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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3

Waza Logone Floodplain and Fisheries

3.1 Introduction

The sub-Saharan arid zone contains some of the most important inland fisheries in Africa, mainly in seasonally flooded tropical wetlands (FAO, 1995). More than 59% of Cameroon's fresh water resources and 86% of its fresh water area are comprised of floodplains (Emerton, 2005). After the reflooding of the Waza Logone floodplain in 1994 and 1997, the human population increased from approximately 100,000 inhabitants (Scholte *et al.,* 2006; Bauer, 2003) to 145,000 inhabitants (estimation from BURCREP, 2010). Politics have always linked the Cameroonian fisheries sub-sector to the livestock breeding sub-sector, which is also reflected in the name of the ministry that is in charge of these sub-sectors (Ministry of Livestock, Fisheries and Animal Industries). Both sub-sectors contribute significantly to local economics, especially in rural areas. More than 30% of the rural human population has found a means of subsistence in either fishing or livestock husbandry (Mohamadou *et al.,* 2006). The contribution of both these sub-sectors to the Gross Domestic Product (GDP) of Cameroon was estimated at 117.4 billion FCFA for livestock and 65.6 billion FCFA for fisheries in 2001 (MINEPIA, 2002). They account for about 15% of the rural production and constitute a major source of income for nearly 30% of the rural human population.

This chapter summarizes the techniques and tools used for fisheries in the Waza Logone floodplain. It is a first step to evaluate the impact of the fishing efforts and the sustainability of the fisheries in the Waza Logone floodplain.

3.2 Methodology

3.2.1 Rapid Rural Assessment of fisheries in the floodplain

Between March and April 2009 a Rapid Rural Assessment (RRA) was carried out in the Waza Logone floodplain during which socio-economic data on vil-

lages, population, fisheries, community perceptions on the drying out of waterholes and the reduced flow in the Logomatya River was collected (for more details see Chapter 1, General methodology).

3.2.2 Daily survey of selected fishing reservoirs

In order to investigate the dynamics and the complexity of the floodplain fishery status, several known fishing spots were visited on a daily basis. The selection procedure of fishing spots consisted of an initial rapid assessment in the Waza Logone floodplain during the 2008-2009 fishing season, which focused on fisheries, fishermen, fishing materials and fishing methods. Nine fishing spots were selected near/in the river bodies (Logomatya, Lorome Mazera) and in natural waterholes (Table 3.1). The selection procedure considered the geography of the floodplain (see Figure 2.2, Villages and National Park in the Waza Logone floodplain, Chapter 2).

In total, 1781 observation days, with 18 observers, were included in the survey from August 2008 to June 2009. The fishing season was divided into three periods: the flooding period (July to October), the retreat period (November to January) and the dry period (February to April). Anticipating the intensity of the fishing activities, records for some fishing spots began later (November 2008) or ended earlier. Table 3.1 provides the number of recorded observation days for each fishing spot and period.

Table 3.1
Selected fishing spot and period of observation (See GPS locations in Annex 2)

Fishing spot	Observations days		Fishing period	Observations days	
	Number	Percentage		Number	Percentage
Bazi	240	13.48	July-Aug-Sept-Oct	450	25.27
Dagalo	139	7.80	Nov-Dec-Jan.	769	43.18
Kaziré	240	13.48	Feb-March-April	562	31.56
Lahaï	272	15.27			
Malazina	273	15.33			
Moukak	181	10.16			
Sarasara	163	9.15			
Tchouno	92	5.17			
Zina	181	10.16			
Total WLFP	1781	100	Total WLFP	1781	100

Each day, research assistants recorded the number of fishermen, the number of canoes and the type and number of fishing materials used in the fishing spot. The data were grouped in ten-day periods. The first period of the month corresponds to the 1st-10th day of the month (first period of ten days); the second period corresponds to the 11th-20th day (second period of ten days) and the third period corresponds to the 21st-31st (third period of ten days).

3.2.3 Data analysis and statistics

Fisheries data were entered into a Microsoft Excel database and analyzed using statistical software such as SPPS, version 2010. Calculations were directed at fishing spot characteristics and dynamics over time.

3.3 Results

Table 3.2 provides more information on each parameter that was included in the survey. These include type of fishermen, canoe and fishing materials.

Table 3.2
Specification of research parameters

Parameter	Specification
Fisherman	Resident Migrant
Canoe	Wood sheet
	Metal sheet
	Dugout
Gillnet	Measured in yards (1 yd = 0.9144 m) ½, 1, 1.5, 2, 3, 4 inches
Cast net	½, 1, 2, 3, 4 inches
Hook	Sizes 11, 12, 13, 14, 15, 16, 17, 18
Malian trap	No further specification
'Scissor net'	No further specification
'Aring trap'	No further specification
'Touski trap'	No further specification
'Mouman trap'	No further specification

3.3.1 Fisheries in the Waza Logone floodplain

Fisheries in the Waza Logone floodplain are not simply open access but also open exit, meaning that fishermen not only choose between different fishing patterns, they may also choose to enter or to leave the fishery depending on the opportunities it offers in relation to other options, as well as the risks involved in fishing (Van Zwieten *et al.,* 2011).

The floodplain is characterized by fluctuations in fishing water availability which influence the timing of fishing. From September to December, the flooded area could be considered as one large fishing area. People use canoes to move from one village to another. When the water retreats, the remaining, more scattered fishing sources could be divided into several types, as described in the following sections.

River fishing spot

Three main rivers run through the study area: the Logone River, the Logomatya River and the El-beid River (see Figure 2.2 and Figure 3.1). The Lorome Mazera, a short shunt of the Logone River, is less prominent but also provides a fishing resource during a considerable portion of the year.

The Logone River originates from sources in western Central African Republic, northern Cameroon, and southern Chad. It has two major tributaries: the Pende River (Eastern Logone) in the prefecture Ouham-Pende in the Central African Republic and the Mbere River (Western Logone) in the East of Cameroon. The river and its branches are surrounded by numerous large and small swamps (Naah, 1990). The river's total length is about 1,000 km for a basin estimated at 78,000 km^2.

In the eastern part of Cameroon, the Logone River forms a natural geographical boundary between Cameroon and Chad. Its main tributary in the floodplain is the Logomatya, which becomes almost completely dry during the dry season.

The Logomatya River is strongly linked to the SEMRY rice scheme. Before the construction of the Maga dam, it collected water from the Mayo Vrick. After the dam was built, the flow of the Mayo Vrick was blocked and regulated during the dry season. The water flow in the Logomatya was maintained through water from Lake Maga. The Mayo Vrick provides the main reservoir for discharging water in case Lake Maga overflows. Residual water from cultivation is drained into the Logomatya (with a peak between January and May). The collected water is rich in fish stock, which makes the Logomatya River an attractive spot for fishing during the dry season. To control this important fishing spot year round, the Zilim Dyke was built in 1985. Picture 3.1 (from Google Earth, taken on 22 December 2005) shows the Maga Lake and its dam

(in blue), with the Mayo Vrick on the left and the Logone River on the right. Between the Mayo Vrick and the Logone River, the SEMRY rice production scheme is visible (black and green area in square). On the Guirvidig side the rice fields are visible.

Picture 3.1
Hydraulic relation between the Logomatya River and the SEMRY rice production scheme (22 December 2005, downloaded from Google Earth on 12 July 2011)

The El-beid is another small river that connects the floodplain to Lake Chad during periods of high flooding. It dries out during the dry season (Figure 2.2).

Natural waterholes

A number of natural waterholes are present throughout the floodplain, some of which contain water until the end of the dry season. These waterholes are also sometimes used for fishing. Table 3.3 provides an overview of the main natural waterholes present in the area.

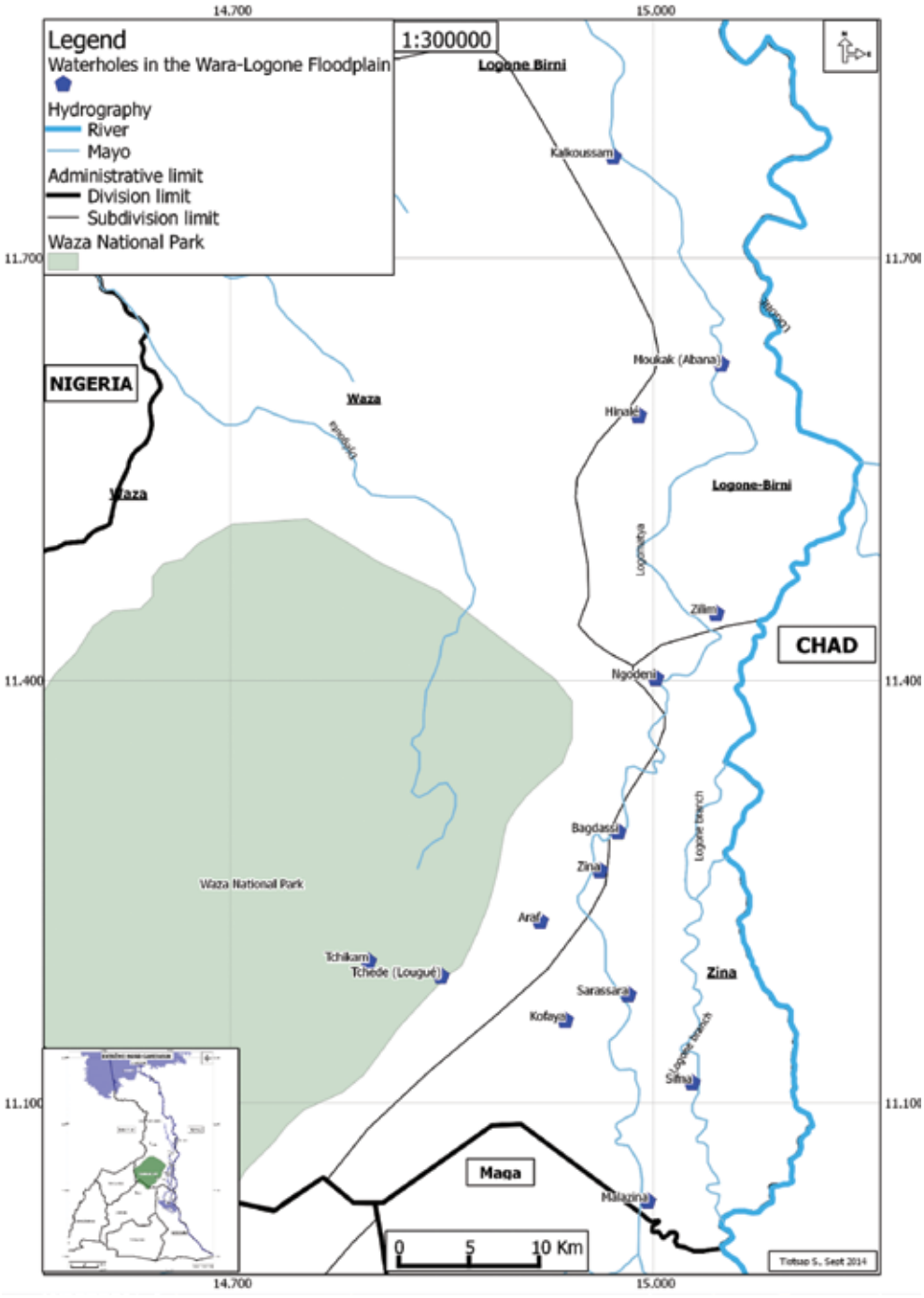

Figure 3.1
Situation of waterholes in villages in the Waza Logone floodplain (NIC and field data)

Man-made waterholes for cattle

Several waterholes have been constructed specifically to provide livestock with a source of water during the dry season (Table 3.4). These waterholes are situated at between 2 and 5 km from the park perimeter and are visited by both resident and transhumant pastoralists. In addition to these waterholes, there are a number of others in the south of the park, which become flooded during the wet season. All of these man-made waterholes are also used for fishing.

Man-made waterholes for wildlife

In the eastern part of the Waza National Park there are a number of waterholes that have been constructed to provide water for wildlife when natural water sources become scarce (Table 3.3). Despite the fact that human activities are prohibited inside the park, fishermen and poachers from adjacent villages have often been observed to use the waterholes for illegal activities. Groups as large as 40 people capture fish in some of the waterholes, or use them for drinking water while staying in small poaching camps close to the waterholes, sometimes for several days.

3.3.2 Fishermen in the Waza Logone floodplain

For the present study, fishermen have been categorized into two groups: resident fishermen and migrant fishermen. Resident fishermen live near their fishing waters, while migrant fishermen have to travel to get to their fishing waters. The latter group brings their family along (sometimes even very small children and elderly) to stay near the fishing spots for a certain amount of time.

Results show that an average of 5.3 resident fishermen (RF) and 9.75 migrant fishermen (MF) visit a certain fishing spot (2008-2009 fishing season). In most fishing spots, with the exception of Moukak, migrant fishermen outnumbered resident fishermen (Figure 3.2). The total number of fishermen observed on the fishing spots at Bazi, Kazire, Moukak and Zina is more than 10 per day. The fishing pressure in Moukak is very high because it has water all year round and therefore a high productivity.

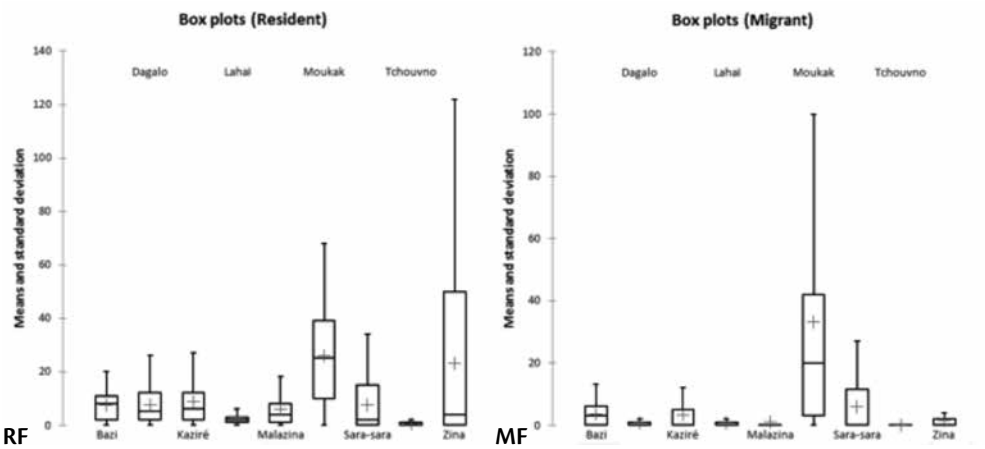

Figure 3.2
Mean number of resident fishermen (RF) and migrant fishermen (MF) per selected fishing spot (2008-2009 fishing season).

Figure 3.3 displays the linear distribution of the number of fishermen during the fishing season.

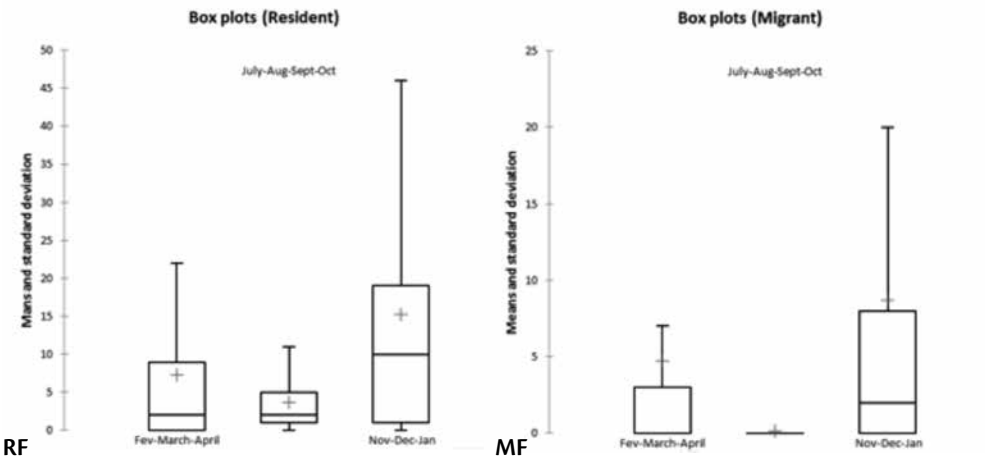

Figure 3.3
Mean number of active fishers (RF and MF) during the 2008-2009 fishing season)

The increase in number of fishermen during December is related to the retreat of water from the floodplain. Water becomes more patchily available and fishermen are more dependent on fishing spots.During the inundation period (July-October), fish are available throughout the floodplain, which is reflected in the low numbers of fishermen visiting the nine surveyed fishing spots.

3.3.3 Fishing canoes

Three types of canoes are used for fishing in the Waza Logone floodplain: wooden sheet canoes, metal sheet canoes and wooden dug out canoes. Wooden dug out canoes are traditional canoes made by local craftsmen. These canoes are carved and usually burnt out from a single tree trunk. They represented 24.8% of the total number of canoes in use during the 2008-2009 fishing season. The majority of canoes used are metal sheet canoes (63.04%). They are the preferred type of canoe throughout the Waza Logone floodplain and are cheaper than the wooden sheet type (27,000 FCFA vs 76,000 FCFA respectively). Metal sheet canoes are made using a second-hand metal sheet.

3.3.4 Fishing materials

Nine main fishing gears are used in the Waza Logone floodplain. Which type of gear is used for fishing, largely depends on the characteristics of the fishing spot and the time of year.

Gillnets

Gillnets have several mesh sizes. The smaller the mesh of the gillnet, the higher the capacity of the catch; i.e. smaller meshed nets also capture small fish species and juveniles. Consistent use of small meshed nets will eventually compromise the viability of the present fish populations.

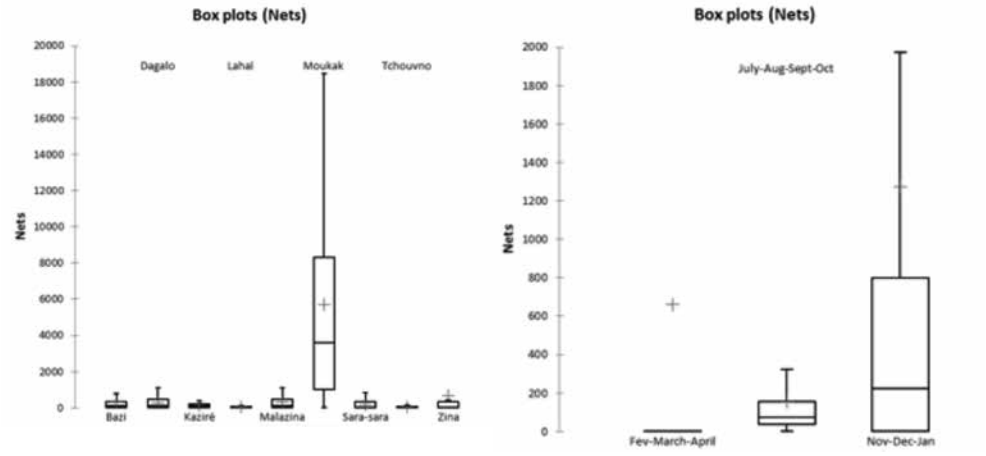

Figure 3.4
Importance of gillnets per fishing spots and fishing period in the study area (2008-2009 fishing season)

The use of differently sized gillnets varied greatly among the surveyed fishing spots (Figure 3.4). In the Moukak fishing spot, the total number of gillnets used is much higher than in other fishing spots, as is the number of small meshed gillnets (5708±6055). At this fishing spot, gillnets are mostly used during the retreat period.

Beach seine

The beach seine is a fishing net that is often used in community fishing. It is a big net with floaters and is used to pull fish from the waterbed to the banks (the beach). A beach seine is a seine net operated from the shore. It consists of a bunt (bag or loose netting) and long 'flaps' which are often lengthened with ropes for towing the seine to the beach. The head rope with floaters remains on the surface, while the foot rope is in permanent contact with the bottom, thus forming a barrier that prevents the fish from escaping from the area enclosed by the net. It is operated by a large group of fishers – sometimes more than a hundred – depending on the length of the beach seine and the predicted size of the catch. This type of net is mainly used when the water level is low.

Picture 3.2
Fishermen employing a beach seine in Zina

In the Waza Logone floodplain, the beach seine is used from December until June (dry season). The total number of beach seines used by fishermen changes over time and varies per surveyed fishing spot (Table 3.4). The mean number of beach seines used per day is 0.12±0.45. The highest number of beach seines was used in Kazire fishing spot (0.29±0.86). No beach seines were used at Moukak fishing spot. Beach seines are mostly used during the dry season (0.26±0.67), with a peak in March, when the water level in the Logomatya River is at its lowest and the water coming from the SEMRY rice scheme is not enough to fill the river.

Table 3.3
Mean number of beach seines used per fishing spot and fishing period (2008-2009 fishing season)

Fishing spot	Means and Sd	Fishing period	Means and Sd
Bazi	0.23±0.48	Feb-April	0.26±0.67
Dagalo	0.029±0.16	July-Oct	0
Kazire	0.29±0.86	Nov-Jan	0.09±0.35
Lahai	0.01±0.12		
Malazina	0.03±0.23		
Moukak			
Sara-sara	0.21±0.5		
Tchouvno	0.01±0.14		
Zina	0.22±0.51		
Total WLFP	**0.12±0.45**	**Total WLFP**	**0.12±0.45**

Fishing hooks

Fish hooks can be defined as devices for catching fish either by hooking them in the mouth or, more rarely, by snagging the body of the fish. There are no international standards for hook sizes, but in general each size has a number, corresponding to a relative size, with size 1 hooks in the middle of the size range. Smaller sizes are indicated by larger whole numbers and larger sizes by increasing whole numbers followed by a slash and a zero. In the study area, size '11' fishing hook is most commonly used, followed by hook size '16' (Table 3.2). While some fishing hooks tend to be used more in November and December, there are some that are used more in March. Fishermen appeared to rarely use bait. Fish hooks are normally attached to a long line which is then traversed over the river, with one fisherman on each bank to hold it.

Cast net

Another type of net that is frequently used in the floodplain is the cast net. The particular type used is a circular net with small weights distributed around its edge. It is thrown by hand in such a manner that it spreads out on the water and sinks. The fisherman can throw it standing in a canoe (Picture 3.3) or simply while standing in the water. Fish are caught in the net when the edges gradually close, as it is hauled back in.

Picture 3.3
Fisherman throwing a cast net in the Logomatya River

Several types of castnets with variable mesh size are used at the surveyed fishing spots. The number of cast nets with the smallest mesh size (½ inch) is highest in Bazi (Figure 3.5) indicating the pressure on the fish populations at this fishing spot is particularly high. Cast nets with a relatively small mesh size are also intensively used in the fishing spots at Bazi, Kazire and Sarasara (Figure 3.5).

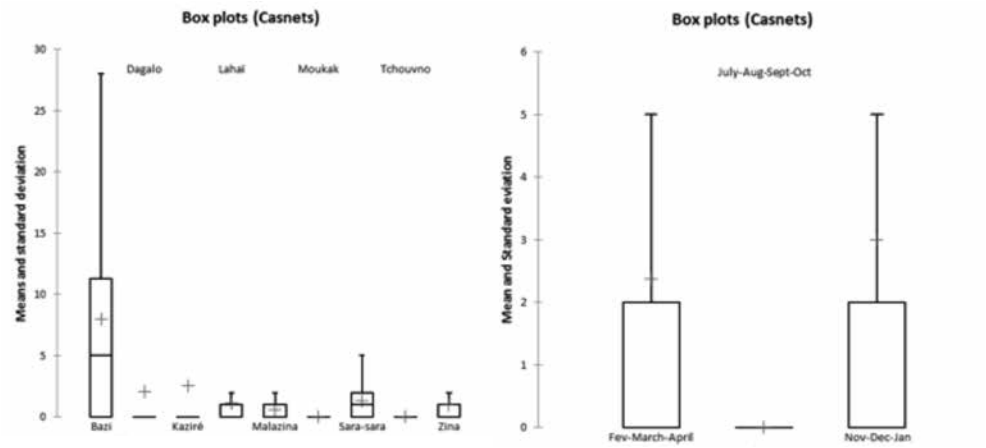

Figure 3.5
Means of cast nets used per day per fishing spot and fishing period (2008-2009 fishing season)

Cast nets were used most frequently in December 2008, January 2009 (end retreat period) and February 2009 (beginning of the dry season).

Scissor nets

The 'scissor net' is a large net held together by two pieces of wood in the shape of a 'V'. It is launched into the water and then gradually raised. The fish are retained in the mesh that forms a bag under the influence of gravity. Picture 3.4 shows a fisherman arranging his scissor net on the bank of the Logomatya.

Picture 3.4
Fisherman with a scissor net in the Logomatya River

Fishing traps

The most common fishing trap used in the study area is the *Malian trap*. The Malian trap is a kind of basket of 1.2 m high and 0.75 m at the base, made from flexible wood and nets. Three or four open gaps at the base allow the fish to enter, attracted by a bait of fried rice bran. The small mesh size of the net (1/2 inch to 1 inch at most) prevents the fish from escaping. Since 1990, the traditional basket nets have been abandoned and replaced by these Malian traps. Picture 3.5 shows a fisherman braiding a Malian trap (3.5a) and a Malian trap with captured fish inside (3.5b).

Picture 3.5a
Malian trap

Picture 3.5b
Malian trap with catch

The *Malian trap* is an effective tool; it is light, modular and it proves to be productive. Their design (dimensions, materials, mesh, and bait) and the skills of the fisherman in setting the traps do however influence their effectiveness. Fishermen at the surveyed sites have been observed to manage more than one hundred *Malian traps* arranged in lines at the same time. A Malian trap is set for several days. The fisherman re-installs the trap in the waterhole as soon as the catch has been removed.

Malian traps are used most frequently in Moukak and Zina fishing spot (Figure 3.6). During the fishing season, *Malian traps* were used most frequently from November 2008 to January 2009 (Figure 3.6) which is consistent with the fact that these traps are mostly used for catching migrating fish.

Fish migrating to the floodplain were in the most advanced stages of sexual maturity for spawning in October 2008. Regardless of any brooding fish that might be caught or the potential damage to fish reproduction, the use of Malian traps reaches a peak during this period, suggesting that the viability of the fish populations is not taken into account by fishermen when choosing their gear or timing their catching season.

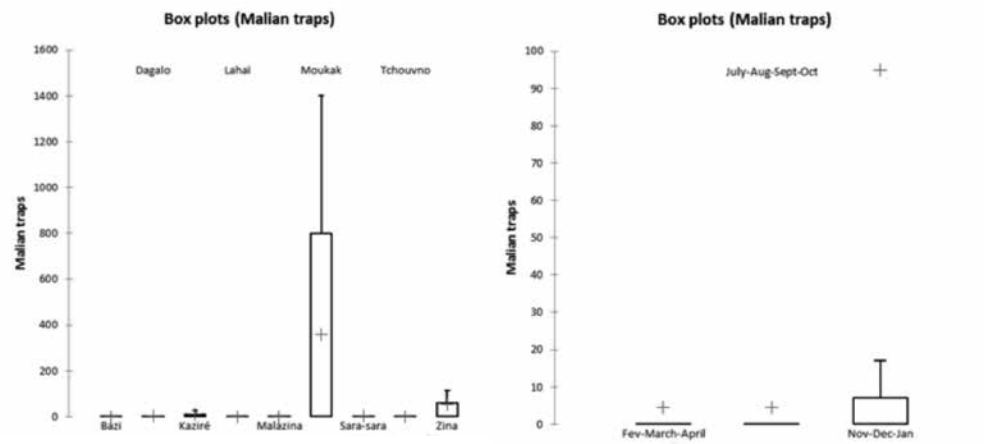

Figure 3.6
Daily use of Malian traps in the selected spots and per period (2008-2009 fishing season)

Moumam traps

The *Mouman trap* is a kind of fence that is placed in shallow water in such a way that the ends of the fence meet, while still allowing for a small entrance (Picture 3.6). After putting bait inside, the trap is gradually filled (a process of several hours) with a variety of fish. Especially at the Moukak fishing spot this type of trap is used frequently.

Picture 3.6
Mouman traps in the Logomatya River

Aring trap

An Aring trap is a plunge basket, mostly used by women and children (Picture 3.7). The basket is held by the top and plunged into shallow water. Trapped fish can be taken out by hand through a small opening in the top. Similar to the Malian traps, the Mouman and Aring traps were used most frequently between November 2008 to December 2009 to catch migrant fish during the retreat of the water from the floodplains.

Funnel nets

Funnel nets are specifically used to capture fish in channels. This net is also used to catch fish during the retreat of the water. The fishing method using funnel nets is described in more detail in Chapter 5.

Although some of the nets discussed here are used in relatively small numbers, their mere presence in the array of nets used in the Waza Logone floodplain is an indication of the complexity of fishing techniques used in this area.

Picture 3.7
Women using the Aring trap in the Logomatya River

3.3.5 Fishing methods

The fishing methods used in the Waza Logone floodplain aim to maximize the catches. Factors such as the biology of the fish species and the hydrology of the floodplain are secondary to factors that maximize the catch, such as type of fishing material, the period of fishing, the cost of the nets and the bait that is used.

Sometimes fishing methods don't need to be advanced to be effective. I noticed a simple fishing method which involves only a single fishing gear that is used in either the river bed or the floodplain, whichever provides the best chances for a good catch.

Other fishing methods consist of a more complex combination of several materials and strategies in order to optimize catches. Among these more complex techniques are the use of fishing channels, fishing grasses and fishing wells with barriers to drain fish into the traps, or the use of multiple barriers in river beds, in conjunction with Malian traps.

I also observed some specific methods that are used during the retreat of the water. These include a combination of a fence and a hole dug in the soil. The fence forms a barrier in the waterway and guides the fish to a well with smooth borders (Picture 3.8).

Picture 3.8
Fence and small hole used for capturing fish around the Tchikam waterhole

3.4 Discussion

Compared to other livelihood forms in the Waza Logone floodplain, such as agriculture and livestock husbandry, fishery is regarded as the most important.

Fishers often take their families along when they migrate along the floodplain. They are often found at completely different parts of the floodplain, within only a few weeks. The case of Moukak (Abana) deserves a special note, especially in terms of the strongly rising human pressure on both the fishing resources and the surrounding ecosystem. This is partly due to a significant increase in the population of the village during the fishing season. People are attracted to the area around Moukak, situated in the North West of the floodplain, because they recognize it as a productive area in terms of fish production. Moreover, water retreats later compared to other areas in the floodplain. Because of the abundant water sources available and the suitable grazing grounds nearby, large numbers of pastoralists lead their livestock through this area at the end of each dry season.

Except perhaps in Lake Victoria, Uganda (Beuving, 2010), where young people are migrating to rural villages to seek jobs, people do not normally migrate to rural areas in great numbers. In that sense, the Waza Logone floodplain is not an exception, where the potential of conflict might also discourage settlers.

In other types of inland water, the complexity of the gear is positively related to the diversity of social practices, with at least three major groups of fishermen or fishermen-farmers who invest their time in different ways, during various seasons (Welcomme, 1999). In these cases, Welcomme (1999) distinguished between professional fishermen who depend completely on the fishery, part-time fishermen who switch between fishery and some other activities seasonally, and occasional fishermen who participate in fisheries only on an irregular or casual basis. This strict classification cannot be applied to the Waza Logone floodplain, as most people are both fisherman and farmer. The extent to which they are involved in one activity versus the other differs, often depending on the expected production from e.g. rice cultivation. Young people become oriented towards farming, while fishing is an activity for rich people who own channels, or poor people who have no other options open to them. In general, fishing is considered as an activity for the poorest of the poor in the Lake Chad Basin, with the exception of some rich fishermen using fishing channels (also refer to Bene *et al.,* 2003b).

In many tropical small water bodies, the intensification of fishing practices is regarded as a potential opportunity to create a new export market with obvious economic benefits (Beuving, 2010). A multitude of local business opportunities grows as a result of the income generated by the fishery, as is also

the case in Lake Victoria, Uganda (Geheb *et al.,* 2008). The case of the Waza Logone Floodplain does not comply with these observed innovative developments in other regions. In the Waza Logone floodplain, the fishing equipment is still traditional, labor is generally still manual, and the processing consists of traditional drying and smoking. Markets created from fisheries in the Far North of Cameroon have remained stable over the past decades, or at least did not follow the sharp intensification of fish resources which did become evident. This is in sharp contract with e.g. the situation around Lake Victoria, in Kenya and Uganda. In the Nile perch fisheries there, successful careers seem to be determined primarily by access to capital (Geheb *et al.,* 2008; Beuving, 2010). Boats and equipment are expensive around Lake Victoria, and new businesses are not easily financed. A small minority of fishermen who are successful in the Nile perch business know how to acquire external financial resources, whereas the great majority lacks the financial basis to become part of this expanding business (Beuving 2010).

Unlike the specialized Nile perch fishing industry in e.g. Lake Victoria, the Waza Logone floodplain is characterized by the combined use of several types of fishing gear. Between 1965 and 1970 there was a gradual change in fishing materials. Traditional fishing practices were replaced with the introduction of nylon nets and the spectacular extension of the number of gillnets (Durant, 1980). Fishermen created new techniques and elaborated on existing techniques, designed to catch more fish. Despite efforts by government to regulate the increased pressure on fish resources, there is little respect for laws or administrative decisions that prohibit the use of materials such as *Malian traps* or nets with small mesh size. The relatively intensive use of cast nets of ½ inch in the fishing spots of Bazi and Kazire imply that fishermen at these fishing spots aim at smaller and younger fish during the catch season. The excessive catch of juvenile fish can be detrimental to the fish stocks (Durant, 1980). The traditional ideas about fisheries management: using minimum mesh sizes, but avoiding fishing on juveniles, is gradually shifting towards using the fish community proportional to its productivity. That means it is possible to harvest juveniles, because juveniles already experience the highest natural mortality. In traditional, low-tech, open-access-easy-exit fisheries with a plethora of gears, the fishery is more or less unselective and proportional to the productivity (Jul-Larsen *et al.,* 2003).

The intensified use of beach seines at the end of the dry season, strongly depletes the remaining breeding stock. The fishing channel practice is used in the same way, during short periods when the water retreats to the river. Fish migrate from the floodplain to the river or to the *mare* to reproduce and are caught when passing through the channels. This practice will be discussed further in Chapter 5.

Even in the waterholes inside the Waza National Park, the fishing effort is oriented towards short term catches and short term gain, while the impact on breeding stock is not taken into account.

Using gear for fishing is by definition selective (Garcia & Csirke, 1989). Fishermen have traditionally developed techniques to increase their catch, but also to select certain species and specific components of fish populations, at different times of the year and in selected areas. In the Waza Logone floodplain, selective fishing is linked to the seasonal hydrology of the floodplain. During flooding, fishing gear is used in certain fishing spots to catch *Alestes spp*. and in waterholes, *Protopterus sp*. is targeted. As noted by Fulton and Smith (2011), the form of fishing used (i.e., the fishing patterns across fish sizes and species) was far more important for fishermen than the type of ecosystem that was fished. However, if fishing was broadly distributed across many species and if fish of all sizes were caught, the yield curve increased linearly with the exploitation rates to high levels. Nevertheless, with this strategy the yields could collapse suddenly (Fulton & Smith, 2011). The issue of selectivity of fishing gear and the practice of its regulation is a complicated issue, which needs tailor made approaches.

Fisheries in inland waters are often extremely complex in terms of both gear and strategies used. Welcomme (1999) distinguished between two main types of fisheries: those that employ only one type of gear, usually gillnets, and those that target a range of fish species in their different life stages through a diversity of static and active gear, which are often deployed seasonally. The Waza Logone fishery belongs to the second category. The variation in fishing systems varies in space and in time. The particularities of these fisheries include man-made waterholes and fishing channels. Many of the waterholes are dug in order to maintain water for livestock grazing outside the Waza National Park and for wildlife inside the Park during the dry season.

In general, each waterhole 'belongs' to a (group of) resident fishers. Migrant fishermen need to get permission from the owner to use a certain waterhole. Waterholes inside the park, are illegally visited by people coming from surrounding villages. Fishers (who often also poach wildlife as a food source) organize themselves in groups and plan their expeditions into the park together as to avoid park guards and poaching patrols. I also observed that they use boats made of reeds when the water is too high and they organize intelligence systems to detect the arrival of the park rangers. The diminished fish stock available to fishing birds (e.g. black-headed heron *Ardea melanocephala*, marabou stork *Leptoptilos crumenifer* and African fish eagle *Haliaeetus vocifer*) as a result of fishing activities inside the park only adds to the human-induced degradation of the park and its resources.

3.5 Conclusion

Fishing in the Waza Logone floodplain is organized as an open access system and people come from several villages to fish. Fishing spots are shared between newcomers (often migrant fishermen) and resident fishermen.

Fishing occurs all year round, but not always at the same intensity. In the flooding period, the Waza Logone represents a unique fishing system: the floodplains transform into a big lake with the villages situated in the non-flooded areas and the higher river banks looking like small islands.

My daily surveys showed that fishermen are very mobile in the floodplain, using different types of canoes and navigating to productive fishing grounds based on their experience. Fishing strategies are generally complex in terms of fishing materials used and the fishing methods adopted by fishermen. This complexity can affect fish yield, fish stocks and can be a source of conflict.