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Fisheries in the Waza Logone floodplain : an analysis of the status of the fisheries sector and mitigation of conflicts within the sector in North Cameroon

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5

Evolution of fishing practices: fishing channels and man-made waterholes

5.1 Introduction

The Waza Logone floodplain, with a flooded area estimated at 6,399 km² per year (Westra, 2005), has historically been an important area for fisheries. Kotoko groups established themselves in the area many centuries ago and are experienced and skillful fishermen. Their livelihood is organized around fishing and their income comes from a combination of fisheries and agriculture. Fishing activities are undertaken by the community and they are supervised by the powerful *maginvini*, the responsible guardian of water (Van Est, 1999).

Thus, the Waza Logone floodplain provides ecosystem services that are interlinked with fishing practices as well as other main activities. The arrival of the Musgum ethnic group in the floodplain during nineteenth century gave rise to changes in social organization and impacted the relationships within the population. In 1979, the construction of SEMRY resulted in the settlement of new farmers producing irrigated rice. Some individuals from other ethnic groups as well as civil servants, employed through the developing rice sector, also relocated from other parts of the region to settle in the Waza Logone floodplain.

The Maga dam had a major environmental impact as it was built across the rivers that provided the floodplain with water (Loth, 2004; Sighomnou & Naah, 1997). The embankment (almost 30 km), which was constructed along the Logone River, created a drying out effect throughout the floodplain (Evan 2003; Sighomnou 2003). Aggravated by the general drought in the Sahel in the Eighties, people started to leave the area, which finally resulted in a rural exodus and migration towards other fishing places, such as the man-made reservoir at Lagdo. A number of actions were implemented in order to restore the ecosystem for livestock, wildlife in the Waza National Park and fisheries, but also for rice farmers. New waterholes were created in and around the Waza National Park, a large dam (the Zilim dyke; Drijver & Kouahou, 1995)

was constructed across the Logomatya River in the sub-district of Ngoudeni, and later two outlets (the *Petit Goromo* in 1994 and *Aretekele* in 1997) were opened to re-inundate the floodplain (Loth, 2004). The waterholes were financed by the LCBC and the dyke was built by the Ministry of Livestock, Fisheries and Animal Industries (MINEPIA) with a financial contribution from the former Logone-Birni Council. A study of the impacts on the inhabitants through questionnaires and on the environment through hydrological computer simulations (Evens *et al.*, 2003; Loth, 2004; ACEEN, 2007) about 5 years after these measures had been implemented, concluded that all parties were satisfied. It was decided that the configuration of the 1997 re-inundation should be retained. Unfortunately, as it turned out later, the fishermen had never been consulted about the actions, while this succession of events that resulted from these actions did, according to the fishermen, have a great impact on several fisheries practices that were commonly employed in the Waza Logone floodplain.

My study will therefore focus on these impacts. I will focus on man-made waterholes and fishing channels.

Ever since people settled in the Waza Logone floodplain, fishing channels have been utilized as an important tool to enhance their fishing yields. As human population numbers started to increase, these fishing channels became gradually integrated into community activities and the harvest was naturally distributed among all members of the community. In recent years, however, fishing channels have increasingly become a practice limited to a few rich people who receive the majority of the yield and revenues.

The history of fishing channels is linked to the establishment of the Musgum in the area. Blache *et al.* (1962) described that in 1955 there were some rare natural channels in the floodplain. These channels were maintained artificially and barred by means of fences, interspersed with traditional basket nets. At the time Blache *et al.* (1962) were carrying out their study, this type of channel was rare.

The Musgum newcomers dug new channels with the permission of the local *Blama* and over time these activities expanded.

During my fieldwork, I learned that the population was generally not satisfied with certain new regulations that forbid them to dig new fishing channels or to restore old ones (e.g. the provincial decision of May 2006⁹). In spite of the new legislations, some people started digging new channels and this has

9 Arrêté provincial n°5 du 03 mai 2006 portant mesures conservatoires préalables à l'inversion des tendances de dégradation des ressources naturelles de la plaine d'inondation de Waza Logone (Département du Logone et Chari)

become common practice up to today. Each year some fishing channels are illegally being restored.

Considering the popularity of the use of fishing channels in the area, and in view of the fact that other specializing fishing practices are becoming less profitable (Oostenbrugge *et al.*, 2004), I hypothesize that in the Waza Logone Floodplain, only owners of fishing channels have yields that are large and stable enough to provide a decent income throughout the year.

The aim of this chapter is to assess the state of fishing channel and water-hole practices in the Waza Logone floodplain, to compare their productivity and to determine their impact on fishery resources and floodplain ecology.

5.2 Materials and methods

5.2.1 Selected fishing channels and waterholes

The selection methods are the same as those described in Chapter 1. Data collection focused on waterholes and selected fishing channels in the floodplain.

Table 5.1

Overview of fishing channels and waterholes included in the survey of 2008-2009 (see also Figure 5.2. and Annex 2 for GPS position)

Location in the WLFP	Fishing area	Village	Owner
North of the WLFP	Abana	Abana	Adam Abare
North of the WLFP	Abana	Abana	Blama Moukak
North of the WLFP	Abana	Abana	Mahamat
Center of the WLFP	Logomatya	Zilim	Aba Kadir
Center of the WLFP	Logomatya	Zilim	Ahmat Zamakai
Center of the WLFP	Logomatya	Zilim	Alhadji Abkar
Center of the WLFP	Logomatya	Zina	Abagoni
Center of the WLFP	Logomatya	Zina	Djawi
Center of the WLFP	Logomatya	Zina	Kaskala
South of the WLFP	Logomatya	Sarasara	Abdoul Sali
South of the WLFP	Logomatya	Sarasara	Djibrine
South of the WLFP	Logomatya	Sarasara	Moussa Beladan
South East of the WLFP	Tchouvno	Tchouvno	Mazera
South West of the WLFP	Tchikam waterhole	WNP	Waza National Park service (government)
South West of the WLFP	Lougue waterhole	Tchede	Tchede community

An experimental survey targeted two additional man-made waterholes (one inside the Waza National Park and one outside) and 13 fishing channels along the Logomatya River, the Mazera River and in Moukak. Table 5.1 provides an overview of the fishing waterholes and fishing channels. All fishing channels along the Logomatya River, from Tekele in the South to Evie in the North were counted (see also 3.3.1; Figure 5.1).

5.2.2 Topographical assessment of waterholes and the Zilim dyke

A topography assessment aims to gather existing data in the field for their transcription, to scale, on a plane or on a map. Mapping occurs at different scales, the planimetry scale (X and Y) and the altimetry scale (Z axis).

With the support of the regional service of agricultural engineering (Ministry of Agriculture and Rural Development), I was able to perform a topographical assessment in the two man-made waterholes and in the Zilim dyke. During the assessment, the following elements were measured: (i) natural filling channels, (ii) the sedimentation basin, (iii) the retention basin, and (vi) the natural overflow channels. The sedimentation basins and retention basins communicate directly with each other, there is no intermediate space.

5.3 Results

5.3.1 Characteristics of the Tchikam and Lougue man-made waterholes

The original purpose of the Tchikam and the Lougue man-made waterholes was to provide drinking water to wildlife and livestock. Main users were nomadic herders coming from the region and from neighboring countries. Management interventions that were implemented during the Waza Logone Project (1994-2000) to limit human-related impacts on the park assigned the Tchikam waterhole, which is located inside the Waza National Park, for use by wildlife only. The Lougue waterhole (outside the park boundary) was maintained as a drinking water source for livestock. The area surrounding these waterholes was particularly affected by the reduction of flooding caused by the construction of the Maga dam and the containment dyke along the Logone River.

As there is no physical boundary or fence delineating the perimeters of the Waza National Park, both waterholes are openly accessible to humans and animals alike. Table 5.2 below shows the dimensions and the estimated volumes of the waterholes.

Table 5.2

Physical characteristics of Tchikam and Lougue waterholes

Water-holes	Length		Width		Height		Slope bank	Waterhole' capacity		Volume water	Volume sludge
	Li (m)	La (m)	Wi (m)	Wa (m)	Hi (m)	Ha (m)		Pi	Vi (m ³)		
Tchikam	108	117	54	68	1.2	1.2	0.33	6,300	4,600	4,600	1,900
Lougue	160	180	35	40	4.60	3.80	0.5	20,000	18,000	10,500	3,500

The indices (i) denote the initial dimensions presumed. The indices (a) denote the current estimated size.

Li = Initial length; La = Actual length; Wi = Initial width; Wa = Actual width; Hi = Initial height; Ha = Actual height; Pi = Initial slop bank; Vi = Initial volume; Va = Actual volume; Vw = actual estimated volume of water; Vs = Actual estimated volume of sludge

Although Lougue waterhole is about three times larger than the Tchikam waterhole, both waterholes contain thousands of m³ of water during the dry season (Table 5.2). The quality of the water in both waterholes has not been determined, yet I observed that during the flooding period (July-September), the water was clear while during the retreat of the water (October-December) it became more turbid. The dried clay soil along the edges provided sufficient nutrients for vegetation, such as wild sorghum, to emerge. At the start of the dry season (January-April), the water in the waterholes was greenish in color and water lilies and other aquatic vegetation started to grow, while at the end of the dry season (May-June) the water was muddy.

5.3.2 Fishing channels

When water retreats from the flood plain, small trenches are formed by the effect of the water current grinding the soil. These may eventually develop into larger channels that carry water back into the rivers or artificial waterholes. Figure 5.2 from a Google Earth view, shows a set of channels linking the ponds on the right side to the Logomatya River.

In general, there has been an exponential increase of fishing channels in the Waza Logone floodplain, especially after the construction of the Maga dam and reservoir (Figure 5.4). During a survey in 2006, a total of 4000 fishing channels were counted throughout the floodplain (ACEEN, 2007).

I counted a total of 413 of fishing channels from the source of the Logomatya River (Tekele Village) to the end where it joins the Logone River (Evie Village).



Figure 5.2
View of fishing channels in the Waza Logone floodplain (From Google Earth taken on 22 December 2005 and downloaded on 16 July 2011)

The channels are not evenly distributed over the landscape (Table 5.3), but rather concentrate near the village of Ngodeni and the Zilim dyke (Figures 5.2 and 5.3).

Table 5.3
Distribution of fishing channels along the Logomatya River

Site	Number of fishing channels
From Tekele to Zina	125
From Zina to Ngodeni	175
From Ngodeni to Zilim dyke	77
From Zilim dyke to Evie	36
Total	413

After the water has retreated completely (by mid-January latest), most of the fishing channels are dry, except for two channels near the dyke of Zilim, which still receive residual water from the Logomatya River, released by rice cultivators of SEMRY. These channels have been dug in the North West of the floodplain in order to create better conditions for the water supply of livestock.

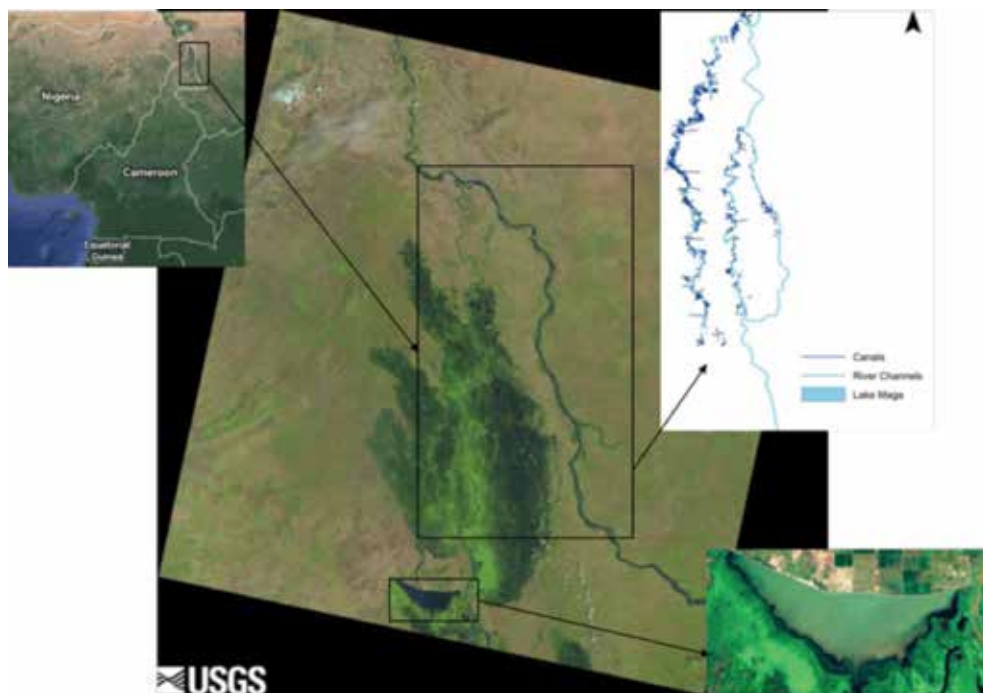


Figure 5.3
Distribution of fishing channels in the Waza Logone floodplain and the Maga Dam

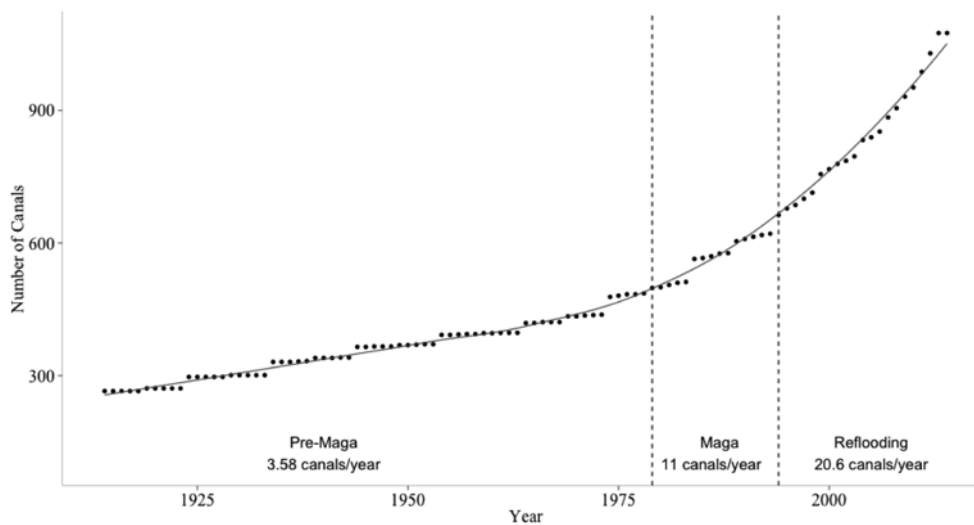


Figure 5.4
Evolution in time of the number of fishing channels before the construction of the Maga dam, after the construction and after the implementation of the reflooding project in 1994 (based on own interview data after 2005, date before 2005 are based on previous interviews during 2005; ACEEN, 2007)

The Zilim dyke is a dam made of a mass of clay-silt material in the form of a trapezoid, perpendicularly embedded in the water course. It is approximately 200 meters long (Figure 5.5).



Figure 5.5 Concentration of fishing channels around the Zilim dyke. Source: Google Earth, taken on 22 December 2005 and downloaded on 16 July 2011

The construction has a base width of about 10 meters and reaches a height of five meters at the axis of the water course bed. This barrier was designed to maintain a body of water year round, as a drinking water source for the animals of the nomadic herders. Over the years, fishermen started to catch fish here, and today the Zilim Dam, as well as the numerous fishing channels that have been constructed and now lead up to it (Figure 5.6) mainly serve as fishing waters.

5.3.3 Fishing in man-made waterholes and fishing channels

Fishermen in the study area mainly use cast nets, gillnets, hooks and Malian traps when fishing in man-made waterholes and fishing channels (see also Chapter 3).

The cast nets used are of a similar model, but their sizes vary with the strength and the ability of the fisherman. Cast nets are active fishing gear; the fishermen actively operate the cast nets while fishing. The nets are used

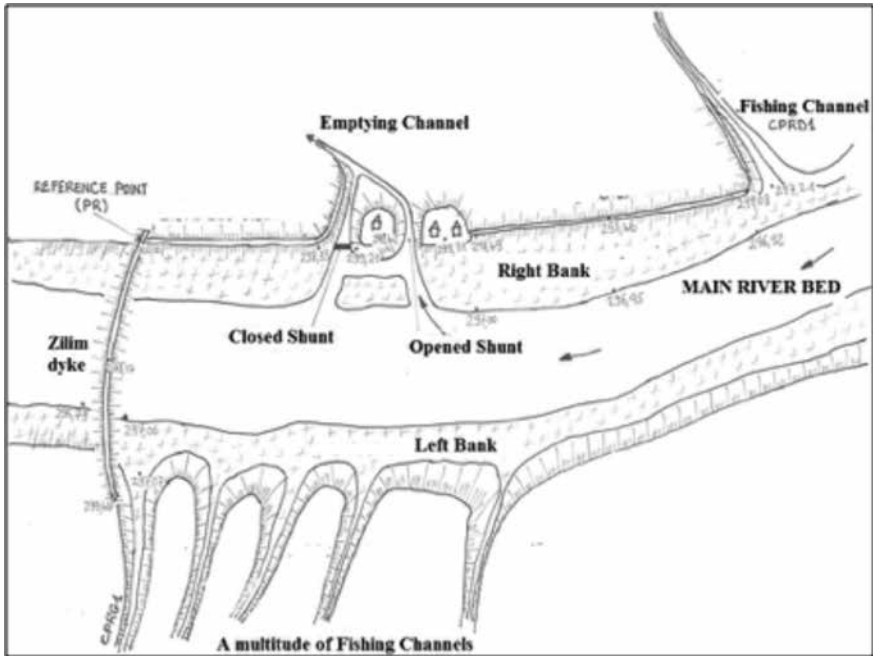


Figure 5.6
Synoptic sketch of the Zilim dyke and the surrounding fishing channels

during periods of low water. Fishing time observed is about 15 minutes (per cast) and each session can be repeated several times during the day.

Gill nets are used passively; the nets are left out, usually overnight, allowing the fish to get caught by the gills in the mesh. The gill nets that are used are made of nylon and are generally two meters deep. When a net is placed in a waterhole during low water (less than two meters deep), it forms a large pocket that can rest on the bottom depending on the ballast. The characteristics of the mesh are the same as those of the cast nets. The Malian trap is the most commonly used trap. I registered an average of 67 Malian traps per fisherman in Lougue waterhole and an average of 53 Malian traps per fisherman in the Tchikam waterhole.

The size of conventional hooks is indicated by the number specified by the manufacturer and generally known to fishermen (Number 15 based on surveys). Its use varies with water level in the waterholes. During periods of low water, the tool is actively used. At higher water levels it is used passively; hooks are then usually placed in the morning. The line and hooks are removed from the water at the end of the day.

In the fishing channels, fishermen often use funnel nets. These nets are placed to completely block the flow of water. The net has a special pocket that

is placed on top of a couple of stakes in the river bed or the waterhole. When the fish leave the fishing channels to enter the river bed or waterhole, they are caught inside the pocket. The pocket can be detached and replaced. This method is particularly effective during the retreat of the water from the flood-plain into the rivers, between the beginning of November and early January, with some slight variations depending on the location (Table 5.4).

Table 5.4

Period of selected fishing channels activities in the study area during November 2005-January 2009

Location	Village	Owner	November				December				January	
			8	15	22	29	6	13	20	27	3	10
Abana	Abana	Adam Abare										
Abana	Abana	Blama Moukak										
Abana	Abana	Mahamat										
Logomatya	Sarasara	Abdoul Sali										
Logomatya	Sarasara	Djibrine										
Logomatya	Sarasara	Moussa Beladan										
Tchouvno	Tchouvno	Mazera										
Logomatya	Zilim	Aba Kadir										
Logomatya	Zilim	Ahmat Zamakai										
Logomatya	Zilim	Alhadji Abkar										
Logomatya	Zina	Abagoni										
Logomatya	Zina	Djawi										
Logomatya	Zina	Kaskala										

5.3.4 Catches and Catch Per Unit of Effort (CPUE)

In the Lougue waterhole, 36 fish species were recorded in the catches. The dominant species were *Protopterus annectens* (59.5%), *Clarias anguilaris* (12.6%), *Clarias gariepinus* (7%) and *Tilapia dageti* (5.2%).

In the Tchikam waterholes, in total 42 fish species were recorded. The dominant species were *Protopterus annectens* (25.7%), *Clarias anguilaris* (20.5%), *Clarias gariepinus* (13.9%) and *Brienomyrus niger* (10.1%).

In the fishing channels, the main species were *Clarias anguilaris* (53.32%), *Clarias albopuntatus* (21.2%) and *Brienomyrus niger* (10.3%). In both Lougue and Tchikam waterhole, *Protopterus* sp., is dominant followed by *Clarias* spp., and species belonging to the families *Cyclidae* and *Mormiridae*. These species

are considered to be resident here. For *Prototerus* sp., waterholes are a suitable environment for hibernation.

The annual total production and CPUE of the Tchikam waterhole (21 tons) are twice as high as that of the Lougue waterhole (10.7 tons; Table 5.5).

Table 5.5

Estimated catches and CPUE for the fishing season 2008-2009 in the selected waterholes and fishing channels

Waterholes and fishing channels	Total catch (tons)	Mean CPUE (kg/fisherman/day)
Lougue	10.7	2.94
Tchikam	21.01	18.78
Fishing channels	0.78	53.24

Productivity in the Tchikam waterhole (4.57 kg/m³) is more than 7.5 times as high as the productivity in the Lougue waterhole (0.6 kg/m³). Thus, both CPUE and production greatly differs among these two waterholes. Based on the total number of 4,000 fishing channels in the floodplain (ACEEN, 2007), I estimated a total production of 3,133 tons from the fishing channels, which represents 20.3% of the total catches in the Waza Logone floodplain (15,436 tons for the 2008-2009 fishing season; Chapter 4).

5.4 Discussion

5.4.1 Fishing in man-made waterholes and fishing channels

Fishing strategies in waterholes recently tend to shift towards a specific new strategy using funnels nets and fences in combination with small holes (Table 5.2 and Figure 5.2).

Reports by ACEEN estimate that the number of fishing channels was about 4,000 in 2006 (ACEEN, 2007). Their database (personal communication) shows that 40% of the channels were dug between 1996 and 2006. During my field-work, I observed the digging of some new channels and maintenance works of the old ones. Rich fishermen continue to dig new channels despite the prohibition on digging new fishing channels, a decision taken by the Governor in 2006.

5.4.2 Fish ecology in waterholes and fishing channels

In both the Tchikam and the Lougue waterholes, the number of fish species is approximately half the total number for the floodplain (42 for Tchikam and 36 Lougue).

For the evaluation of variations on an annual basis or differences within and between floodplains, Welcomme (1977) suggested to use a general index, based on the relation between catch and floodplain ration. However, as noted by Sparre and Venema (1998), it is difficult to model a small scale and diverse fisheries such as the multi-species fisheries in the Waza Logone floodplain. I assume that the ecological role of the waterholes is substantial, since they serve as a source of breeding stock when the floodplain gets flooded. Waterholes are a good environment for hibernation of species such as *Protopterus* sp. and *Clarias* spp. Claridae and Cyklidae may even spawn inside the waterholes (Loth, 2004).

5.4.3 Capture and productivity of man-made waterholes and channels

Although my study indicates that fishing is still highly productive in waterholes (20 tons per annum in the Tchikam waterhole) as well as in fishing channels (3,133 tons estimated during the 2008-2009 fishing season), the proliferation of fishing channels also leads to the early drying out of the mares with which they are connected. During the dry season, only the presence of artificial water-containing waterholes allows for the resident fish species to hibernate and thus sustain a viable fish population.

Fishing channels allow a relatively small number of privileged fishermen to enhance their fish production. In fact, these fishermen spend part of their time managing their channels and they use available labor to dig out the channels, to maintain them and sometimes even to catch the fish. The waterholes and mares form the basis for subsistence fisheries for the majority of fishermen in the floodplain. This is consistent with observations by Bene *et al.*, (2003a, 2003b) and by Neiland and Bene (2003). The Zilim dam in this area maintains water in the Logomatya and thus plays a key role in dry season fisheries in fishing channels. The production around Zilim dam provides a sufficient source of income for few fishing channel owners, while other fishermen in the area need alternative sources of income to cope with the high basic uncertainty associated with the fishery (Oostenbrugge *et al.*, 2004).

In terms of production, the Waza Logone fisheries are comparable with many other African floodplain fisheries, which are highly adaptable and dynamic (Bernasek & Lopes, 1984a). During a monitoring survey in Bangladesh, De Graaf (2003) observed that in permanent water sources about 165 ± 28 kg/

ha of fish was caught annually and in seasonal floodplain 83 ± 23 kg/ha annually. However, he also observed that the fish catch exhibited a strong seasonal variation, with a highest catch when the floodwater recedes towards the river, and the lowest catch during the dry season (De Graaf, 2003; Welcomme 1977). I observed a similar variation during my study; the annual catch varied with the extent of flooding, with high catches in wet years and low catches in dry years.

Although it is difficult to justify conclusions based on a single fishing season, my data suggest that currently deployed fishing practices in the Waza Logone floodplain are non-sustainable. Despite relatively high production rates in the surveyed waterholes, my findings comply with the general definition by Jul-Larsen *et al.* (2003) of non-sustainably harvested fisheries on a few aspects; (i) direct investment, (ii) greater effort catches, (iii) increase in fish price. According to the same authors, overfishing at the community level occurs if the total fishery exceeds the overall annual surplus production of the combined fish community in a reservoir. A specific component of the fish community will be overfished only when specific investments are directed at that component, and fishers continue to fish the species despite the greater effort needed to maintain catches.

5.5 Conclusion

The situation described in this chapter is a cause of concern for the future of the Waza Logone floodplain as part of the vast hydrological system of the Lake Chad basin. A disastrous drop in fishing yields can be expected in the near future when for instance some natural event (e.g. extreme drought) or mismanagement (e.g. through governmental actions) alter the seasonal flooding patterns of the floodplain. Fishing yields almost entirely depend on the seasonal flooding. What is also worrying is the strong increase in the number of fishing channels, in combination with highly selective fishing practices, especially considering that the incomes generated in the area increasingly come from such fishing practices (i.e. using fishing channels and inappropriate techniques).

Eventually, it may be expected that the diminishing fish stocks will lead to more conflicts between people living in the area.

