. Subtracting home consumption from utilized catch yields an estimate of the catch sold.

The structure of any market is extremely complex. In order to estimate the traders markup it is necessary to assume a "typical" market route. The assumption here is that the fishermen deliver to Yvie. Delivery costs to Yvie were accordingly allocated on a per sack basis to the fisherman. The productwas all assumed to be sold in Maroua.

Prices were taken in Yvie, and Pouss for different species in October, November and December in 1997. In this journey prices and margins varied widely. This can be expected in a dynamic fish market where strict rules of supply and demand do not apply as traders jostle for control and market share. The results of the market survey are presented in Annex 5.5.0. The traders markup is estimated to be 37% between Yvie and Pouss.

The journey from Pouss to Maroua suggests a more stable margin applies. Here merchants are transacting rather than competitive buying so margins can be expected to be more stable. The markup is estimated at 12.5%.

The total markup from Yvie to Maroua is in the region of 50%. For the purpose of this model a more conservative estimate of 45% is applied. This is higher than the markup of 30% suggested in other studies. The contribution of retail market traders has not, however, been included in either study. The markup of 45% can therefore be considered conservative.

An estimation of a traders economic returns is shown in Annex 5.6.0. Again it has been necessary to simplify the market structure into a typical trader travelling from Maroua to Yvie and buying five sacks. The assumptions associated with the model are clearly indicated. The opportunity cost of labour is estimated as FCFA 1,500 per day for the five day trip. Taxes, being transfers, are excluded from the economic valuation. The opportunity cost of the traders capital is at the unofficial market rate of 5% per month. It is applied for a week. Traders economic costs are estimated to be 43% of the markup.

The proportion of costs at 43% is lower than that (50%) suggested in other studies as a factor. The proportion of fixed costs of the trip will be reduced in direct proportion to the quantity purchased. This makes a big difference to the calculation and may explain the difference. Five sacks was agreed with project staff to be a reasonable quantity on which to base the calculation.

A calculation of the traders financial profit for the trip for the five sacks shows he might make a return to his capital and labour of FCFA 38,500 or more for the weekly round trip. At 21% of turnover this does not seem unreasonably high. Factoring in higher costs does not seem justified. This model according selects the 43% as being reasonable.

These factors enable us to complete the economic valuation of the traders contribution in 1996/97. This is estimated to be in the region of FCFA 249 million.

5.1.3 Total Economie Value of the Fishery in 1996/97

The Total Economie Value of the fishery 1996/97 is the contribution attributed to the fishermen plus the value added by the traders. The Total Economic Value of the fishery in 1996/97 is estimated to be **FCFA 739 *million.***

***Table* 5.1.1**
Total Economic Value of the Fishery in 1996/97

Total Economic Value added by fishermen	FCFA 490 million
Total Economic Value added by traders	FCFA 249 million
Total Economic Value of fishery	FCFA 739 million

Source: Summary of Calculations in Annex 5

This value came from a flood covering 2,000 km^2. The total wet weight caught was 6,190 tons. The fishery yield was 31kg/ha. The Total Economic Value of each ton caught was FCFA 119, 400.

The TOTAL ECONOMIC VALUE per km^2 is FCFA 369,500 per annum

5.1.4 Variation Factors

There are two potential variations which will limit the application of a fixed valuation per hectare of area flooded to a model. These are:

- the lag period in which benefits will build up
- variations in the price of fish.

Build-up of Productivity

Potential productivity can be 40 kg/hectare per annum. Present productivity is slightly lower at 31 kg/ha/ar. This difference may be attributed to over fishing. Statistically it is not proven that the floodplain is over fished yet there are indications that catches in the canals have fallen.

Increasing the area flooded will automatically decrease the intensity of fishing. Productivity in the long term will tend to rise; particularly if some simple management measures can be introduced. Stopping dry season fishing in the National Park is a clear enforceable possibility. If the resource is not over-exploited the size of the fish will increase and their value increase accordingly.

There does not appear to be much lag in building up the yield of the fishery provided sufficient brood stock are available. Fish are able to migrate up and down the river and replenish breeding stock very quickly. The catch appears very closely related to surface area flooded. If the area flooded increases then the fish will be more spread out over the floodplain making them more difficult too catch in the "floodplain" period. They will have more time to grow. The concentrating effect of the receding waters makes the fish easier to catch in the canals and "natural depressions" later in the season. The larger the flood the longer the growing period. It is not considered necessary to complicate the model by factoring in a buildup of yield.

Annex 5.8 gives an indication of the dramatic change in yield in between December 1996/January 1997 and December 1997/January 1998 when the flood receded early and catches fell by around 1,000 tons per month. The duration of inundation and the surface area flooded have an effect on catches.

Variations in Fish Prices

There are marked differences in price between good flood years and poor flood years. All data analyzed here for the 1996/97 year relate to a slightly better than average year. The 1997/98 year looks set to be a poor year. Prices (Annex 5.7) are available in February 1998 which suggest that prices of catfish have risen by 15% whilst Alestes sp. are up 40% on last year. This trend can examined in greater detail over the coming months to obtain some hard data prior to the completion of the full CBA.

A previous study (Wesseling, 1994) has suggested that prices in a good year can be 30% of the prices in a poor year. Clearly a factor for price variations needs to be included in the model. The actual variations are concerned with the price elasticity of demand for fish and the cross-elasticity of demand for substitute products such as meat. It is very difficult to calculate.

This will have a significant effect on the model. The model must have the price of fish included as a part of the sensitivity analysis.

5.2 Livestock

5.2.1 *Description of the model; methods and data*

Since the calculation of the direct benefits of additional livestock production is complicated, we have prefered to use a model based on feed cost avoided with reference to the use of substitute forage such as cotton cake in the absence of a reinundation.

The general model has been defined as follows:

$$NB/KM^2 \text{ flooded} = B/KM^2 \text{ flooded} - C/KM^2 \text{ flooded}$$

NB/KM^2 = Net Benefits per square kilometre flooded
B/KM^2 = Benefits per square kilometre flooded
C/KM^2 = Costs per square kilometre flooded

$$B/KM^2 \text{ flooded} = SR/km2 * FC$$

SR = stocking rate (in TLU days)
FC = feed costs avoided per TLU day: 2.08 kg of cotton cake times price cotton cake/kg + 4.17 kg of straw times price straw/kg

$$C/KM^2 \text{ flooded} = SR/km^2 * EC$$

EC = extra costs involved when herding cattle in the floodplains instead of in the dry plains, essentially costs associated with waterborne diseases.

Primary production and actual exploitation
First we must make a distinction between the total primary productivity (in terms of forage produced per surface unit) of a rehabilitated floodplain and the forage that can be actually exploited by pastoralists. Wesseling *et al.* (1994) calculated (or rather predicted) the "productivity" (in TLU's) or carrying capacity after 100% restoration of floodplain pastures for different zones within the floodplain. This carrying capacity formed the physical basis of their monetary valuation exercise. We have chosen to base the calculation on actual exploitation rates, i.e. actual stocking rates, as long as they did not exceed the carrying capacity, calculated by Wesseling *et al.* (1994). Our arguments are the following:

1. A 100% exploitation of carrying capacity is not likely. Actual exploitation rates will depend on many factors, including political factors (will Woila and Arab Choa be able to cross the borders easily?), duration of the flood (may work both ways), and accessibility of the terrain (e.g. depressions at Zilim and Hinale) but will probably on the

whole remain below carrying capacity. Of course the actual yearly difference between carrying capacity and actual exploitation is a left-over, possibly exploited by wildlife.

2. The actual exploitation rate is a precise figure for policy makers and potential donors. It validates to a certain extent the implicit assumption that pastoralists from regions surrounding the floodplain will step in to exploit the productivity of the floodplain.

There are also some shortcomings to using actual exploitation rates. In fact, while an increasing number of cattle present in the pilot zone were observed during the years after the pilot flooding of 1993/4, there remains the problem of relating it to the size and duration of floodings. This is for two reasons:

1. Exact figures on flooded surfaces in the pilot zone before the pilot release are not available, although we can and do use an estimate by Braund/Kouokam, based on interviews with villagers. We have found at the WLP data on stocking densities (in terms of TLU-days spent in the pilot zone) and figures on flooded surface within the pilot zone for three years (1994/95, 1995/96 and 1996/97). When data on stocking densities in 1997/98 become available they can be easily incorporated into the database.

2. While in fisheries physical production of year x can be more or less directly related to the scale and duration of flooding in year x, the quality of pastures is likely to be related also to past floodings. Because of the absence of Paul Schölte, the ecologist responsible for research on pastures and pastoralism, we could not (yet) sufficiently account for this element in the model. The two problems are related to some degree as the provision of pre-pilot release data on flooded surfaces would allow us to say something on the effects of post-pilot release floodings on pasture recovery.

Although in principle stocking data were available for more zones (e.g. northern zone, Zina zone, east zone, Maga zone) we decided to use only pilot zone data. There were two reasons for this:

1. Only for the pilot zone detailed flooded surface data seemed to be available (Sighomnou *et al.*, 1996).

2. Data were not yet sufficiently processed, so we had to spend a lot of time in getting the data in a spreadsheet. To include the data on other zones would have taken almost a week.

5.2.2 *Pricing*

While the regional cattle stock seems to increase steadily in the Far North Province of Cameroon (p.c. Andre Teyssier, SODECOTON and Melanie Requir-Destardins, CIRAD) pasture and forage become increasingly scarce, especially during the dry season. The consequences are an overexploitation of dryland pastures and an increase in conflicts between pastoralists, sedentary cattle raisers and farmers. The increasing scarcity of pastures and forage is indicated by an increasing use of cotton cakes to feed cattle in the region. In fact, because of burgeoning local demand, the export of cotton cakes has been stopped since 1993/94 (SODECOTON 1993 and 1994). The demand for cotton cake has steadily risen to the point where there is a shortage of supply. Prices have reached up to FCFA 5,000 per bag of 60 kg. The following quote refers to the year of 1993/94, which was a dry year.

"Allthough we have pushed up our production capacity to the maximum we have not been able to avoid scarcity to become general, especially in the Far North Province"
(SODECOTON, 1994)

The bulk of local demand for cotton cakes is concentrated in the dry season; about 95% of cattle cakes sold by SODECOTON are sold between December and June. Cotton cakes are used not only by sedentary cattle raisers but also by semi-nomadic and nomadic cattle raisers (p.c. Saidou, WLP and Zakariam, Service d'Elevage Maroua). The contribution of cotton cake to total food intake by nomadic cattle may be up to 40% during the height of the dry season (source: p.c. Saidou, WLP), the season during which dryland pastures have lost their productivity and the season during which floodplain pastures are still productive. We may thus expect that a large-scale reflooding of the Logone fioodplain will have a large positive impact on the supply of dry season forage in the region.

Cotton cakes (combined with straw) can be considered to be a substitute for the forage produced on fioodplain pastures. This is why we used the prices of cotton cake and straw as surrogate market prices in order to value changes-in-productivity of fioodplain pastures. We do not know the actual size of "preventive expenditures" on cotton cakes made by nomads and semi-nomads, the groups able to exploit the fioodplain pasture resources, compared to sedentary cattle raisers. Furthermore, it is clear that effective demand for cotton cakes is constrained by income and many cattle raisers are therefor forced to continue exploiting available dryland pastures and crop residues, at the cost of environmental degradation and diminishing quality of the cattle stock.

Cotton cakes and straw are not what economists call a "perfect" substitute for fioodplain forage (*Dixon et al.*, 1995). There may be extra costs involved in fioodplain pastoralism, compared to feeding cotton cakes and straw in the villages. These costs include costs of herding and costs due to waterborne diseases more prevalent in the floodplain. On the other hand, in the village people may have more problems in providing water to their cattle. We tried to take these costs into account in the following way. We estimated additional herding costs on the basis of information supplied by Saidou (Waza Logone Project). Eventually they turned out to be at about the same level per TLU day as the labour costs involved in feeding cattle cake and straw and providing water to the animals in the village (or for the nomads, on dryland pastures). With regard to the costs of waterborne diseases we have used an estimate of Wesseling et al (30% more mortality in the floodplain than in the village; valued at FCFA 3150 per TLU season or FCFA 21 per TLU day spent in the floodplain).

Calculating the scarcity price of cotton cake gave some problems. Cotton cakes are sold by SODECOTON at prices that are fixed each year (presumably October) at the level of the general management at Caroua. These inside-plant prices can be considered to be lower than scarcity prices. They are political prices in the sense that large quantities are preferentially sold to a few big traders. Just outside the plant prices are already at least 30% higher and we may safely assume that this mark up is not caused by real economic costs (e.g. in transporting it over 50 meters). To give an example: while in 1993/94 the in-plant price was set at FCFA 1,200 per bag (of 60 kg), outside the plant prices were as high as FCFA 3,000 to FCF 4,000. In some villages prices of FCFA 5,000 per bag (of 60 kg) have been observed (SODECOTON, 1994). Although these figures refer to the problematic season of 1993/94 they give some indication of the problem of calculating a scarcity price. Over the last three years in-plant prices have risen from FCFA 1,200 in 1993/94 to FCFA 1,800 in 1997/98. Consequently the difference between in-plant and outside-plant prices has decreased.

Although there are reasons to expect outside plant prices to be somewhat higher than scarcity prices (as the big traders control cotton cake supply on the free market and may thus create artificial scarcity at particular moments in time), for the moment we assume the outside plant prices to reflect scarcity prices. So we use them for our calculations. The straw price used in the calculation was FCFA 5/kg (Wesseling *et ai,* 1994), which amounts to 4.17 kg (daily intake per TLU) times FCFA 5 = FCFA 2o.85/TLU-day.

5.2.3 *Actual stocking rates*

Stocking densities are based on field research in pilot zone in the years 1993/94 (dry season before pilot release), 1994/95 (dry season just after pilot release), 1995/96 and 1996/97. It is claimed that the information covers all herdsmen (and thus cattle) who visited the pilot zone (p.c. Saidou). WLP researchers visited different groups of pastoralists, counted the number of their herds and asked the pastoralists how long (in weeks) they have been staying in the different zones. Obtaining exact cattle numbers by interviewing or by outright counting was not possible because pastoralists are not eager to provide this information to outsiders. So the output of the research was the total number of herd-weeks (number of herds x number of weeks spent) spent in the pilot zone by the different pastoralist groups. The distinction between different pastoralist groups, including semi-nomadic groups (Northern transhumance and Southern transhumance) and nomadic groups (Woila, Arab-Choa, Alidjam and Addankos) was important, because of the different average sizes of their herds. Information (Saidou, pc 1998) on average herd size for the different groups of pastoralists allowed us as to calculate the weighted average herd size (about 80) and the total number of cattle-days spent in the pilot zone. The mode! is sensitive to this parameter.

By multiplying the figure on cattle-days spent with 0.7 the total number of TLU-days spent was got, 0.7 TLU being an appropriate estimate for the size of the cattle of this region (source: Service d'Elevage and writings Paul Schölte). On the basis of estimated flooded surface (in km^2) (R. Braund and R. Kouokam) for the years 1993, 1994, 1995 and 1996 we were able to calculate the figure of TLU-days/km^2 flooded. This was the basis of our economic valuation. In the course of time we discovered that the "pilot zone" as defined for hydrological research purposes (Sighomnou et al., 1994) did not match the definition used by Schölte during his research on pastoralists. In fact the latter turned out to be about 75 km2 (ail flooded after pilot release) larger. The model was accordingly adapted, i.e. the 75 km2 is included in the flooded area figures of table 5.2.2.

The food-intake equivalent of one TLU-day is 2.07 kg of cotton cake and 4.17 kg of straw (Wesseling *et al.*, 1994). Information on prices of cotton cakes through the year were obtained at SODECOTON, the Service d'Elevage, traders outside the SODECOTON plant, and various other informants.

5.2.4 Results

Table 5.2.1 summarizes the results of the stocking density analysis. Three groups of pastoralists are responsible for about 90% of the total TLU-days spent in the pilot zone. These groups are the Northern semi-nomads (33-35%), the Arab Choa (17-29%) and the Woila (24-37%). The Woila enter the floodplain from Nigeria, and (part of the) Arab Choa enter the floodplain from Nigeria and Chad (p.c. Kouokam), so it can be concluded that about 40-55% of floodplain benefits derived from improved pastures are captured by non-residents. Of course for the economic valuation exercise only the absolute figures on stocking rates are relevant. Nevertheless, as Woila and Arab Choa cattle makes up a large part of the total stocking density, actual stocking rates (and thus economic value of reflooding) may be very sensitive to events, which reduce the access of these groups to the Logone floodplain.

***Table* 5.2.1**

Total of TLU days spent in pilot zone and percentage contribution of different pastoralist groups

Year	Type_nomad	total herds.weeks*	ANCH	TLU-days	percentage
1993/94	Addankos	24	50	5880	0.3
	Arabes_choas	627	no	337953	17.2
	Alidjam	70.5	48	16581.6	0.8
	Woila	2123.5	70	728360.5	37-2
	Trans_nord	1673.5	85	697012.8	35-6
	Trans_sud	465	75	170887.5	8.7
	TOTAL			1956675	100
94/95	Addankos	21	5°	5145	0.1
	Arabes_choas	1515	110	816585	29.1
	Alidjam	277.5	48	65268	2-3
	Woila	1987	70	681541	24-3
	Trans_nord	2394	85	997101	35.5
	Trans_sud	645.5	75	237221.3	8-4
	TOTAL			2802861	100
95/96	Addankos	326	50	79870	3-4
	Arabes_choas	1082	no	583198	25-4
	Alidjam	165	48	38808	1.6
	Woila	2152.5	70	738307.5	32.2
	Trans_nord	1861.5	85	775314.8	33.8
	Trans_sud	208	75	76440	3-3
	TOTAL			2291938	100
96/97	Addankos	464	5°	113680	3.0
	Arabes_choas	1838.5	110	990951.5	26.9
	Alidjam	533-5	48	125479.2	3-4
	Woila	3240.5	70	1111492	30.2
	Trans_nord	2959.5	85	1232632	33.5
	Trans_sud	271	75	99592.5	2.7
	TOTAL			3673826	100

* (based on pastoralist research by Schölte and Saidou, WLP).

- ANCH = average number of cattle per herd
- TLU-days: number of TLU-days spent in pilot zone

Table 5.2.2 presents the results of the monetary valuation exercise. The net value per km2 flooded varied between FCFA 432.695 in 1994/5 and FCFA730.381 in 1996/7based on in-plant prices. When using outside prices the net value/km² varies between FCFA 866.956 and FCFA 1.573.545. Net value/km² depends on actual stocking rates (TLU-days) on the one hand and the price of cotton cake on the other. With "given" stocking rates net value/km2 has an almost linear relationship with cotton prices, because extra costs of 30% mortality (FCFA 21) more or less equal the costs of straw (FCFA 20.85).

***Table* 5.2.2**
Monetary valuation per km² flooded

Year	1993/94	1994/95	1995/96	1996/97
TLU-DAYS	1956675	2802861	2291938	3673826
KM²-flooded	155	268.5	279.5	276.5
TLU days per KM²	12623.7	10438.9	8200.1	13286.9
PRICE cotton cakes/kg (inside plant)	20	20	32	26.5
PRICE straw per kg	5	5	5	5
COSTS straw per TLU day	20.8	20.8	20.8	20.8
COSTS cotton cakes per TLU day	41.6	41.6	66.5	55.1
TOTAL FEED COST/TLY DAY	62.4	62.4	87.4	75.9
VALUE FEED/KM²	788350.6	651913.1	716773.8	1009405
MORTALITY COSTS/TLU DAY	21	21	21	21
MORTALITY COSTS/KM²	265097.903	219218.18	172202.8551	279025
NET VALUE/KM²	523252.7	432694.9;	544571.0	730381
PRICE cotton cakes/kg (outside plant)	60	40	60	40
TOTAL FEED COST/TLU DAY	145.6	104.0	145.6	104.0
VALUE FEED/KM²	1838643.3	1086173.9	1194349.8	1382501
NET VALUE/KM²	15735454	866955.7	1022146.9	1103476

- Values in FCFA; TLU-Days = Tropical Livestock Unit days;
- TLU days per KM² = Tropical Livestock Unit days per square kilometre flooded;
- KM²-Flooded = square km flooded;
- TOTAL FEED COSTS TLU/DAY = 2.08 x price of one kg of cotton cake + 4.17 x price of one kg of straw;
- VALUE FEED/KM² = Value of feed costs avoided per square kilometre;
- NET VALUE/KM² = VALUE FEED/KM² minus MORTALITY COSTS/KM² (Net Value/KM² is Net Value per square kilometre flooded;)

Assumptions:

a. one TLU-day feed equivalent is 2.08 kg of cotton cakes and 4.17 kg of straw.
b. mortality rate is 30% higher than in non-floodplain; costs are 21 cfa/TLU-day (3150 cfa per TLU season/150 days) (source: Wesseling *et al.*, 1994)
c. costs of herding in floodplain equal labour costs in village.
d. 155 km2 flooded before pilot release is estimate of Kouokam; other flooded surfaces are calculated by Braund.

We see that although in 1995/96 stocking rates (TLU-days/km²) were about 20% lower than in 1994/95, the price of cotton cakes was 60% (using inside plant prices) or 50% (using outside plant prices) higher, resulting in a higher net value/km². The exact reason for the relatively low stocking rates in 1995/96 is not known. It should be noted that in this particular year the (free market, i.e. outside plant) price of cotton cake was high, which clearly indicates scarcity of forage in the Far North Province. It should also be noted that reduced visits by Arab-choa and the Southern semi-nomads were responsible for the decrease.

On the basis of the Net Benefits/km² figures presented in Table 5.2.2. Table 5.2.3 provides the results of the "Model Reinundation", which will contribute 1390 km² of additional flooded area outside the Waza park. Although a large area of Waza Park will be flooded this cannot be used for cattle grazing, because of legal restrictions. Net benefits are estimated to lie between FCFA 600 million in 1994/65 and FCFA 1 billion FCFA in 1996/67, using in-plant prices. The use of outside plant prices more or less doubled the net benefits in 1994/65 to between FCFA 1.2 billion and FCFA 2.19 billion. It should be noted that the straightforward multiplication of net value/km² by the additional flooded area of 1390 km2 may not be altogether realistic. it may not be possible to exploit the additional area to the same degree as the pastures of the pilot zone. Much depends on the "economic accessibility" of the terrain and the total cattle stock of potential users in the regions which surround the floodplain. The fact that 40-55% of the actual users enters the floodplain from Nigeria and/or Chad suggests that the total "stock" of potential users is considerable and migration response is rapid.

***Table* 5.2.3**

Trail: changes in total Net Value of "Model Reinundation" as function of different cotton cake prices

YEAR	1993/94	1994/95	1995/96	1996/7	AVERAGE
PRICE cotton cakes (in plant)	20	20	32	26.5	24.625
NET VALUE/KM²	523252.7	432694.9	544571-0	730380.5	557724.8
TRIAL OPTION	727321345	601445951	756953730	1.015E+09	775237489·
PRICE C cakes (outside plant)	60	40	60	40	50
NET VALUE/KM²	1573545.4	866955.7	1022146.9	1103476.5	1141531.1
TRIAL OPTION	2.187E+09	1.205E+09	1.421E+09	1.534E+09	1.587E+O9

Assumptions:

a. Total flooded and exploitable area is 1390 km2, thus Waza part excluded.

b .No off-site effects, e.g. on lake Maga or Lake Chad.

c. Linear relationship between area flooded and total net economic value.

d. Values in FCFA.

Given the considerations discussed above concerning the scarcity price of cotton cake we estimate the economic value of pastures to be created by the "Model Reinundation to be FCFA 1.587 billion/year (i.e. the average for the four years using outside plant prices, which are assumed to reflect scarcity prices more accurately than inside-plant prices). *This equates to FCFA* ***1142,000/ km²***.

Table 5.2.4 gives an indication of the magnitude of forage production (i.e. the cotton cake equivalent part) due to the "Model Reinundation" by comparing it with the cotton cake sales by SODECOTON in the Grand Nord in 1994/95 and 1996/97. It shows that the nutritional value of the forage to be created is more or less of the same magnitude as that of the total production of cotton cakes by SODECOTON.

Table 5.2.4
Cotton ***coke equivalent*** *of created forage in "Mode! Reinundation"*

YEAR	TLU day/KM²	CC EQUIVALENT[a]	SODECOTON SALES[b]
1993/94	12624	36.397,669	24,400,000
1994/95	10439	30,181,124	32,000,000
1995/6	8200	23,708.233	28,000,000
1996/7	13287	38,415,066	?

a. CC EQUIVALENT: Equivalent quantity of cotton cakes (in kg's) for 1390 km² additional flooded area (see **also** annex 5.11)

b. SODECOTON SALES: cotton cake sales by SODECOTON in the Grand Nord during that particular year.

5.2.5 *Conclusions*

It appears that reflooding in the "Model Reinundation form will have an enormous positive impact on the productivity and sustainability of cattle raising in the Far North Province and surrounding regions, including regions in Nigeria and Chad. The benefits of improved pasture in the floodplain will be captured not only by nomads and semi-nomads. Sedentary cattle-raisers will also profit because of less pressure on dryland pastures and of a reduced scarcity of cotton cakes, which eventually may lower the in-plant price of cotton cakes down to the level of world market prices (minus transportation costs to Douaia). The total economic value of these benefits we estimate to be about FCFA 1.5 billion per year or FCFA 1142,000/km².

5.3 Agriculture

5.3.1 *Overview*

The most important staple crops grown in the floodplain appear to include rice, red millet and mouskouari (white dry season millet). In the recent past also the cultivation of the "traditional" floating rice was observed (Wesseling *et al.*, 1994; annex), but this activity appears to have been stopped and traditional varieties have been lost (p.c. Kuoukam).

Agriculture means different things for different floodplain dwellers. In Kotoko society, agriculture has *a* low status. The Kotoko cultivate staple crops like red millet and dry season millet, but only because the possibilities of earning a living by fisheries were insufficient (Van der Beek, 1997). In Mousgoum society agriculture does not have a low status. Depending on local circumstances Mousgoum grow red millet, white dry season millet, and/or rice.

5.3.2 *Model and results*

Unlike pastoralism and fishing, agriculture is a localized activity. It is in the neighbourhood of villages that agriculture takes place. For this reason it is not a realistic exercise to try to work out a figure on net benefits or losses per km2 flooded, because much depends on the precise area of flooding. Furthermore, on the basis of information available at WLP, it was easily concluded that the impact of large-scale reflooding on agriculture will not be impressive. In the following we therefore provide only a brief sketch of the impact.

Reflooding closes some agricultural possibilities and offers new ones. The possibilities for cultivating red millet and white dry season millet will decrease (Kuoukam, 1996 and personal communications). The gross value of red millet production affected by the floodings associated by the Model Reinundation he calculated as about FCFA n million.

Approximately 300 ha of white dry season millet fields are likely to be lost due to floodings. The gross value of white dry season millet produced on these fields is estimated to be about FCFA n million cfa (Kuoukam, 1996); based on a productivity of 4.6 bags/ha and a price of FCFA 8,000 per bag. The figure of FCFA n million takes into account effects in the pilot zone only, but according to Kuoukam the actual cultivation of white dry season millet is largely restricted to the pilot zone.

According to Kok and Kuoukam the total acreage cultivated with rice will increase by about no ha (80 communally and 30 individually cultivated) due to the flooding associated with the Model Reinundation. Cross revenue is calculated by them to be about 25 million cfa yearly, based on 3 tons/ha (on communal fields) and 1.5 tons (on individual fields), and after deduction of external input costs for the communal fields. In the calculation on the communal fields the costs of WLP staff in stimulating farmers to cultivate rice communally are not incorporated. Furthermore, the productivity of communal fields may be a too optimistic estimate given past experiences in this field.

So for the three crops together we have a gross benefit of only 3 million. If we calculate net benefits to be about 0.15% of gross benefits, as Anderson did for Kano state in Nigeria (Anderson, 1987), net benefits will not even reach half a million cfa/year!

The net benefits (about 20 million) calculated by Wesseling et al were largely based on the assumption that floating rice would regain the importance it had in the distant past. The traditional floating rice varieties, however, have been lost (Koukam, pc 1998).

5.4 Tourism and Hunting

5.4.7 *Tourism*

Overview

Table 5.4.1. summarises the numbers of tourists, visiting Waza National Park.

Table 5.4.1
Numbers of tourists visiting Waza National Park (source: Conservateur WNP)

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	540°

Actual numbers of tourists visiting WNP were at a minimum in the 1994/95 season, clearly related to the economic crisis and the insecurity in the area. During 1995/96 to 1996/97 there is a tendency of increase in numbers. According to the Conservateur the long term target is 12,000 tourists per year, while before the economic crisis started, an average of 7,000 tourists were visiting the Park. According to Tchamba (1996) elephants are the number one attraction of WNP for tourists, giraffe being a good second. Tchamba (1996) also indicated that due to the reinundation of the plan, elephants tend to stay longer in the Park, which may increase the attraction value of elephants for tourists after the *model reinundation.* Of the tourists visiting WNP, 15% are nationals, 25% residents and 60% non-resident visitors. The average length of a visit to the Park is three days. The expenditure of tourists per day in WNP is given in the table below.

Table 5.4.2

Exenditure per day of tourists visiting Waza National Park (CFA)

Entree fee non resident	5000
Entree fee resident	3000
Entree fee national	1500
Rent bus	8000
Fuel	3000
Meals and drinks	15000
Hotel	13500
Miscellaneous (tolls, souvenirs etc.)	5000
Total FCFA	45,500-49,000

Economic Contribution from Tourism

The economic contribution of tourism cannot be attributed to the surface area of the park flooded. A relationship between the number of visitors and the general condition of the park can be inferred. If the park is restored to its former state with a large increase in animals, particularly of the main attractions elephants and giraffes then there is good reason to expect a return of visitors.

The extreme north of the Cameroon's has sufficient tourist attractions to develop a reasonable tourist industry. Wildlife parks are proving valuable tourist attractions in many African nations. Waza park is potentially one of the best parks in West Africa. Potentially the benefits of the park could be enormous particularly if facilities are developed to exploit the "luxury" end of the market. Waza may never have sufficient "big game" to compete with East African Parks but the bird life is exceptional. The park could be marketed successfully to ornithologists as well as the more traditional park visitors.

The more of the park that is restored the more attractive it will be. Two options are modelled. One, called the "grande option", is full restoration arising from the full Mayo Vrik widening. The second is called the "Petite Option" which represent the impact of the pilot flooding after 1994, which halves the rate of visitor increase.

The number of visitors was fairly stable from 1987 to 1991 at about 5,500 per annum. Following the decrease in visitors in 1994 and 1995 numbers have risen to about this level where they might stabilize. The model assumes a gradual increase at a rate of 2% per annum. This is the number of visitors without improvement.

In the "Model Reinundation" it is assumed that tourist numbers gradually build up at a rate of 7.5% per annum to reach almost the capacity figures of 11,500 in ten years after reinundation. In the "Petite Option" visitors increase at a rate of 3.75% per annum; only

1.75% more than the without project scenario. The number reaches a maximum of 8,000 per annum.

it is assumed that the proportion of visitors also remains the same at 15% locals, 25% residents and 60% tourists. All are assumed to spend the existing average number of days (3) in the park.

Expenditure figures are multiplied by a factor of 0.8 for the vehicles and tours and by 0.7 for other categories to remove costs and attain the net visitors expenditure. Incremental Park fees are assumed to be entirely a benefit as the Park costs are mostly fixed and would be spent with or without the additional visitors.

The Annex 5.4.1 presents the full model but the main points are summarized below:

Table 5.4.3
Economic Value of Tourism - Model Reinundation

Tourist Numbers	Park Fees	Visitors net Spending	Total Economic Contribution
6000	0	0	0
6400	1.3m	12.1m	13.4m
7400	4.3m	39.9m	44.2m
8000	6.0m	55.7m	61.7m
9200	9.9m	92.0m	101.9m
10700	14.5m	135.0m	149.5m

For the sake of simplicity we assume that tourist number increase to slightly more than the previous number of 7,400 but less than the park capacity. This occurs four years after the "model reinundation" option or seven years after the "petite" option. Visitors would have increased with or without the project so the net economic values in terms of tourists are proposed as:

Model Reinundation	–	FCFA 17.6m after 4 years.
Petite Option	–	**FCFA 10m** after 7 years

5.4.2 *Safari hunting*

Overview

The only form of Safari hunting permitted in the Extreme North Province is the hunting of elephants. For the whole of Cameroun an annual quotum has been set of 80 elephants, of which a quotum of 20 elephants has been set for the North and Extreme North. According to MINEF Caroua, per annum an average of 50 hunting licenses are issued for elephants nation wide. The actual numbers shot in the Extreme North Province range from 4-10 elephants per annum, but the quotum of 20 elephants is never filled (MINEF, Caroua).

Of the permits provided each year, approximately 80% go to non-residents and 20% to nationals.The average expenditure of a Safari trip by a non-resident to shoot one elephant is CFA 6 million (MINEF Caroua, 1998). The fees for Hunting permits and Hunting tax for elephants differ per category of hunter.

Table 5.4.3
Fees (in FCFA) of hunting permits and hunting taxfor sportshunting on elephants in Cameroun (source: MINEF Caroua)

Category hunter	Hunting permit	Hunting tax
Non-resident	250000	1000000
Resident	120000	800000
National	100000	100000

Economic Value of Safari Hunting

The quota for elephants in the extreme north is 20 elephants. Between 4 and 10 are shot in the sport hunting sector. The quota is not taken up. Although an elephant, as a sports trophy, could be worth FCFA 3m, if one allows 50% costs, it is difficult to envisage the project contributing to sports hunting if the park is already at capacity and a quota is not taken up. The value of the elephants is implicit in the attraction to tourists as the elephants decide to stay longer in the park due to its better grasses and condition after the projects completion.

The population of elephants around Waza is estimated at 1,200. Recruitment in ideal conditions is about 8%. Recruitment at Waza is around 5%. Recruitment could improve if conditions in the park improve. The park is regarded as being at carrying capacity. Elephants are being culled at rate of 20 per annum (1.6%). The meat is sold for FCFA 600 per kilo. The dressed carcass weighs about 1,200 kg. Increasing recruitment by 3% would increase the requirement to cull by 1.4%. An additional 17 elephants would need to be shot. The gross value of the carcasses would be FCFA 1.25M. Costs are estimated at 70% making the net contribution some FCFA 370,000. Although of little economic value this represents some 2Otons of meat which could be used strategically as gifts around the park to help convince villagers of the value of the park,

Culling provides "bush meat" to the additional net economic value of FCFA 370,000

5.4.3 Duck and Goose Hunting

Overview

In addition to Safari hunting on elephants, Sport hunting takes place, mainly on ducks and goose. The main species hunted are 1) Knobbill goose (*Sarkidiornis melanota*), 2) Spurwinged goose (*Plecopterus gambiensis*), 3) Egyptian goose (*Alopechen aegiptiaca*), 4} Gargany (*Anas querquedula*) and White faced tree duck (*Dendrocygna viduata*).

The Project provided rather accurate census results of waterbirds for the period 1993-1997, which are presented below for the species under consideration.

Table 5.4.4
Results of waterbird census during 1993 (De Kort and Van Weerd) and 1995-1997 (Bobo Kadiri et al.) with special reference to geese and ducks.

Species	1993	1995	1996	1997
Spurwinged goose	2,128	845	2,928	5,249
Knobbill goose	230	623	681	1,184
Egyptian goose	–	–	5	10
Gargany	121	735	6,781	2,035
White faced tree duck	7,524	5,784	5,427	15,317
Total	12,103	7,986	15,817	23,795

The available census results show an increase of goose and ducks in 1996 and 1997, when compared with the census data of 1993.

The fees of Hunting permits for Nationals is CFA 25,000 per annum, for Residents CFA 50,000 per annum and for Non-residents CFA 80,000 per annum. Some 50 hunting permits are provided per annum, mainly to residents and non-residents. Hunting season lasts from January until June, with (by estimate) weekly hunting of 20 hunters, harvesting 40-50 ducks and goose per week. During February 1998 the mean price of goose in the Supermarket at Maroua was CFA 2,750.-.

Value of Duck and Goose Hunting Economic

There can be surmised to be a direct relationship between duck numbers and area flooded. The restoration of the floodplain has seen duck numbers increase from about 8,000 in 1995 to 23,795 in 1997. The area flooded in 1997 was 2,000 km^2. This approximated to about 12 ducks per km^2. Assuming a sustainable yield of 5% it could be said that 1,200 ducks could have been safely shot in 1997. This corresponds to the estimated number actually shot of between 1,040 and 1,300.

The sustainable yield per kilometer square is therefore 0.6 ducks per km^2. Assuming a local market sales prices of FCFA 300 and costs at 50% the economic value of last years harvest was about FCFA 360,000 and the Economic Contribution is FCA 180 per km^2.

Adding 1,300 km^2 will increase sustainable yield by 780 birds. If a hunter shoots 50 birds a trip these birds can support 15 extra hunters. A further 15 hunters will take out licenses. The license fees contribute about FCFA 562,500. If they stay a week for the shooting trip (stay in a hotel, eat and require transport) and we apply the same net contribution per day as the National Park model estimates (FCFA 12,500) each hunters stay and local spending may contribute FCFA 87,500. A total FCFA 1,312,500. The Net Contribution becomes:

Duck Value	780 x FCFA 300	=	234,000
Licenses	15 x FCF 77,500 avg	=	562,500
Shooting Expenses	7 days	=	1,312,500
Total		=	2,109,000

This is divided by 1,300 km^2 to give a Net Economic Contribution of FCFA 1,622/km^2.

Duck hunting contributes an additional net economic value of FCFA **1,622/km^2.**

5.5 Natural Products

Based on the criteria of a) availability of data and b) expected enhanced production as a result of the reinundation, the following list of products came forward, after consultation with the project staff; 1) Cum Arabic, 2) Bush meat, 3) Perennial grasses;

Cum *Arabic*

Women of the villages surrounding the WNP are allowed to gather Cum Arabic inside the Park during September- January. They enter the Park in groups of 5-6 women and spent one to three times per week (from 9.00-13.00 and from 9.00-16.00 hours) inside the Park, gathering 2-3 *kom* of Cum Arabic (1 *koro*=2-3 kg). The price of one *koro* is reportedly CFA 250-550, and prices may differ slightly from village to village (Maureen Roell, 1998). No information is available on the amounts of Gum Arabic harvested per tree or per surface area. Here the study team had to rely largely on estimates of project staff (50 gram of gum per tree and 50 kg per ha). The available information is however to scanty, to allow a further calculation and it is strongly recommended to improve data gathering on the harvesting of Cum Arabic.

When analysing old vegetation maps of the Park (Wit, 1980) and comparing them with more recent ones (Gaston, 1991), an area of approximately 100 sq km of *Acacia* has disappeared after the construction of Maga dam. A direct causal relationship with the construction of the dam in 1980 has never been made, but it is a fact that after the pilot flooding in 1994 the recruitment of *Acacia* trees in this part of the Park has been accelerated.

Bushmeat

Njiforti (1998) made an assessment of the preferences and recent demand for Bushmeat in North Cameroun (including the Waza Logone area. Bushmeat was estimated to representing ca. 24% of the animal protein intake in the region and the respondents generally preferred Bushmeat to meat from domestic livestock. There was a tendency for the mean price per kilogram of large animals to be less than that of small animals, but the price did not correspond with preference. The most preferred species were not necessarily the most expensive. Prices of Bushmeat ranged from CFA 600 (for Elephant) to CFA 2,400.- (for Cane rat). No data are available on trends in Bushmeat consumption, but the assumption is made that the reinundation of the plain will result in larger numbers of small game like Cane rats, goose and ducks Further data gathering is needed to allow an economic assessment.

Perennial grasses

The main perennial grasses used for roofing, mats and fences are *Hyparhenia rufa*, *Vetiveria nigritana, Oryza longistaminata* and *Ischaemum afrum*. The latter two are more commonly used for roofing than the first two. On average once a year roofs and fences are being replaced, while before the construction of the Maga dam, villagers would take the grasses from the surroundings of the village. Due to the disappearance of perennials, this work is nowadays often paid for (300 CFA for a days work).

Research on the floodplain vegetation from 1993 until 1997 has proved that the weight % of perennials of total biomass in the reflooded areas is increasing at the expense of the annual grass *Sorghum arundinaceum*, the latter being less palatable for cattle and wildlife due to high cellulose content (Van der Klundert and Oosterhuis, 1997).

Further data gathering is needed to allow an economic assessment.

5.6 Indirect Use and Non Use Values

According to Barbier *et al.* (1991) Indirect Use Values cover *benefits* such as flood control, storm protection, groundwater recharge and can be valued as *damage costs avoided, preventive expenditures* and *values of changes in productivity.* Barbier stated that due to constraints on data limited the coverage of wetland benefits in the Hadejia-Jama'ra floodplain, to *direct use of key resources only* (Agriculture, Fishing and Fuelwood). *Indirect Use Values and Non Use Values* were not taken into account during the study of Barbier *et al.* (1991). Similar constraints are faced by the study team of the present study. Since the importance of the construction works proposed for the *Grande Option* for reducing the risk of collapse of the Maga dam is stressed by SEMRY, this additional benefit will be taken into account, but not further quantified.

Costs and benefits of surface water being closer to human habitat.

Surface water being closer to human habitat may result in both costs and benefits. The benefits are mainly in finding water used by the household closer to the home. The total benefit was calculated by IUCN 1996 to be about 20 million per year. We found WLP-material which stated that 888 households were expected to be closer to surface water during about 300 days on the average. The time saved in getting water to the home was calculated as 45 minutes per day. By applying a opportunity cost of 100 FCFA the figure of 20 million per year was calculated. The study team could not find any reference to documents or other sources to check these data and the way they were gathered. The opportunity costs used seem to be somewhat high.

Costs associated with surface water being closer to human habitat are health costs (e.g. caused by malaria or bilharzia). These costs are not easily quantified but it may well be that these costs outweighed the above mentioned benefits. Maybe further research on this matter is necessary.

6 TOTAL ECONOMIC VALUE

The Total EconomicValue of the "Model Reinundation" is presented here. The total area to be flooded in the model will be 1,770 km^2 comprising 1,390 km^2 outside Waza Park and 380 km^2 in the Park.

Table 6.1
Summary of Economic Values

Section	Sector	Contribution/ km^2	Non Waza 1,390 km^2	Waza 380 km^2	Total Area 1,770 km^2
5.1	Fishery	369,500	513.6 M	140.4 M	654 M
5.2	Livestock	1,142,000	1,587 M	Nil	1,587M
5.3	Agriculture	Nil			Nil
5.4.1	Tourism			17.6 M	17.6 M
5.4.2	Hunting	1,622			3. M
Totals			2,013 M	192.4 M	**2,261** M

+ 100% of value of fishery allocated to Waza National Park as the fish will migrate out of the park or the pools are exploited.

The total economic value of the model reinundation of 1,770 km^2 is calculated to be *FCFA* ***2,261*** per annum, which represents 1,277,400 FCFA per km^2/annum.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 General

The fishery catch of 1996/97 amounting to 6,190 tons is estimated to accrue from a flood which covered 2,000 kilometers squared.

The Total Economic Value of the fishery is the contribution attributed to the fishermen plus the value added by the traders. The Total Economic Value of the fishery in 1996/97 is estimated to be FCFA 739 million. This value came from a flood covering 2,000 km^2. The total wet weight caught was 6,190 tons. The fishery yield was 31kg/ha. The Total Economic Value of each ton caught was FCFA 119, 400. Benefits associated with increased fisheries production were calculated to FCFA 369,500 per km^2 of flooded area per annum.

It appears that the major reflooding proposal will have an enormous positive impact on the productivity and sustainability of cattle raising in the Far North Province and surrounding regions, including regions in Nigeria and Chad. The benefits of improved pasture in the floodplain will be captured not only by nomads and semi-nomads. Also sedentary cattle-raisers will profit. The total economic value of these benefits we tentatively estimate to be about FCFA 1.587 billion per year or FCFA 1,142,000/km^2. In order to further validate these preliminary conclusions some data should be checked and some additional data should be gathered.

Contrary to pastoralism and fishery agriculture is a iocaiized activity; it is in the neighbourhood of villages that agriculture takes place. For this reason it is not a realistic exercise to try to work out a figure on net benefits or losses per km^2 flooded, because much depends on the precise area of flooding. Furthermore, on the basis of information available at WLP, it was concluded that the impact of large-scale reflooding on agriculture will be negligible.

We have assumed that tourist numbers increase to 7,400, slightly more than number of 7,000 mentioned as an average before1984, when economic conditions were still favourable. This number is less than the park capacity. This occurs four years after the "grande" option or seven years after the "petite" option. Visitors would have increased with or without the project so the net economic values in terms of tourists are proposed as FCFA 17.0 M after 4 years for the Grande Option or FCFA 10 M after 7 years.

Assuming improved conditions in the Waza National Park after the Grande Option, an additional 17 elephants would need to be shot. The gross value of the carcasses would be FCFA 1.25 M. Costs are estimated at 70% making the net contribution some FCFA 370,000. Although of little economic value this represents some 20tons of meat which could be used strategically as gifts around the park to help convince villagers of the value of the park.

Based on regular census data of duck and geese, adding 1,300 km^2 will increase sustainable yield by 780 birds. if a hunter shoots 50 birds a trip these birds can support 15 extra hunters. A further 15 hunters will take out licenses. The total calculated added value of FCFA 2,109,000, divided by 1,300 km^2 gives a Net Economic Contribution of FCFA 1,622/km^2.

In order to make the economic assessment more reliable and accurate the following data should be gathered and/or processed:

- data on 1997/98 stocking densities in the pilot zone: we understood that these data are in fact gathered. Rogier Kouokam should take care that they are processed and put in the spreadsheet "rawdat" in the right format, and using the same assumptions and "dummy" data as we have done .

- data on stocking densities of the other zones (ie other than the pilot zone) included in the pastoralist research should be processed and put in the same format as the "raw-dat" spreadsheet; this goes for all years, i.e. 1993/94, 1994/95, 1995/96, 1996/97 and 1997/98 (if available). Combined with estimates on flooded areas in these zones a comparable output as what we got for the pilot zone can be obtained, allowing us to extrapolate more safely on pilot zone analysis.(the same goes for the aerial counting, the results of which were not yet available to us)

- a check of the data on in-plant cotton cake prices; for this a visit to Mr Karagama, director of the Department of Commercial Affairs of SODECOTON at Garoua will be necessary. Mr Karagama should also be able to give data on world market prices for cotton cakes during the last 7 years.

- data on outside plant prices over several years and for different months within years; this will be difficult to obtain but maybe some research has been done on this at IRA, Service d'Elevage, or CEDC.

- a check on the value of straw in the villages and cities; try to get data for several years According to Melanie Requir-Destardins straw is right at this moment sold in Mindif so it should be relatively easy for WLP to obtain these data..

- a check on the mortality rates of cattle in the floodplains compared to the village/ Diamare plains. It was estimated at 30% higher by Wesseling et al and valued at 3150 FCFA for 150 days or 21 FCFA/day. If 30% is a good estimate we still need data on cattle prices during the last 5 years in order to see if 21 FCFA/day can be applied for the whole period.

- some genera] data will be needed concerning the overall situation of cattle-raising in the Far North Province and surrounding regions. The question is: to what degree can the floodplain pastures which will be created be expected to be exploited?

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ANNEXES

Annex Terms of reference for the economic evaluation

Annex Fisheries

Annex Livestock

Annex Tourism

ANNEX

TERMS OF REFERENCE FOR THE ECONOMIC EVALUATION BY CML OF THE PROPOSALS FOR REINUNDATION OF THE LOGONE FLOODPLAIN

INTRODUCTION

The Waza-Logone Project is situated in the Extreme North Province of Cameroon, covering approximately 800 000 hectares mainly in the floodplain of the Logone river. The area is used by up to 100 000 people for fishing, grazing and agriculture, and is also of great importance both regionally and internationally for the conservation of biodiversity.

The natural hydrological balance of the Logone floodptain has been affected however by the construction in 1979 of a dam and embankments along the Logone river for an irrigated rice scheme for the parastatal organisation SEMRY. These structures, together with lower than average rainfall, have in recent years reduced the extent of the annual flood, which has led to serious ecoiogical degradation of the floodplain and a decline in biodiversity. The collapse of the floodplain fisheries and the diminution of dry season pasturage has resulted in economic hardship and the mass movement of people from the area.

The Project was established in 1992 to redress the ecological and socio-economic problems of the region. It has the global objectives of achieving a long-term enhancement of biodiversity and a sustainable improvement of the quality of life of the population.

One of the principal means of attaining these objectives in the Project programme is by the reinundation of the floodplain to restore as far as practicable the physical conditions which existed before the construction of the SEMRY infrastructure. Preliminary hydrological studies led to recommendations for a pilot release of floodwater from the Logone river through a channel blocked by the rice scheme works. The first of these pilot releases took place in 1994 and a second in 1997. Proposals for the large-scale releases are expected to be implemented in 1999/2000.

The Project's activities are administered by the IUCN (The World Conservation Union), funded principally by the government of the Netherlands, with major financial, logistical and technical support from the Centre of Environmental Science (CML) at the University of Leiden in the Netherlands, the Netherlands Development Organisation (SNV), the World Wide Fund for Nature (WWF) and the Cameroon government.

SCOPE OF WORK

Context

The first pilot release, which took place during the flooding season of August to November 1994, resulted in the inundation of almost 300 km² of floodplain not flooded since the 1970s, including 100 km² in Waza National Park. Similar inundations have taken place during each subsequent flooding season, and have been augmented in 1827 by a second pilot release. Data collection and monitoring of the rapid ecological, hydrological and socio-economic changes resulting from the inundations have been taking place since 1994. The indications are that there are significant economic benefits to be obtained from the reinundation process.

The large-scale reinundation of the floodplain has been programmed for implementation during the dry season of 1999/2000. The present proposals expect that up to an additional 2000 km² of floodplain may be flooded compared with before the first pilot release.

The economic changes which will occur as a result of the reinundation will be evaluated, and the results presented such that they may be applied to a number of options for reflooding. Final options will depend upon the results of a hydrodynamic modelling exercise, which will permit a better estimate to be made of the areas which are likely to flood for a given set of releases. The design and costing of the infrastructural works proposed will then be followed by a Cost-Benefit Analysis of the proposals, to allow a final choice of option to be made.

Objectives of Consultancy

1. Estimation of the economic values of the changes attributable to the large-scale reinundation of the floodplain.
2. Presentation of the data, methodology and results in a format such that they may be used in a Cost-Benefit Analysis of the options for reflooding.
3. Calculation of the Total Economic Value of the large-scale reinundation of the floodplain for a trial option and for up to three other options for reinundation.
4. Dissemination of information to Project personnel through working groups and the holding of a one-day seminar in which the methodology and conclusions of the study will be presented.

Activities - Stage 1 (January - February 1998)

1. Carry out a literature review both outside and inside Cameroon of publications relating to the economic value of sahelian wetlands.
2. Gather and review all relevant information available from the Waza-Logone Project and elsewhere in respect of the estimation of the economic value of the changes resulting from the implementation of proposals for reinundation of the floodplain.
3. Analyse the data using appropriate and accepted methods and carry out an economic evaluation for one trial reinundation.
4. Present the data, methodology, and results, including the Total Economic Value of the trial reinundation, in a Preliminary Report. The results should be presented such that they can be applied to different reflooding options that will be finalised after the hydrodynamic modelling of the floodplain has been carried out.
5. Set up working groups within the offices of the Waza-Logone Project, Maroua, to discuss the transfer and use of data and the evaluation methodology to be adopted. Present at a one-day seminar in Maroua the methodology used and the conclusions reached.

Activities - Stage 2 (July - September 1998)

1. Carry out the economic evaluation for three reflooding options adopted following the hydrodynamic modelling, using the results from the Preliminary Report.
2. From available literature, consider and if possible make an assessment of the economic value of the opportunity costs of the reductions in flooding or the availability of water (as determined by the hydrodynamic model) which may result in other parts of the floodplain and in Lake Chad
3. Present the Total Economic Values for the three options in a Draft Final Report. Following approval by the Director of the Waza-Logone Project, the report will be issued as a Final Report.
4. Liaise with the consultants carrying out the Cost-Benefit Analysis for the three chosen options to assure the comprehension of all relevant information, methods and results relating to the economic evaluation and estimation of the Total Economic Value (note that additional inputs and support costs will be met from the Cost-Benefit Analysis consultancy).

Programme

Activity	Team Leader (Hans de Iongh)	Socio-Economist (Aard Zuiderwijk)	Environmental Economist (Peter Hamiing)
Stage 1 (Jan - Feb 1998)	0.25 MM	1.5 MM	0.5 MM
Preparation/literature review Data collection and analysis, methodology, economic evaluation, Total Economic Value (trial option), Preliminary Report One-day seminar	 7 - 14 Feb 21 - 24 Feb 24 Feb	January 3 - 24 Feb 24 Feb	 14 - 24 Feb 24 Feb
Stage 2 (July - Sept 1998)		1.0 MM	0.5 MM
Total Economic Value (three options) Draft/Final Report Consultation for CBA	July - September	July - September	July - September

Reporting

Preliminary Report (February 1998)

Final Report (by September 1998)

1. To include but not to be limited to: Discussion of available data, discussion of methodologies available and description of those adopted, discussion of economic values and those selected or discarded, presentation of (unit) results in a format usable for different reflooding options, presentation of the Total Economic Value for one trial reinundation option. (Preliminary Report)
2. Presentation of the Total Economic Value for three options for reinundat'on. The options will be made available to the Consultants following the completion of the hydrodynamic modelling, expected during July - August 1998.
3. Discussion and assessment (if data permits) of tne economic value of the opportunity costs cf the reductions in flooding or the availability of water (as determined by the hydrodynamic model) which may result in other parts of the floodplain and in Lake Chad.

A. Appendices presenting data used.

Approach

1. The Consultants will work closely with the staff of the Waza-Logone Project in the collection and processing of data, and will disseminate their knowledge and ideas through the operation of working groups and in the presentation of a one-day seminar.
1. Data available at the Project or in the literature is expected to be sufficient for the purposes cf the study. However, recommendations may be made on the necessity of obtaining further data for the achievement of satisfactory results.
3. Consult and liaise with the consultants responsible for the CBA, and provide the necessary information from the results of the study.
4. The Consultants will ultimately be responsible to the Direction of the Project.

Methodology

1. The evaluation should include, but not be limited to, the elements listed. An initial review will decide which are relevant to the economic evaluation.

(i) Direct Use Values:

- fisheries
- livestock
- agriculture
- tourist incomes
- natural products

(ii) Indirect Use Values

- groundwater recharge
- ecological processes
- socio-economic processes (infrastructure, health, reduction in conflicts, services)
- effects of illegal utilisation of wildlife resources
- biodiversity improvement

(iii) Non-Use Values

- Option Values
- Existence Values
- Request Values

2. Evaluation will be by accepted methods (change in productivity/replacement/etc) chosen as most appropriate to the circumstances.

CONSULTANCY SERVICES

Personnel and Inputs

	Cameroon	Outside
Team Leader (Hans de Iongh)	0.25 mth	
Environmental Economist (Peter Hamling)	0.5 mth	0.5 mth
Socio-Economist (Aard Zuiderwijk)	1.0 mth	1.5 mth

PROJECT SUPPORT AND PAYMENT FOR SERVICES

1. The Project will provide the following services free of charge to the Consultant:

- Access to all literature, reports, studies, maps, data and documents in the possession of the Project which are relevant to the assignment.
- Use of Project computer.
- Logistical support, office services (including essential use of telephone and fax) at Maroua.

2. Consultancy, travel, subsistence and miscellaneous costs payable by the Project will consist of those listed in Table II), totalling Dfl 76 390. Payment will be effected by deduction from the balance of CML's Waza-Logone Project budget for 1998 - 2000, in accordance with the existing contract between CML and the Project.

ANNEX **FISHERIES**

5.1 .1 Economic Valuation of the Fishery Catch in 1996/97

	Fishermens Economie Value					Traders Added Value				
	Ton»	Utilized (Tons)	Gross Value	Cost of ' Production	Economic Value	Consumed Wet Tons	Sold Dry tons	Gross Value Added	Costs 43%	Economic Value Added
Clariassp	2140,17	2 062,48	528 038 840	324 784 854	203 253 986	474,80	529,23	182874015	78 517 834	104 356 180
Tilapia sp'	1 247.49	1 122,74	98 943 465	61 229 214	37 714 251	354,05	256,23	30 591 815	13 134 742	17 457 072
Alestes sp.	487,77	478,15	104 033 387	66 088 369	37 945 018	159,07	66,52	26207932	11 252 501	14 955 431
Gnatonemus sp	470,36	464,77	130 095 743	75 834 432	54 261 311	30,00	144,92	55 067 885	23643660	31 424 225
Hemichromis f.	225.78	221,33	38 130 086	24 223 810	13 906 276	55,81	55,17	12 861 225	5522029	7 339 197
Labeo sp	197,27	192,39	35 537 897	21 728 777	13 809 120	9,17	61,07	15 255 969	6550223	8 705 746
Bagrus sp	205,15	203,10	54 250 556	32 143 094	22 107 462	64,11	46,33	16790243	7208971	9 581 272
Synodontis	147,88	142,30	8 517 629	4 825 484	3 692 145	17,06	41,75	3 281 572	1 408 959	1 872 613
Petrocephalus t	248.47	245,99	93 261 048	51 769 176	41 491 873	7,62	79,46	40888820	17 555 811	23 333 009
Heterotis n	79,86	72,26	18 058 170	10 823 183	7 234 987	37,38	11,63	4076026	1 750 920	2327106
Polypterus sp	63,12	36,68	305 633	190581	115 052	17,77	6,30	70 896	30 440	40 456
Schilbe sp	110,31	109,21	24 089 967	13 731 019	10 358 948	12,73	32,16	9459333	4 061 410	5 397 923
Hydrocynus	48,57	48,57	8 511 250	5214074	3 297 176	18,86	9,90	2 387 503	1 025 086	1 362 417
Mormyrus sp	87,11	87,11	21 617 792	12 171 989	9 445 803	9,63	25,83	8 765 325	3 763 434	5 001 891
Districhodus sp	49,68	49,68	4 440 008	2 704 113	1 735 896	1,37	16,10	1 941 290	833 502	1 107 788
Laies n.	26,46	26.08	8 645 709	4 883 873	3 761 836	11,42	4,89	2 304 684	989 527	1 315 157
Others	354,92	336,09	62 898 672	37 054 998	25 843 674	52,45	94,55	24054874	10328075	13 726 799
	6190,38	5 898,92	1 239 375 852	749 401 039	489974813	1 333	1 482	436 881 406	187577125	249 304 281

Fishermens Contribution	Gross Value	Cost of Production	Economic Value
Total Value of Catch	1 239 375 852	749 401 039	489 974 813
Per Sac	25 842,56	15 625,96	10 216,60
Per ton wet	210 102,11	127 040,35	83 061,76
Per ton Dry	630 306,32	381 121,04	249 185,28

Traders Contribution	Gross Value	Cost of * Production	Economic Value
Total Value of Catch	436 881 406	187577125	249 304 281
Per Sac sold	11 791,41	4 894,48	6 896.93
Per ton Wet Sold	74061.23	31 798,55	42 262,69
Per ton Dry Sold	294 785,14	126 567,41	168 217,73

5.1.2 Total Economie Value of Fishery In 1886)97

Value added by Fishermen	489 974 813
Value added by Traders	249 304 281
Total Economic Value	739279094

Total Economic Value of Fishery	739 279 094
Total Weight Caught	6 190
Economic Value per Ton Caught	119431

5.1.3 Economic Value per Kilometer Square

Total Economic Value of Fishery	739 279 094
Total Area Flooded in Sq Km.	2000
Economic Value per Sq Km Flooded	369 640

5.2.1 Economie Valuation of the Grande Peche in 1996/97

FISHERMENS ECONOMIC VALUE

	ISM	% in catch	% Losses	% Auto	Utilized (Tons)	Dry Wt [Tons)	Sacs	FCFA/Sac	Value	Coat of • Production	Economic Value
Clarias sp	1 744,33	36,97%	4%	22%	1 674 56	558 19	13 954 64	29 500,00	41 1 661 880	262 481 564	149 180 316
Tilapia sp'	1 045,54	22,16%	10%	30%	940.99	313,66	7841,55	10 300,00	80 767 965	51 498 822	29 269 143
Alestes sp. **	480,99	10,19%	2%	33%	471 37	117,84	2946,06	34 500,00	101 839 199	64 806 623	36 832 577
Gnatonemus sp	279,58	5,93%	2%	8%	273,97	91,32	2283.07	26 500,00	60 501 443	38 576 595	21 924 849
Hemichromis f	222,59	472%	2%	25%	218.14	7271	1 817,79	20500,00	37 264 774	23 760 558	13 504 215
Labeo sp	162,71	3,45%	3%	5%	15783	5261	1 315.24	20 100,00	26436307	16 856 172	9 580 136
Bag rus sp	124,55	2,64%	1%	34%	123,30	41,10	1 027,54	29 500,00	30 312 356	19 327 596	10 984 760
Synodontis	87,46	.85%	5%	8%	83,09	27,70	692,39	3 750,00	2 596 469	1 655 546	940 923
Petrocephalus b	64,19	,36%	1%	9%	63.55	21,18	529.57	34000,00	18005295	11 480 436	6 524 859
Heterotis n	60,27	,2S%	10%	50%	54.24	1808	452 04	25 000,00	11 301 COO	7 205 681	4 095 319
Polypterus sp	57,52	' ,22%	45%	27%	31,84	10,55	263,63	1 000,00	263 633	168 096	95 537
Schilbe sp	49,20	,04%	1%	6%	4871	1824	405,90	20100,00	6158590	5 202 035	2 956 555
Hydrocynus	38,58	0,82%	0%	45%	38.58	12,86	321.50	20 000,00	6 430 000	4 099 861	2330139
Mormyrus sp	37,98	0,80%	0%	15%	37,98	12,66	316,50	18500,00	5 855 250	3 733 392	2 121 858
Districhodus sp	37,27	0,79%	0%	2%	37 27	12,42	31058	10300,00	3 199 008	2 039 734	1 159 274
Lates n	11.99	0.25%	2%	53%	11.75	3,92	97,92	25500,00	2 496 918	1 592 071	904 847
Others	213,36	4,52%	7%	18%	198,42	66,14	1 653,54	20 000,00	33 070 600	21 086 420	11 984 380
	4718,09	100,00%	7%	18%	4 465,38	1 449,18	36 229,47		839 960 888		304 389 686

Gross Value /sac	23 1 84	Net Value/sac	8 401,71
Gross Value /ton (dry)	579 612	Net Value/ton	210042,87
Gross Value/ton (wet)	188 105	Net Value/ton	68 166,59

TRADERS ECONOMIC VALUE ADDED

	Consumed Wet Tons	Sold Dry Tons	% Sold	Sold Sacs	Markup 45%**	Costs 43%	Economic Value Added
Clarias sp	383.75	430,27	39.93%	10 757	142795215	61 309 810	81 485 405
Tilapia sp'	313,66	209,11	19,40»	5 228	24 230 390	10403434	13 826 956
Alestes sp. **	158,73	64,93	6,03%	1 623	25 202 373	10 820 760	14 381 613
Gnatonemus sp	22,36	83.87	7.78%	2 097	25 003 148	10735221	14 267 926
Hemichromis f	55.65	54,16	5,03%	1 354	12 491 304	5 363 201	7 128 103
Labeo sp	8,14	49,90	4.63%	1 247	11 283 125	4 844 464	6 438 661
Bag rus sp	42.35	26,99	2.50%	675	8855923	3845269	5 110 655
Synodontis	7,00	25,36	2,35%	634	1 070 018	458418	610 601
Petrocephalus b	5,78	19.26	1,79%	481	7 365 803	3162543	4 203 260
Heterotis n	30,14	6.04	0.75%	201	2260200	970 428	1 289 772
Polypterus sp	15,53	5,37	0,50%	134	60 396	25 931	34 465
Schilbe sp	2,95	15,25	1,42%	381	3448859	1 480 784	1 968 075
Hydrocynus	17,36	707	0.66%	177	1 591 425	683 286	908 139
Mormyrus sp	5.70	10,76	1,00%	269	2239633	961 597	1 278 036
Districhodus sp	0,75	12,17	1,13%	304	1410763	605718	805 045
Lates n	6,35	1,80	0,17%	45	515945	221 523	294 421
Others	38,40	53,34	4,95%	1 334	12 001 500	5152902	6 848 598
	1 114,59	1 077,65		26941,22	281 926 018	121 046 287	160 87» 731

Value added/sac	5 971,51
Value added /ton (dry)	149287,73
[Value added /ton (Wet)	49 762,58

Source : Boboetal: 1996

* = Sarotherodon galileus: Tilapia rendalli: Tilapia zilli; Oreochromis niloticus; Oreochromis aureus
** = Alestes wet weight to dry weight conversion is 1 4, Remainder is 1: 3
59 species listed as being of commercial value of which 31 comprises 90% of the catch

5.2.2 Total Economic Value of Catch during Grande Peche

Value added by Fishermen	**304 389 686**
Value added by Traders	**160 879 731**
Total Value Added	«66269417
Total Wet Weight Caught (tons)	**4 718**
Value Added per ton	**98 614**

5.3.1 Economie Valuation of the Petite Peche in 1996/97

FISHERMENS ECONOMIC VALUE

	Tons	% in catch	% Losses	% Auto	Utilized (Tons)	Dry Wt (Tons)	Sacs	FCFA/Sac	Value	Cost of * Production	Economic Value
Clarias sp	395,84	26,89%	2,00%	23.00%	387,92	129,31	3232,69	36000,00	116 376 960	62 303 290	54 073 670
Tilapia sp'	201,95	13.72%	10.00%	20,00%	181.76	60.59	1 514,63	12000,00	18 175 500	9 730 392	8 445 108
Alestes sp	6.7S	0,46%	0,00%	5,00%	6,78	1,70	42.38	56 500,00	2 394 188	1 281 746	1 112 441
Gnatonemus sp	190.80	12,96%	0,00%	4.00%	190,80	63,60	1 590,00	43 770,00	69 594 300	37 257 837	32 336 463
Hemichromis f	3.20	0,22%	0 00%	5,00%	3,20	1 07	26 63	32 500 00	865 313	463 252	402 061
Labeo sp	34,56	2,35%	0.00%	3,00%	34,56	11,52	288,03	31 600,00	9 101 590	4 872 605	4 228 985
Bagrus sp	80,60	5,47%	1,00%	27,00%	79,79	26,60	664.95	36 000,00	23 938 200	12815497	11 122703
Synodontis	60,42	4,10%	2,00%	16,66%	59,21	19,74	493,43	12 000,00	5921 160	3 169 938	2 751 222
Petrocephalus b	184,28	12,52%	1 00%	1.00%	182,44	60,81	1520,32	49500,00	75 255 753	40 288 740	34 967 014
Heterotis n	19,59	1.33%	8.00%	37,00%	16,02	6.01	150,16	45000.00	6 757 170	3 617 502	3 139 668
Polypterus sp	5,60	0.38%	10,00%	40,00%	5,04	1,68	42.00	1 000.00	42 000	22 485	19515
Schilbe sp	61.11	4.15%	1,00%	16,00%	60,50	20,17	504,16	31 600,00	15 931 377	8 528 984	7 402 393
Hydrocynus	9,99	0,68%	0,00%	15,00%	9,99	3,33	83,25	25 000,00	2 081250	1 114213	967 037
Mormyrus sp	49,13	3,34%	0,00%	8,00%	49,13	16.38	409.42	38 500,00	15 762 542	8 438 596	7 323 945
Districhodus sp	12.41	0.84%	0.00%	5,00%	12.41	4,14	103,42	12000,00	1 241 000	664 379	576 621
Lates n.	14.47	0,98%	1,00%	35,00%	14,33	4,78	119,39	51 500,00	6 148791	3 291 802	2 856 989
Others	141,56	9,61%	2.75%	9,92%	137,67	45.89	1 147,23	26 000,00	29 827 872	15 968 578	13 859 294
	1 472,29	100.00%	2.75%	9.92%	1 433.54	477	11 932		399 414 965		185 585 128

Source Bobo et al; 1996

Gross Value /bag	33 474	Net Value/bag	15 553,48
Gross Value /ton (dry)	836 852	Net Value/ton	388 837,10
Gross Value/ton (wet)	278 621		129 459

TRADERS ECONOMIC VALUE ADDED

	Consumed Wet Tons	Sold Dry tons	% Sold	Sold Sacs	Markup 45%**	Costs 43%	Economic Value Added
Clarias sp	91.04	98.96	24,47%	2 474	40078800	17208025	22 870 775
Tilapia sp'	40,39	47.12	11,65%	1 178	6 361 425	2 731 308	3 630 117
Alestes sp	0,34	1,58	0,39%	40	1 005 559	431 741	573 817
Gnatonemus sp	7,63	61,06	15,10%	1 526	30 064 738	12 908 439	17 156 298
Hemichromis f	0,16	1,01	025%	25	369921	158827	211 094
Labeo sp	1.04	11,18	276%	279	3 972 844	1 705 760	2 267 084
Bagrus sp	21,76	19,34	4,78%	484	7 834 320	3 363 703	4 470 617
Synodontis	10,07	16,38	4,05%	410	2 211 553	949 541	1 262012
Petrocephalus b	1,84	60.20	14,89%	1 505	33523017	14393268	19 129 749
Heterotis n	7.25	3,59	0,89%	90	1 817 826	780492	1 037 333
Polypterus sp	2,24	0,93	0,23%	23	10500	4508	5 992
Schilbe sp	9.78	16.91	4,18%	423	6 010 474	2580626	3 429 848
Hydrocynus	1,50	2,83	0,70%	71	796 078	341 800	454 278
Mormyrus sp	3.93	15.07	373%	377	6 525 692	2 801 837	3 723 855
Districhodus sp	0.62	3,93	097%	98	530 528	227 785	302 743
Lates n.	5,07	3,09	0.76%	77	1 788 739	768 004	1 020 735
Others	14,04	41,21	10,19%	1 030	12053374	5175174	6 878 200
	218.69	404,38		10109,62	154955388	66 530 838	**88 424 550**

Value added/sac	8 746,58
Valus added /ton (dry)	218664,45
Value added /ton (Wet)	72 888,15

5.3.2 Total Economic Value of Catch during Petite Peche

Value added by Fishermen	185 585 128
Value added by Traders	88 424 550
Total Value Added	**274 009 677**
Total Wet Weight Caught (tons)	1 472
Value Added per ton	186112

5.4.0 Fishermens Costs

Financial Costs	Economic Costs
Equipment	Equipment
Repairs	Repairs
Own transport	Own transport
Produce transport	Produce transport
Return to labour	Opportunity Cost of Labour

Assumptions

1 Migrants and Sedentary fishermen together fish the Grande Peche period
2. Only Sedentary fishermen fish the Petit Peche
3. The opportunity cost of labour for fishermen is FCFA 300

5.4.1 Calculation of Average Depreciation per Fisherman

Type	Set net	Lift nef	Throw nef	Traps	Seine net"	Hooks	Canoe***
Cost each	18500	7400	20000	790	350000	5550	85000
No per fisherman	2	0.5	0.5	8	0,05	6	0,25
Cost each	37000	3700	10000	6320	17500	33300	21250
Life	2	3	2	2	5	3	15
Depreciation	18500	1 233	5000	3 160	3500	11 100	1 417
Total Depreciation	43 910						

Source Boboetal, 1997

Notes
'Onepertwofishermen
'* One between 20 fishermen
*** One for every four fishermen

5.4.2 Annual Maintenance of Fishing Gear

Value of Equipment	129 070
10% maintenance*	12 907

Source Consultants estimate
Note
* Including clothing etc

5.4.3 Transport
Grande Peche 6.800 Fishermen

Total Catch in sacs	36 229
Number of Fishermen	6 814
Sacs per fisherman	5,32
Transport per sac	600
Transport of sacs/man	3 190
Personal transport*	8 000
Total Transport	11 190

Source : Consultants estimate
Notes
* Four trips for 4 family member " FCFA 500 per trip

5.4.4 Transport
Petit Peche 3.600 Fishermen

Total Catch in sacs	11 932
Number of Fishermen	3 600
Sacs per fisherman	3
Transport per sac	600
Transport of sacs/man	1 989
Persona! transport*	2 000
Total Transport	3 989

Source : Consultants estimate
Notes
* Two trips for 2 famiJy member " FCFA 500 per trip

5.4.5 Fishermans Economic Profit and Loss
Grande Peche Period
Sedentaires et Migrants

Gross Value of Catch *		839 960 888
Number of Fishermen **		6 814
Gross Value per Fisherman		123 270
Less		
Maintenance	6 454	
Transport	11 190	
Depreciation	21 955	
Labour	39 000	
		78 599
Return to Labour ***		44 671
Cost as Percentage of Gross value		64%

Source : Consultants estimate
Notes
* Includes home consumption
** Really fishing family
*** Assumes opportunity cost of fishing family labour is zero

5.4.6 Fishermans Economic Profit and Loss
Petit Peche Period
Sédentaires

Gross Value of Catch *		399 414 965
Number of Fishermen **		3 600
Gross Value per Fisherman		110 949
Less		
Maintenance	6 454	
Transport	3 989	
Depreciation	21 955	
Labour	27 000	
		59 397
Return to Labour ***		51 551
Cost as Percentage of Gross value		54%

Source : Consultants estimate
Notes
* Includes home consumption
** Really fishing family
"* Assumes opportunity cost of fishing family labour is zero

5.4.7 Labour Require Grande Peche

5 month at 6 days per week =	130
Return to labour	44 671
Rate per day*	344
Opportunity cost	300
Labour cost	39 000

* Excluding family labour but famiiy fish

5.4.8 Labour Requirec Petite Peche

7 month at 3 days per week =	90
Return to labour	51 551
Rate per day*	573
Opportunity cost	300
Labour cost	27 000

* Man or woman fishes

5.4.9 Annual value of Floodplain per Fisherman

Migrant	44 671
Sedentaire	96 223

5.5.0 Traders Markup

6.S.1 Mark-up *f vie* to Pous

	1997			
	October	November	December	Average
Clarias				
Prive Yvie		17500	20000	18750
Price Pous		26 000	24 5X	25 250
Gross Margin		8 500	4500	6500
%		48,57%	22,50%	34,67%
Labeo				
Prive Yvie	18 500	21 250	28 750	22 833
Price Pous	30000	30 500	32 000	30833
Gross Margin	11 500	9 250	3 250	B 000
%	62,16%	43.53%	11,30%	35,04%
Alestes				
Prive Yvie	35000	47 500	50 000	44 167
Price Pous	55 000	62 500	65000	60 833
Gross Margin	20 000	15000	15 000	16667
%	57,14%	31,58%	30,00%	37,74%
Tllapla sp,				
Prive Yvie	15000	15000	20000	16667
Price Pous	24 000	20000	23 000	22 333
Gross Margin	9000	5000	3000	5667
%	60,00%	33,33%	15,00%	34,00%
Gnatonemus sp				
Prive Yvie	17500	33000	35000	28 500
Pnce Pous	30 000	45 000	48 000	41 000
Grass Margin	12 500	12 000	13 000	12500
%	71,43%	3636%	37,14%	43,86%

Summary Yvie to Pous

	October	November	December	Average
Clanas	0%	49%	23%	35%
Labeo	62%	44%	11%	35%
Alestes	57%	32%	30%	38%
Tilapia	60%	33%	15%	34%
Gnatonemus	71%	36%	37%	44%
Average				37%

Traders Markup

5.5.2 Mark-up Pous to Maroua

	December 1995
Alestes	
Price Pous	40 000
Price Maroua	45 000
Gross Margir	5 000
%	12,50%
Petrocephalus	
Prive Pous	40 000
Price Maroua	45 000
Gross Margir	5 000
%	12.50%

5.6.0 Traders Profits and Costs

Financial Costs	Economic Costs
Sacs and string	Sacs and string
Transport to Field	Transport to Field
Accommodation	Accommodation
Interest at local rates	Interest at local rates
Transport of Product to Market	Transport of Product to Market
Own Transport to Market	Own Transport to Market
Storage before Sale	Storage before Sale
Loading and Unloading	Loading and Unloading
Taxe veti naire	* Transfer cost
Taxe Communale	* Transfer Cost
	Opportunity Cost of Semi skilled Labour

Assumptions

1 All produce is bought at Yvie and sold in Maroua
2. A typical trader buys and transports 5 sacs
3 The opportunity cost of capital is the local black market interest rate of 5% per month.
4 The opportunity cost of the traders labour is FCFA 1,500 per day
5 A round trip takes four days including selling days
6 Interest is for one week per trip at black market rate

5.6.1 Traders Economic Return

Sells sac for				37 472
Trader buys sacs for				25 843
Gross **profit per** sac*	45%			11 629
Variable Costs per sac				
Sac & string		250		
Interest at local rates		323		
Transport of Product to Market		1800		
Loading and Unloading		200		
VariaWe costs per sac				2 573
Fixed Costs Per Trip				
Opportunity Cost of Labour		7 500		
Transport to Field		1 800		
Own Transport to Market		1 800		
Accommodation		500		
Storage before Sale		500		
			12 100	
Fixed Costs **per Sac** **				2 420
Net Economic Prom (Benefit) per sac				**6 636**
Benefit as Percentage of Markup				57%
Cost as Percentage of Markup				**43%**

Note
* Markup estimated from Market Analysis
** Divide by 5 bags

5.6.2 Traders Financial Return per Trip

Sells five **sacs for**			187 359	
Trader buys sacs for			129 213	
Gross margin	A5%			58 146
Variable Costs per sac				
Sac & string		1 250		
Interest at local rates		1 615		
Transport of Product to Market		9000		
Loading and Unloading		1000		
Taxes 400 per sac		2000		
Variable costs			14 865	
Gross Profit				43 281
Fixed Costs Per Trip				
Transport to Field		1 800		
Own Transport to Market		1 BOO		
Accommodation		500		
Storage before Sale		500		
			4 600	
Return to capital and **labour**				38 681
%				21%

5.7.0 Seasonal Variations in Price

Prices of Fish Medium Season 1996/97 and Dry Season 1997/98

	GRANDE PECHE					PETITE PECHE						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug
Clarias SR												
1996/97			19500	20000	25000	25000	27500	33000	37000	40000	45000	45000
1997/98		21000	20000	26000	30000	28750						
			2,56%	30,00%	20,00%	15,00%						
Tilapia sp*												
1996/97		7500	8700	10000	15000	20000	20000	22000	7500	6000	5000	4000
1997/98	10000	14000	15000	15000	150ÛO	20500						
		86,67%	72,41%	50,00%	0,00%	2,50%						
Alestes nurse												
1996/97		25000	30000	32500	35000	39000						
1997/98	38000	27500	46500	53000	55000	55000						
		10.00%	55,00%	63,08%	57,14%	41,03%						

Source : Bobo et al; 1997 and Project unpublished

5.8.0 Seasonal Variations in Quantities

Medium Season 1996/97 and Dry Season 1997/98

	GRANDE PECHE					PETITE PECHE						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug
Total												
1996/97		315,592	728,459	2068,1	1477,365	615,467	329,76	152,962	130.454127.	127,349	155,549	89,443
1997/98	269,84	797,76	1051,6	1051,6	291,83							
Difference		482,168	323,141	-1016,5	-1185,54							

Source : Bobo et al; 1997 and Project unpublished

ANNEX 3. **LIVESTOCK**

ANNEX

TABLE 9; SODECOTON COTTON CAKE SALES.

1993/4 COTTON CAKE SALES				
MONTH	N&A	EXNO	TOTDPA	TOTAL
NOV	30	991	1021	1112
DEC	607	1238	1845	2050
JAN	831	978	1809	1612
FEB	1379	1491	2870	3180
MAR	1314	1707	3021	3280
APRIL	1256	1655	2911	3310
MAY	1026	1494	2520	2553
JUNE	194	1336	1530	1756
JULY	63	432	495	544
AUG	189	77	266	281
STEPT	18	83	101	123
OCT	0	0	0	22
TOTAL	6907	11482	18389	19823
TOTAL DS	6607	9899	16506	17741
%DRYSEA	95.65658	86.2132	89.76018	89.49705

1994/95 COTTON CAKES SALES				
MONTH	N&A	EXNO	TOTDPA	TOTAL
NOV	68	234	302	716
DEC	1123	1080	2203	4924
JAN	2340	2190	4530	5397
FEB	1077	2017	3094	4004
MAR	2206	2182	4388	4626
APRIL	1076	1756	2832	2968
MAY	468	582	1050	1127
JUNE	54	648	702	718
JULY	86	103	189	210
AUO	25	72	97	109
SEPT	21	94	115	129
OCT	1	47	48	63
TOTAL	8545	11005	19550	24993
TOTAL DS	8344	10455	18799	23766
%DRYSEA	97.64775	95.00227	96.15857	95.09063

Notes:

1993/4 was a bad year

ANNEX 10.

year	code_nom	type_nom	nbre_herd	weeks_pz	total_herds.weeks	a_n_c_h	cattle.wee	TLU_days
1993/94	1	Addankos	6	4	24	50	1200	
	2	Arabes_ch	104	6.028846	627	110	68970	
	3	Alidjam	63	1.119048	70.5	48	3384	
	4	Woila	169	12.56509	2123.5	70	148645	
	5	Trans_nor	176	9.508523	1673.5	85	142247.5	
	6	Trans_sud	80	5.8125	465	75	34875	
		TOTAL			4983.5	80.12872	399321.5	1956675
		average			0	79.52174	15358.52	
		increase rate			0		0	
	increase rate base line				0		0	
94/95	1	Addankos	6	3.5	21	50	1050	
	2	Arabes_ch	121	12.52066	1515	110	166650	
	3	Alidjam	73	3.80137	277.5	48	13320	
	4	Woila	174	11.41954	1987	70	139090	
	5	Trans_nor	168	14.25	2394	85	203490	
	6	Trans_sud	108	5.976852	645.5	75	48412.5	
		TOTAL			6840	83.62756	572012.5	2802861
		average			0	79.49846	22000.48	
		increase rate			0		0	0.432461
	increase rate base line				0		0	0.432461
95/96	1	Addankos	42	7.761905	326	50	16300	
	2	Arabes_ch	155	6.980645	1082	110	119020	
	3	Alidjam	60	2.75	165	48	7920	
	4	Woila	214	10.05841	2152.5	70	150675	
	5	Trans_nor	164	11.35061	1861.5	85	158227.5	
	6	Trans_sud	83	2.506024	208	75	15600	
		TOTAL			5795	80.71484	467742.5	2291938
		average				79.63092	17990.1	
		increase rate						-0.18229
	increase rate base line							0.171343
96/97	1	Addankos	46	10.08696	464	50	23200	
	2	Arabes_ch	232	7.924569	1838.5	110	202235	
	3	Alidjam	95	5.615789	533.5	48	25608	
	4	Woila	217	14.93318	3240.5	70	226835	
	5	Trans_nor	204	14.50735	2959.5	85	251557.5	
	6	Trans_sud	94	2.882979	271	75	20325	
		TOTAL			9307	80.55877	749760.5	3673826
		average				81.03604	28836.94	
		increase rate						0.602934
								0.877586

NOTE: AVERAGE SIZE OF HERD IS NOT WEIGHTED FOR ACTUAL TIME SPENT, ONLY WEIGHTED FOR NUMBER OF HERDS. When accounted for, the differnece is not too big, except in 1994/5, because of long presence Arab-Choa.

ANNEX 5.11 :STEP-BY-STEO CALCULATION OF NET VALUE PER KM2

YEAR	TLU-DAYS	KM2-FLOO	TO/KM2	PRICE CC	PRICE ST	FEED COST/TLU-D	VALFEED/KM2	MC/TLU-DA	MC/KM2	NETVAL/K		OUTSIDEPCC	FEEDC/TLU-D	VALFEED/KM2	NETVAL/KM2
1993/94	1956675	155	12623.71	20	5	62.45	788350.669355	21	265097.9	523252.77		60	145.65	1838643.31452	1573545.41129
1994/95	2802861	268.5	10438.961	20	5	62.45	651913.107821	21	219218.18	432694.93		40	104.05	1086173.88101	866955.702235
1995/96	2291938	279.5	8200 136	32	5	87.41	716773.884007	21	172202.86	544571.03		60	145.65	1194349.80215	1022146.94705
1996/7	3673826	276.5	13286.893	26.5	5	75.97	1009405.2847	21	279024.76	730380.53		40	104.05	1382501.24882	1103476.48933

ASSUMPTIONS

ONE TLU-DAY: 2.08 CC AND 4.17 STRAW.

MORTALITY RATE 30% HIGHER; 3150 CFA/150 DAYS)

ANNEX 12 AND 13

ANNEX 12: MONETARY VALUATION TRIAL OPTION:

YEAR	TLU-DAYS	KM2-FLO	TLUD/KM2	PRICE CC	NETVAL/K	GRANDE	OUTSIDEP	NETVAL/K	GRANDE OPTION
1993/94	1956675	155	12623.71	20	523252.8	7.27E+08	60	1573545	2.19E+09
1994/95	2802861	268.5	10438.96	20	432694.9	6.01E+08	40	866955.7	1.21E+09
1995/96	2291938	279.5	8200.136	32	544571	7.57E+08	60	1022147	1.42E+09
1996/7	3673826	276.5	13286.89	26.5	730380.5	1.02E+09	40	1103476	1.53E+09

ASSUMPTIONS

linear relationship between area flooded and total net economic value

no off-she effects, e.g. on Lake Maga or Lake Chad, included.

Total flooded area is 1390 km2, so excluding Waza part (380 km2; non-accessable)

ANNEX 13: PHYSICAL IMPACT OF FORAGE; COMPARISON OF STOCKING DENSITIES WITH CARRYING CAPCITY:

YEAR	TLUD/KM2	CC-FEEDEQUIV	SODSALE	STOCKDE	KM2-FLO	ESTIM CC
1993/94	12623.71	36497669	24400000	84.15806	155	126.9
1994/95	10438.96	30181124	32000000	69.59307	268.5	89.34989
1995/96	8200.136	23708233	28000000	54.66757	279.5	89.57052
1996/7	13286.89	38415066	?	88.57929	276.5	114.646

SODECOTON's sales for 1996/7 not yet available

Stock density calculated on the basis of 150 days: average number of TLU present in one km2 flooded area

Carrying capacity according to Wesseling et al: 126.9 TLU/km2(case of 100% restoration)

Assumption: Non-flooded areas have no productivity, even if flooded year before.

Assumption: productivity 30% of CC in year 1, 50% in year 2, 80% in year 3 (based on estimations de longh).

ANNEX **TOURISM**

5.4.1 Tourist Contribution - Grande Option

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2010
		1	2	3	4	5	6	7	8	9	10
Number of Visitors		6,000	6,450	6,934	7,454	8,013	8,614	9,260	9,954	10,701	11,503
Visitors without improvement		6,000	6,120	6,242	6,367	6,495	6,624	6,757	6,892	7,030	7,171
Additional visitors		0	330	691	1,087	1,518	1,989	2,503	3,062	3,671	4,333
Additional Park Fees		0	330	691	1,087	1,518	1,989	2,503	3,062	3,671	4,333
- **Locals** 15%		0	50	104	163	228	298	375	459	551	650
- Residents 25%		0	83	173	272	380	497	626	766	918	1,083
- Foreigners 60%		0	198	415	652	911	1,194	1,502	1,837	2,203	2,600
Entrance fee											
- local	1,500	0	74,250	155,554	244.470	341,600	447,591	563,138	688,991	825,955	974,897
- resident	3,000	0	247,500	518,513	814,900	1,138,666	1,491,968	1,877,126	2,296,636	2,753,183	3,249,657
- foreigner	5,000	0	990,000	2,074,050	3,259,600	4,554,666	5,967,873	7,508,504	9,186,543	11,012,732	12,998,630
Total Entrance Fees		0	1,311,750	2,748,116	4,318,970	6,034,932	7,907,432	9,948,768	12,172,169	14,591,870	17,223,184
Visitors Expenditure											
- Tour not profit	2,200		726,000	1,520,970	2,390,373	3,340,088	4,376,441	5,506,236	6,736,798	8,076,003	9,532,328
- Meals and drinks	4,500		1,485,000	3,111,075	4,889,400	6,831,998	8,951,810	11,262,756	13,779,814	16,519,098	19,497,945
- Hotel	4,050		1,336,500	2,799,968	4,400,460	6,148,799	8,056,629	10,136,480	12,401,832	14,867,188	17,548,150
- Miscellaneous	1,500		495,000	1,037,025	1,629,800	2,277,333	2,983,937	3,754,252	4,593,271	5,506,366	6,499,315
Net Visitors Contribution			4,042,500	8,469,038	13,310,032	18,598,218	24,368,816	30,659,724	37,511,715	44,968,656	53,077,738
Fees & Net Visitor Contribution			5,354,250	11,217,154	17,629,002	24,633,150	32,276,249	40,608,492	49,683,884	59,560,526	70,300,922

Visitors Expenditure /day

	Revenue	Factor*	et Revenue
Vehicle & Tour Costs	11,000	80%	2,200
Meals and Drinks	15,000	70%	4,500
Hotel	13,500	70%	4,050
Miscellaneous	5,000	70%	1,500

Source : Mission

Note : " = Costs %

5.4.1 Tourist Contribution - Petite Option

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2010
		1	2	3	4	5	6	7	8	9	10
Number of Visitors		6,000	6,210	6,427	6,652	6,885	7,126	7,376	7,634	7,901	8,177
Visitors without improvement		6,000	6,120	6,242	6,367	6,495	6,624	6,757	6,892	7,030	7,171
Additional visitors		0	90	185	285	391	502	619	742	871	1,007
Visitor days		0	90	185	285	391	502	619	742	871	1,007
- Locals 15%		0	14	28	43	59	75	93	111	131	151
- Residents 25%		0	23	46	71	98	125	155	185	218	252
- Foreigners 60%		0	54	111	171	234	301	371	445	523	604
Entrance fee											
- local	1,500	0	20,250	41,614	64,138	87,873	112,867	139,175	166,851	195,952	226,536
- resident	3,000	0	67,500	138,712	213,794	292,909	376,225	463,918	556,171	653,173	755,122
- foreigner	5,000	0	270,000	554,850	855,178	1,171,635	1,504,899	1,855,672	2,224,685	2,612,694	3,020,486
Total Entrance Fees		0	357,750	735,176	1,133,111	1,552,417	1,993,991	2,458,766	2,947,707	3,461,819	4,002,144
Visitors Expenditure											
- Tour net profit	2,200		198,000	406,890	627,130	859,199	1,103,593	1,360,826	1,631,435	1,915,975	2,215,023
- Meals and drinks	4,500		405,000	832,275	1,282,767	1,757,453	2,257,349	2,783,508	3,337,027	3,919,041	4,530,729
- Hotel	4,050		364,500	749,047	1,154,490	1,581,707	2,031,614	2,505,158	3,003,324	3,527,137	4,077,656
- Miscellaneous	1,500		135,000	277,425	427,589	585,818	752,450	927,836	1,112,342	1,306,347	1,510,243
Net Visitors Contribution			1,102,500	2,265,637	3,491,976	4,784,177	6,145,004	7,577,329	9,084,129	10,668,500	12,333,652
Fees & Net Visitor Contribution			1,460,250	3,000,814	4,625,086	6,336,593	8,138,996	10,036,095	12,031,836	14,130,319	16,335,796

Visitors Expenditure /day

	Revenue	Factor*	et Revenu«
Vehicle & Tour Costs	11,000	80%	2,200
Meals and Drinks	15,000	70%	4,500
Hotel	13,500	70%	4,050
Miscellaneous	5,000	70%	1,500

Source : Mission
Note : * = Costs %