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Introduction and Background

1.1 Introduction

Floodplains are defined as areas of low lying land that are periodically inundated by lateral overflow of water from the rivers or lakes with which they are associated (Junk & Welcomme, 1990). Globally recognized as highly productive environments, floodplains are often referred to as 'the cradles of biological diversity', serving as the source on which numerous species of plants and animals depend on (Chapman *et al.,* 2011). Throughout natural history, floodplains supported high concentrations of birds, mammals, reptiles, amphibians, fish, and invertebrate species, and proved to be critical for the maintenance of adjacent ecosystems through processes such as nutrient flushing, effects on microclimates, water holding capacity and as storehouses for genetic material (Chapman *et al.,* 2011).

Many of the world's floodplains are now considered as potential zones of development, in which they also function as a means for soil hydrology, pasture for livestock and floodplain fisheries. Governments and development agencies throughout the world increasingly become aware of the crucial life supporting role floodplains have (Neiland & Bene, 2003). Their impact on local economical growth and human social organizations is indisputable, especially in developing countries (Neiland & Bene, 2003).

In the face of recent human population growth and associated rising levels of poverty in developing countries, the pressure on floodplains is on the increase. In addition, many inland water bodies are shrinking due to climate change (Wirkus & Boge, 2006). With poor communities becoming more and more dependent on disappearing water resources, it has been predicted that a future world war will be a "Water War". The example of the River Nile shows how this controversy has impacted the ten so-called Nile basin countries: Egypt, Sudan, Eritrea, Ethiopia, Uganda, the Democratic Republic of Congo, Rwanda, Kenya, Tanzania and Burundi. In the year 1929, a colonial treaty between Egypt and the United Kingdom gave all management rights relating

to the Nile River to Egypt (Wirkus & Boge, 2006). The other countries of the Nile Basin are claiming a new water-sharing deal called the Co-operative Framework Agreement, but have failed to reach an agreement. Nowadays, Egypt is still in control of the Nile River and its resources. Any attempt by other countries to go against this sovereignty, inevitably leads to a military response by Egypt.

Sixty-three of the world's 261 international river basins are located on the African continent (Chapman *et al.,* 2001). Wetlands form a habitat of great ecological importance here, but they are extremely distributed and particularly the sub-Saharan zone is impacted by water shortages (Loth, 2004). Although exact estimates of wetland surface area in Africa is largely lacking, mainly due to a lack of scientific investigation and inconsistent mapping policies, wetlands are suggested to cover approximately 1% to 16% of the continent (Koohafkan *et al.,* 1998). In terms of surface area, different rough estimates exist, ranging from 220,000 km² to 1,250,000 km² (Bullock *et al.,* 1998) and covering wetlands of varying type, from saline coastal lagoons in West Africa to fresh and brackish water lakes in East Africa. At present, the most accurate approximation of wetlands in Africa was carried out by the World Conservation Monitoring Center (WCMC) and IUCN (Schuijt, 2002).

1.2 Theoretical Background

1.2.1 The Waza Logone Floodplain

The history of the Waza Logone floodplain shows that the construction of the Maga dam in 1979 had a negative impact on the floodplain ecosystem (Loth, 2004; Scholte, 2007; Scholte *et al.,* 2006). The Waza Logone Project (WLP), implemented by the International Union for Conservation of the Nature (IUCN), restored some of the natural resources and partly rehabilitated the ecosystem. It also proposed a strategy for eco-development. These activities and the pilot flooding would eventually lead to the partial restoration of the floodplain ecology (Sighomnou & Naah, 1997).

A number of positive effects of the pilot flooding have been observed for vegetation and wildlife (Loth, 2004). However, this ecosystem rehabilitation also resulted in a great migration into the region of pastoralists and fishermen (Scholte, 2000a; Scholte, 2000b), which resulted in a sharp increase in local human population numbers and associated pressure on the natural resources. (Scholte, 2005, Scholte *et al.,* 2006). When measures to protect the Waza National Park and its floodplains were greatly compromised during a breakdown of the park management between 2007 and 2010 (De Iongh *et al.,* 2010), the

pressure on resources further intensified, particularly in terms of fisheries and wildlife. For example, the number of lions, which are an indicator species, declined from 40-60 in 2002 to 17-22 in 2008 (Bauer, 2003; De Iongh *et al.,* 2004; De Iongh & Bauer, 2008; Tumenta *et al.,* 2009).

In spite of efforts to practice co-management of the natural resources (De Iongh & Bauer, 2008), conflicts between stakeholders over these resources became evident.

As from 2008, the councils of Waza, Zina and Logone Birni started to play a major role in managing resources as part of a new policy of decentralization. They created an intercouncil partnership known as WAZILOBI for a better management of natural resources, including fisheries, pastoral land and the Waza National Park. A number of local NGOs, such as the Association pour la Conservation et l'Education Environnementale (ACEEN), and the Cellule d'Appui au Développement local Participatif Intégré (CADEPI), have also positioned themselves as major actors in the area over the past decades. With the evolution of multipartism, new laws further permitted the creation of associations and Common Initiative Groups.[2] These groups aimed at ameliorating their primary productions and were benefiting from a couple of advantages given by the government or international NGOs.[3] Planning and development activities related to these groups should preferably build on scientific data, tools and methods in order to canalize development action and achieve the Millennium Development Goals (MDG, Heck *et al.*, 2007). At the same time, laws and regulations need to be reinforced in order to achieve sustainable management of natural resources, while maintaining peace between all these stakeholders and reducing poverty in the area (Loth, 2004).

1.2.2 Fishing practices

Fisheries may be defined as an entity with a broad geographical scope. The concept may relate to all fisheries in a lake, or may apply to a more defined scope, such as those in a single jurisdiction, fishing certain target species or using a specific gear type or a vessel. Studying fisheries may encompass a comparison of fishery methods or a graphical analysis of the time trajectories of individual fisheries. Attributes are selected to reflect sustainability within each discipline and should only be adjusted or replaced if improved information becomes available (Tesfa & Pitcher, 2006).

2 Law n°92/006 of the 14 August 1992 on cooperatives and common initiative groups.

3 Here, we consider communities as such a basic group, organized around their chief, or 'Blama'.

The waterholes or *mares* in the Waza National Park and the other parts of the floodplain may play an important ecological role for the recruitment of the Waza Logone fisheries (Bobo & Boukar, 1997).

Since 1994, many development actions have been executed in the area. Among these are the construction of a small dyke near the village of Zilim in the Logomatya River, in the sub district of Ngoudeni (Figure 2.2) and the partial rehabilitation of the natural flooding regime (Van Ooijen & Haberland, 1991; Loth, 2004; Scholte, 2007). These two actions have created new conditions for fishing and pastoralist activities. The effects of these actions include benefits in terms of re-establishing the ecology of the area and they created better conditions for fish reproduction and for grazing. At the same time, several new fishing methods and innovations of traditional methods were introduced into the Waza Logone floodplain (Bobo & Boukar, 1997). However, these new techniques may be destructive, as the use of nets with a small mesh size and small fishhooks result in catching younger age classes of fish.

1.2.3 Maximum sustainable yield and resilience

Wildlife in general and fish populations in particular may be managed in order to (i) increase or decrease production; (ii) harvest for sustainable yield; or (iii) for preservation (Caughley & Sinclair, 2002). In all these cases, the operation must result in a sustainable offtake; i.e. a yield that can be taken year after year without jeopardizing future yields. In theory, the strategy of harvesting is to harvest the population at the same rate as it seeks to increase (Caughley & Sinclair, 2002).

Any fishery management strategy should thus strive to ensure a Maximum Sustainable Yield (MSY), where MSY is the maximum catch (in numbers or mass) that can be removed from a population over an indefinite period. This concept is used extensively in fisheries sciences and management, and relies on the surplus production generated by a population that is depleted below its environmental carrying capacity (Garcia *et al.,* 1989). MSY has evolved from a fisheries management target to a limit on fishing mortality and biomass depletion and is still widely used as a key paradigm in the fisheries sector. However, its general use and applicability have been challenged (Purt & Smith, 2001).

MSY-based management involves setting the harvest rate (in fisheries, defined in terms of fishing effort) to a level that produces a catch of preferably 20% below the MSY (Caughley & Sinclair, 2002). It is purely a physical measure (not tied to any economic or social and hence political doctrine). Fishing the biomass at the level above MSY has been a traditional definition of biological overexploitation. Any exploitation level below MSY is sustainable. Harvesting at the maximum sustained yield (MSY), should never be contemplated (Caughley &

Sinclair, 2002). It imparts instability to the population dynamics. The MSY can only be taken from the unique density. If the population density has, for reasons such as drought, dropped below that value, then the MSY represents an overharvest and the population's density is reduced further.

A harvest can be controlled either by placing a quota on offtake or by controlling harvesting effort (Caughley & Sinclair, 2002). Measures to regulate harvesting effort may include restrictions on fishing gear and fishing material, defining specific periods in time (i.e. fishing seasons) during which fishing is allowed, or by limiting the number of people harvesting the population. The control of harvest by quota has an intuitive appeal because there is a direct relationship between the prescription and the result. Restrictions in fishing gear and material are generally more difficult to implement (Caughley & Sinclair, 2002).

In fact, the disadvantages of regulation by effort are more conceptual than real. It is usually a safer and more efficient means of regulating a harvest than regulation by quota. Harvesting a constant amount of fish each year is inefficient when the population is subjected to large, environmentally induced swings in density. In such cases, the quota should be set low enough to be safe at the lowest anticipated density. Alternatively the size of the population should be censused each year prior to the harvesting season, after which the quota can be adjusted according to the estimate (Caughley & Sinclair, 2002).

Biologically, the rational scheme for harvesting is to reduce the population to a little above the density allowing MSY and then to take the appropriate yield year after year. But it transpires that the 'obvious' biological strategy is not necessarily leading to maximum economic gain. Clark's (2010) book on the economics of harvesting natural resources shows unambiguously that to arrive at the most optimal combination between the biological strategy on the one hand and the economic strategy on the other, the maximum rate of increase of a population should be relatively high. In Ecology, resilience is defined as the capacity of an ecosystem to respond to a perturbation or disturbance by resisting damage and recovering quickly. Resilience is also defined as the capability of the ecosystem to deal with climate change and other threats (Glicksman, 2009).

African floodplains are generally resilient ecosystems (Lai, 1994; Paugy *et al.,* 1999; Tockner & Stanford, 2002; Welcomme, 2001; Tockner, 2002; Welcomme, 2003). Nonetheless, fluctuating patterns in ecosystem degradation do have a direct impact on fishery resources. In principle, a fishery that harvests all species at all trophic levels and sizes, at rates proportional to their natural mortality pattern is expected to be sustainable, which is underlying a new paradigm of balanced harvesting (Jul-Larsen *et al.,* 2003). Overfishing at the community level takes place when the total fishery production is in

excess of the overall annual surplus production of the entire fish community in a reservoir. A certain proportion of the fish community could become overexploited when specific investments are directed at that proportion, and fishers continue to catch the species despite the greater effort they need to invest to ensure catches are maintained (Sparre & Venema, 1998). Jul-Larsen *et al* (2003) suggested that such efforts could only be economically viable if fish prices are increased, if efficiency (per unit of labor) is enhanced, or if economic efficiency in distributing fish to consumers is improved.

In the small-scale fishing sector (including African fisheries), fishing gear is usually regarded from a fishing effort point of view: equipment will enhance catches only if combined with manpower (Kolding & Van Zwieten, 2011). In such a context, one can appreciate the socio-cultural significance fishermen hold with regard to their traditional fishing gear (Beuving, 2015). In the Waza Logone Floodplain, shortages in natural resources have led to more competition between different user groups (Fotsing, 2007). Conflicts as a result of this competition over resources have been reported among fishers, among pastoralists and between pastoralists and cultivators (LCBC, 2007). Increasing pressure from resource users also caused soil degradation, mainly by exposing the soils to erosion and a consequent deprivation of organic matter content (LCBC, 2007). This, in turn, has caused declines in income for those people depending on the local resources (Béné *et al.,* 2003a). Molenaar and Van Santen (2006) explained the perceptions of local people of a common spirit named *Maami Waata.* They found that one-third of the local people believe that *Maami Waata* creates fish, and half of them believe this spirit commands fish. They also confirm that three-quarters of the local people think that over the last ten years the catch in the floodplain and Lake Maga has declined (Molenaar & Van Santen, 2006). Forty-four percent believe that this is partly caused by the increasing number of fishermen, and more than half of the respondents blame the shortage of rainfall. Bene *et al.,* (2000) argue that the relation between fishing activities and the wealth (or poverty) level of households is generally not reflected as a one-to-one ratio. The importance of fishing activities rather increases with poverty; i.e. the poorer the people, the more they rely on fishing. In the floodplain (*yaere),* therefore, many people may have been forced to use fishing as an income generating activity of 'last resort'.

During an environmental assessment of the Zilim dyke on the Logomatya, Fotsing (2007) confirmed that a majority of the fishermen belong to lower income groups. In contrast to this finding, he also suggested that some fishing channel owners may be very rich. Such inequality in income and status between users of the same resources often lies at the basis of conflicts (Fotsing *et al.,* 2007) and could also be a major factor contributing to existing problems between user groups in the Waza Logone floodplain. It may compromise the

sustainability of resource use and the resilience of the floodplain as a whole. The current research therefore provides an opportunity to further analyze the factors and processes underlying such conflicts.

I hypothesize that the Waza Logone floodplain ecosystem, under certain conditions, has sufficient resilience to cope with the fishing pressure. Rainfall and flooding are expected to adequately maintain fish production at its normal level. Taking this into consideration, the emergence of conflicts such as the one that occurred in 2007 between Musgoum and Kotoko fishermen in the Waza Logone floodplain (Tumenta, 2012), may either be related to the unsustainable management of the floodplain, to the increase of human populations and the intention to control fisheries in the area, or a combination of these. To know which factors provide the incentive for conflicts between fishers, we need to know the status of fisheries, the impacts of new fishing practices and current means of innovation of traditional methods.

1.2.4 Sustainable development and co-management of natural resources

The concept of 'Sustainable Development' is defined in the report 'Our Common Future' as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (Earth Summit and its Agenda 21 of the United Nation Conference on Ecology and Development, Rio 1992). This definition of sustainability takes into account three dimensions: economy, society and the environment (Figure 1.1).

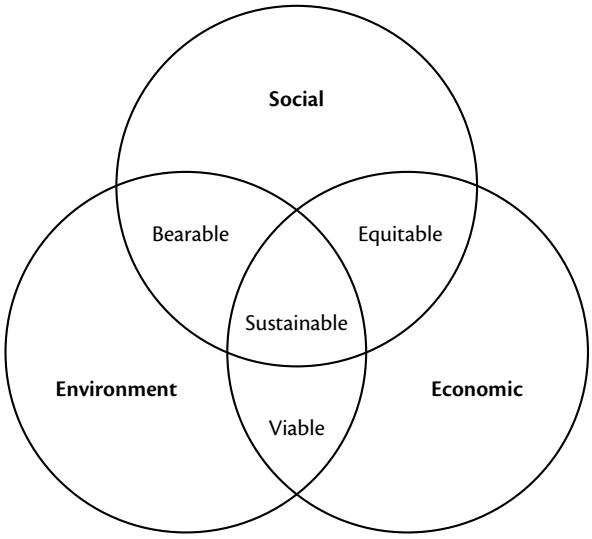

Figure 1.1
Sustainability as an integrated economic, socio-cultural and environmental dimension

Sustainable development is thus primarily a normative concept used to negotiate and establish values and aims in processes of development. According to Hurni and Wiesman (1997), the concept of sustainable development should also focus on values (on what 'ought to be') and on impacts (on what 'is').

In the Waza Logone floodplain, there are several factors that principally influence the sustainability of fisheries. For instance, in Waza National Park and surroundings, a number of artificial waterholes were created between 1976 and 1980 (Loth, 1997). These waterholes support concentrations of fish throughout the dry season and attract people from surrounding villages to organize fishing activities, also inside the Waza National Park where access to resources is subject to regulations (Scholte, 200a).

The Logomatya River is one of the few rivers in the area with flowing water all year around (Naah, 1990). The water in the river largely originates from the local rice scheme and is regulated by a small dam (Van Ooijen & Haberland, 1991). Agro-pastoral and fishery activities were to a large extent linked to this dam, so when it collapsed and the river dried out completely as a result in 2007, the human population along the river suffered a great deal (Fotsing, 2007).

Loth (2004) defined a number of threats to the ecosystem of the Waza Logone Floodplain. Overexploitation of natural resources is a major cause of ecosystem degeneration, especially in fisheries. Destruction of waterholes, collection of firewood, water pollution due to agricultural chemicals used in rice cultivation, hydrological impacts of e.g. fishing channels, and reduced sedimentation due to erosion are also considered to be important human-related pressures impacting the natural floodplain ecosystem (Fotsing, 2007).

To analyze the sustainability of fishery practices, the state of the fish resources should be determined. To make an estimate of the potential production, I reviewed the following references on African floodplains and lakes. Pitcher and Hard (1995), Tockner *et al.,* (2002) give the example of the Pongolo floodplain (South Africa; Heeg & Bren, 1982) and the Hadejia-Nguru floodplain (Nigeria; Hollis *et al.,* 1993). We can also add Merona (1983) (Fresh water of Africa), Welcomme (1986) and Lae (1994) (Central Delta of the Niger River), Paugy *et al.* (1999) (West African riverine), Neiland *et al.* (1990) (Benue River), Ogutu-Ohwayo and Baliowa (2004) (fresh water in Africa), Neiland and Bene (2003) (West and Central Africa fisheries). Also included in my review are textbooks on floodplain fisheries (Welcomme, 1975, 1979) and management books edited by several organizations (FAO, Ramsar secretary, DFID, IUCN and Word Fish Center).

Table 1.1 provides productivity data of some African lakes, compiled by Vanden Bossche and Bernacsek (1990).

Table 1.1
Productivity of some African lakes (from Vanden Bossche & Bernacsek, 1990)

Lake	Altitude (m)	Max depth (m)	Mean depth (m)	Surface (km^2)	Productivity (kg/ha/yr)
Albert	618	58	25	5270	47-65
Chilwa	654	5	2	750	77
Chiuta	620	5	–	200	75
Cohoha	1380	11	5	76	26-37
Edward	914	117	34	2300	61-70
Kariba	485	120	29	5364	30-41
Kivu	1463	489	240	2370	27-42
Malawi	471	758	426	30800	35-45
Mweru	930	37	7	4650	60
Rweru	1350	4	2	100	–
Tanganyika	773	1435	700	32900	90
Turkana	406	73	30	7570	9-16
Victoria	1136	84	40	68000	29-59

Ostrom (1990) demonstrates that the 'tragedy of commons' symbolizes the degradation of the environment whenever many individuals use a resource. Participation and responsibility in using common resources are therefore crucial for sustainability. Management of natural resources is commonly described in literature as an issue for the future (e.g. Bruntlan, 1987; Borrini-Fayerabend, 1997; Borrini-Fayerabend, 2000). Co-management and responsible management are considered to be the two main approaches to control sustainability.

The term co-management is defined by Borrini-Fayerabend (1997) as the sharing of rights and responsibilities between government and citizens. This term is used for several types of management arrangements. The essential common elements are sharing responsibility and institutionalized collaboration in management.

Co-management, as described by Bauer (2003), is related to power relations between government and communities. It includes participation, ownership and sovereignty (Bauer, 2003).The most relevant dimension in co-management is participation. Participation is defined as 'taking part in something.' It is usually presented as a continuum of power sharing between two parties. In the context of the Waza Logone floodplain, the two main parties involved in co-management are government and local communities. This continuum

can be divided into several categories: 'instructive participation', 'consultative participation', 'cooperative participation', 'advisory participation', and 'informative participation' (Bauer, 2003).

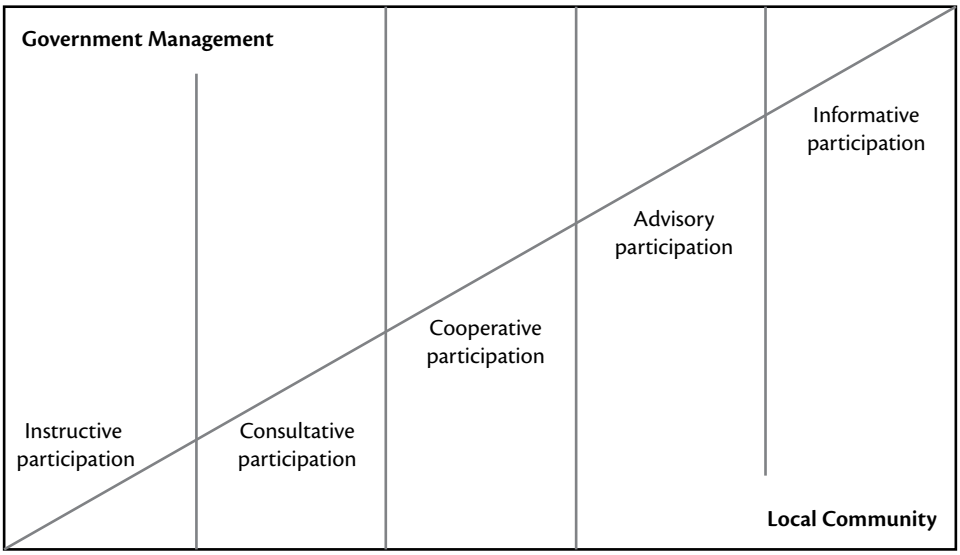

Figure 1.2
Spectrum of co-management arrangement (source Bauer, 2003)

The concept of instructive participation refers to actions at the level of local communities that have been implemented by the government. Consultative participation implies that input from local people is considered, while the final responsibility for analysis, decision-making and evaluation still rests with the government (Borrini-Fayerabend *et al.,* 2004). In cooperative participation, local people and government strive for synergy, consensus or compromise and share responsibility (Evan, 1996). Advisory participation entails that while the government advises a local community, that community has the prerogative of decision-making. Finally, informative participation means that a community is autonomous and informs the government (Evan, 1996).

Co-management implies institutionalized and factual collaboration in the control over a natural area and the organization of its exploitation. Different committees or boards can be involved in this institutionalization and certain statutes or formal contracts may be used to regulate specific issues (generally referred to as 'complementarity'; Evan, 1996). Alternatively, institutionalization could be in the form of verbal agreements and customary law parallel to the style of management discerned by Evan (1996). For a collaboration to be

effective, it should not just be occasional and really has to focus on the management issues.

In Africa, the reasons and arguments for adopting a co-management approach may vary in certain cases. Overexploitation due to the failure of a government to effectively manage capture fisheries, may be one of the most common and widespread reasons for the development of a co-management plan (Mafaniso & Nielson, 2003). In other cases, co-management is used as a means to control fishing effort through the assignment of property rights to some groups in order to forestall future problems of overcapacity. Communities around Lake Kariba in the Republic of Zambia, Lake Nokone in the Republic of Benin and Lake Chiuta in the Republic of Malawi for instance, have all been governed under this form of co-management policy. Furthermore, co-management is sometimes used as a tool in conflict mediation among various stakeholders (Mafaniso & Nielson, 2003).

In general, any government policy affecting rural fishing communities should be implemented to ensure biological sustainability of the natural resources and to conserve biodiversity in a certain area. In this context, it is important to acknowledge that most rural fishing communities previously fished for subsistence (Coburn, 2000). As rural fishing communities became part of market economies, fishery exploitation has shifted much more into the realm of the profit motive. In many countries, this 'neo-liberalism' has progressively led to an inequitable share of incomes between users. Because a higher income inequality leads to lowered social cohesion, conflicts are often inevitable (Coburn, 2000).

Local institutions are generally assumed to be more accountable and more aware of the potential benefits they receive when acting responsible in managing their resources sustainably comparing to official institution (Jentoft, 1994). The efficacy of fishery management strategies is expected to improve where the fishing communities are being involved in the decision-making process for the establishment of a co-management plan. Co-management measures are more effective when practical experiences and field knowledge of resource users are incorporated in their formulation (Jentoft, 1994).

Pinkertin (2003) defined seven key aspects of complete co-management: (i) the government, as a co-manager, plays a key and desirable role and is ideally an engaged partner rather than a delegator, (ii) co-management like management itself involves far more than the control of fishing effort, (iii) sustainable co-management arrangements involve some control by community partners over the terms and conditions of sale to fish buyers, (iv) the successful exercise of rights on one level depends on the exercise of rights to participate in data collection/analysis and setting policy agendas at the highest level, (v) co-management will ideally involve multiple horizontal negotiations leading to coop-

erative activities with other players and potentially greater democratization of civil society, (vi) the power to exclude outsiders from some defined territory is optimal, (vii) complete co-management is based more on the collective rights of a group than on individual rights.

1.2.5 Conflicts in the Waza Logone floodplain

Considering conflicts and violence within and between communities, two schools of thought are often used in literature. The first school of thought argues that more violence may occur in a situation with an abundance of resources and/or when a natural resource has a high commodity-value and is in such abundance at a special location (Collier, 2000; Collier & Hoeffler, 2002). Under such conditions, conflicting parties may gain enormously when they can secure access to that resource. This situation is particularly relevant for conflicts regarding non-renewable resources such as minerals that are scarce at a global level, but abundant in a certain area. It may however also apply to the fisheries sector, in cases where valuable fish commodities are concerned, such as the Blue fin tuna in the Mediterranean (Collier & Hoeffler, 2002).

The second school of thought is based on resource scarcity. An increase of scarcity of renewable or non-renewable natural resources gives rise to conflict that may easily result in violent clashes between user groups when a certain combination of conditions is met (Homer-Dixon, 1999; Bachler, 1999).

In the Waza Logone floodplain, conflicts resulting from limited access to natural resources have occurred in the past and are still considered to play an important role in community interactions (ACEEN, 2007). Some of these conflicts have resulted in homicides and injuries. A recent example involves a dispute about fishing rights in a *mare* (Tchikam) situated within the Waza National Park in 2007 (Tumenta, personal communication).

Between 1995 and 1997, a demographic monitoring survey was undertaken by the IUCN-Waza Logone Project (IUCN-WLP, 1996). This demographic census showed the presence of five main ethnic groups: Musgum (35.9%), Bornouan (22.1%), Peulhs (12.5%), Arab Choa (11.3%), and Kotoko (7.7%). Another census conducted by Bene *et al.,* 2000, from October 1999 to January 2000 in 21 villages in the flooded area, confirmed the dominance of the Musgum group (67%) followed by the Kotoko (10%) and the Massa (10%).

The Musgum people came to the floodplain at the end of the 19th century, during the reign of the Kotoko Sultan of Logone Birni (Van Est, 1999). Initially, the Musgum complied with the authority of the Kotoko who allowed the newcomers to settle on uninhabited small islands in the floodplain under strict conditions. Only in the last decade of the 20th century did the power

base of the Kotoko Sultan decline and the Musgum no longer accepted certain Kotoko privileges and access rights to fishing grounds (Van Est, 1999).

Survey results (IUCN-WLP 1994a, 1994b) further revealed that the average human fertility rate was approximately nine children per woman, and the population growth rate is approximately 2% for the 183,000 resident inhabitants settled in the Waza Logone floodplain. In addition to the resident group, the floodplain is periodically visited by nomadic and transhumant populations; they spend eight months of the year in the area to exploit the dry season grass (Moritz, 2003). Another type of migration is confined to the limits of the floodplain; some local fishermen and agriculturists move within the area in search for zones that are suitable for their respective activities (Scholte *et al.,* 2006). Among the migrant groups, the nomadic pastoralists are the most numerous, followed by nomadic fishermen (Scholte, 2003).

Historically, community leadership has not been evident. Whenever a situation required someone to take the lead, the village elders would organize themselves (Van Est, 1993). Van Est (1993) also suggested that responsibility with regard to the different activities was shared by various people. For fisheries, for example, it was the so called *Mana* who was appointed as a fisheries manager (Van Est, 1993, cited by Bene *et al.,* 2000). Nowadays, these functions have been more or less abolished and are now in the hands of the village headman, the *Blama*. His role could best be described as a representative in dealings with authorities. He would for instance be responsible for taking decisions on opening or closing certain fish reserves.

Moore *et al.,* (1999) demonstrated that food and natural resource shortages are the main factors underlying rural conflicts. Although natural resource management does not usually focus specifically on conflict resolution, it should always be considered in order to guarantee food security for all users (Moore *et al.,* 1999). Food shortages and poverty in general can intensify social unrest. Politics, demographical factors, traditional ways of governing, corruption, overpopulation, inadequate political decisions and climate change can also lead to food insecurity and poverty.

Being confronted with conflict is not necessarily a bad experience for a society. It can boost its evolution if well managed. However, if conflict resolution does not achieve its aim, it can be disastrous for the environment and can even lead to tribal war (Moore *et al.,* 1999).

According to Bennet *et al.* (2001), conflicts between groups have many different causes. Conflicts could arise as the result of an abnormal social structure (the sociological perspective), changes in power relations (the political perspective), or certain rational decision-making by someone who seeks to maximize personal utility given a pool of scarce resources (the economic perspective).

With reference to a social cohesion that can prevent conflicts, Colletta *et al.* (2001) use the term "glue": sticking together promotes harmony, solidarity and commitment to live up to a common good.

Warner (2000) describes four different conditions that could lead to conflicts: (i) demographic change (a sharp influx of newcomers, possibly driven by negative trends in the economic or ecological status of other sectors); (ii) competition over natural resources (competition over space and natural resources as a direct result of an increased dependence upon the resource); (iii) developmental pressures (when government switches its focus from livelihood protection to food production); and (iv) structural injustice by law (legislation in which certain resources are deliberately withheld from dependent groups in society). The situation in the Waza Logone Floodplain shows most resemblance to the latter.

In the Mandara Mountains, situated upstream of the Waza Logone floodplain, Noorduyn (2005) observed that a relative dependency of local communities on natural resources and an uneven distribution of benefits from these resources between more powerful and less powerful actors could cause conflicts.

The Waza Logone Project (IUCN, 1994) included sustainable mechanisms for natural resource management and capacity strengthening of governmental services (Scholte, 2005). Despite the partial recovery of the ecosystem (Sighomnou & Naah, 1997) and the local and regional structures for co-management that were put in place through this project, conflicts between stakeholders increased (Loth, 2004).

The area that had been flooded during the pilot flooding may not have been extensive enough to support the needs of the expanding population (Scholte *et al.,* 2006). A further decline of renewable resources as a result of the Maga dam construction in the Waza Logone area may have aggravated the tensions, as well as the absence of local structures to prevent and resolve any conflicts.

Although conflict situations are commonly linked to the use and management of natural resources, the direct causes and impact of such conflicts are often poorly understood. Study information on conflicts specifically concerning the fisheries sector is available from around the world (e.g. Allison & Ellis, 2001; Bayley, 1988; Bene *et al.,* 2003a; Beuving, 2015; Bullock *et al.*, 1998; Crul, 1992), yet there have been few systematic reviews of the relationship between fisheries and floodplains. This lack of research focusing on fishery dynamics in floodplains particularly applies to tropical fisheries, where the sector has a considerable socio-economic function (i.e. employment, income, and food supply) and in which conflicts consequently affect the poorest members of society (Bene *et al.*, 2009).

To reduce conflicts, organizations and officials encourage community involvement in the management. In the Waza Logone floodplain, some communities have prepared local agreements for the management of fisheries (Loth, 2004).

1.3 Research objective and research questions

In the past, many research activities have been carried out in the Waza Logone floodplain by researchers of the Institute of Environmental Sciences of Leiden University (Van Est, 1999; Bauer, 2003; Moritz, 2003; Loth, 2004; Scholte 2005; Molenaar & Van Santen, 2006; De Iongh *et al.,* 2004), Cameroonian universities (Naah, 1990; Adam, 1994; Bobo & Boukar, 1997; Sighomnou & Naah, 1997; Fokou *et al.*, 2004; Tarla & Bachirou, 2004) and other universities (Benech *et al.,* 1982; Benech, 1992; Neiland & Bene 2003; Bene *et al.*, 2000, 2003). These studies covered fishing methods, and examined local organizations of fishers and herders. Other studies have covered the movement of cattle (Unusa, 2012), the impact of re-flooding on the floodplain ecosystem (Loth, 2004) and the dynamics of wildlife resources in the Waza National Park (Bauer, 2003; Buij, 2013; Scholte, 2000a; Tumenta, 2012).

Reports on the local perception of communities have suggested a decrease in fish stocks in the Waza Logone floodplain (Molenaar & Van Santen, 2006; LCBC, 2007; IUCN-WLP, 1994b). This is in line with continent-wide observations by several authors (Welcomme, 2003; Welcomme & Halls, 2001; Benech, 1992; Paugy *et al.,* 1999; Lae, 1994), who reported that such declines are often influenced by environmental factors and by human interventions such as the construction of dams in the watersheds. In general, increasing numbers of fishers, erosion of traditional fishery management systems and the use of destructive fishing methods could significantly contribute to fish depletion in the Waza Logone floodplain, as has been observed in other floodplains (MFO, 1995).

This study covers the status of fisheries and fishing techniques, the fish productivity and catches in the Waza Logone floodplain, as well as fishing in waterholes and fishing channels. The research focuses on conflicts between different groups of fishers and other groups in the Waza Logone floodplain, and elaborates on how these conflicts relate to established management practices in the area and to the livelihoods of fishers in general.

The main objective is to understand the dynamics of the fisheries sector in the Waza Logone floodplain and specifically the level of fishing effort, diversity of fishing gear and conflicts between fishermen. The following three sub-objectives were defined:

- To assess the current situation of the fishing effort and catches in the Waza Logone floodplain,
- To evaluate the sustainability of fisheries practices, and
- To provide a means to better understand the factors influencing conflicts and conflict resolution between fishers in the Waza Logone floodplain.

The general focus of this research is to study the relationship between the current dynamics of fish production systems and any existing conflicts and conflict management practices that have been put in place within the fisheries sector of the Waza Logone floodplain.

These two interlinked themes (dynamics of fisheries and conflict management) are investigated through both natural science research approaches and socio-economic research approaches. Research questions have been defined as follows:

1 What are the recent dynamics of the fisheries sector in the Waza Logone Floodplain?
   - a What is the state of the fisheries sector in the Waza Logone floodplain during flooding?
   - b What is the state of the fisheries activities in the waterholes inside and outside the Waza National Park during the dry season?
   - c What is the possible ecological role of the waterholes?
   - d What are the main fishing methods used in the Waza Logone floodplain?
   - e What are the differences in catches between types of fishing practices in the Waza Logone floodplain?
2 What is the magnitude of conflicts in the fisheries sector and how are conflicts between fishermen managed in the Waza Logone floodplain?
   - a What is the frequency and magnitude in time and space of conflicts between fishermen?
   - b What are the institutional and organizational arrangements for conflict management for fishermen or communities within the Waza Logone floodplain?

1.4 Terms and definitions

The Waza Logone floodplain is known as *yaere*, the local dialect name for the floodplain.

Mares are large depressions that conserve water during the dry season. Waterholes are man-made water points. Waterholes were initially dug for the livestock outside the Waza National park and for wildlife inside the park.

Fishing reserves in this context are the fishing spots where access is forbidden for a certain period. These reservoirs are usually the property of a specific community. It can be either a waterhole or a part of the river.

In the Sahelian area of Cameroon, almost all rivers dry up after the raining season. They are locally known as *Mayo.*

In local villages, a person called the *manguivini* is traditionally responsible for water and fisheries management, and the *blama* is the traditional chief of the village. Above him in the hierarchy is the chief of the sub-district.

Sub-districts are constituted of villages administrated by a chief of the sub-district. The chief of the sub-district is subordinate to the *sultan*.

The *sultan* is the highest level of traditional authority. He is the representative of the local government. The sultan of Logone Birni and Pouss are the traditional rulers in the floodplain.

1.5 Methodology

For this study, I adapted the Rural Rapid Appraisal (RRA) technique of Fisheries (RAPFISH), which has been developed by Pitcher (1999). Pido (1995) and Pido *et al*. (1997), applied rapid rural appraisal to coastal area management in the Philippines and Indonesia. Recently, Tesfa and Pitcher (2006) used RRA for the Red Sea fisheries and Baeta *et al.* (2005) for the Tagus estuary in Portugal.

I further followed a framework developed by Welcomme (1998) for the development and management of inland fisheries. This framework covers six interlinked areas: (i) policy and planning; (ii) relationships between the fishery, its environment and other users; (iii) assessment of fishery; (iv) management of fisheries under natural regimes; (v) management of intensified fish production; and (vi) monitoring the effects of fishery management upon the fishery. To answer questions related to the dynamics and sustainability of fishery resources, I study (i) gear characteristics and use patterns, including fishing channel and mesh size; (ii) fishing effort (catch per unit effort); (iii) composition of catch by species; (iv) length frequency characteristics of the fish caught; and (v) seasonal and spatial distribution of the fishing spots. The framework is presented in Annex 3.

The results will be used to calculate catch per unit effort (CPUE) and condition factor (K). FAO (1999) defines the CPUE as the quantity of fish caught (in number or in weight) with one standard unit of fishing effort. Changes in CPUE are often considered as an index of fish biomass (or abundance). Condition factor is used as an expression of health and, more generally, the physiological state of the fishes (Paugy *et al.,* 1999). The floodplain is characterized

by two types of water reservoirs: waterholes and *mares.* Their flow towards rivers is often directed through channels, of which some are also present in the Waza National Park. Analyses of fisheries will include both reservoir types. To investigate the role of waterholes inside and outside the Waza National Park and, more specifically to understand the role that the waterholes inside the Waza National Park are playing for the recruitment of the floodplain fisheries, I will use ecological surveys in combination with a topographical assessment.

The Rural Rapid Appraisal of Fisheries Management System Framework (FAPFISH) is composed of four components: the conceptual base, the contextual variables and their attributes, the research or survey steps, and the expected output (Pido *et al.*, 1997).

This framework is applied for the Waza Logone floodplain and is characterized by (i) the willingness for an active commitment and collaboration between stakeholders; (ii) the access to the natural resources within the wetland, which is essential for local livelihood, security and cultural heritage; and (iii) local people that express a strong interest in being involved in the management.

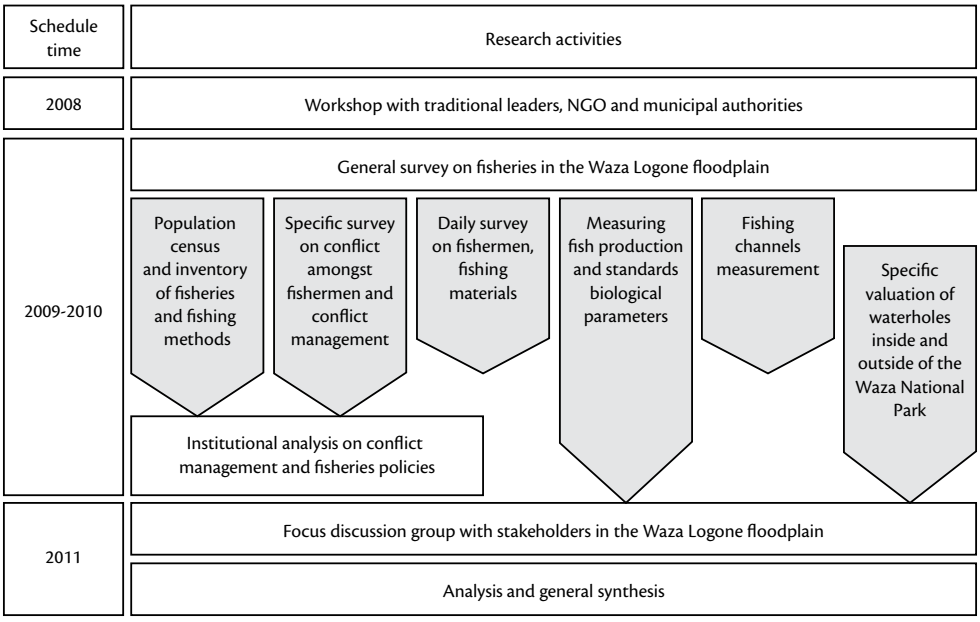

Figure 1.3
Methodology framework and timetable

The design of this study began in 2008 with a participatory workshop aimed at achieving a long-term commitment from stakeholders. A total number of 18 traditional and municipal authorities, as well as leaders of international and national NGOs attended the workshop. They analyzed the history of the area (prior to the building of the Maga dam, after the building, and before and after the pilot reflooding). They discussed the dynamics of the resources (e.g. fish, wildlife, pastoral land, soil and vegetation), social influences (e.g. religion, demography, politics, economy), ecological factors (e.g. climate, landscape dynamics, biodiversity patterns) and actors (i.e. fishermen, farmers, traders, hunters, leaders, traditional authorities, state authorities, municipalities, NGOs and donors). They analyzed the consequences of infrastructure, laws and regulations, and exploitation practices on the functions of the resources and on social relations. Also, a 'Strengths, Weaknesses, Opportunities and Threats' (SWOT) analysis of the councils (as the main actors in the decentralization process) was performed. Strategic planning in general and the SWOT analysis in particular, have their mutual origins in the work of business policy academics (Hill & Westbrook, 1997). The SWOT analysis has been especially influential in popularizing the idea that good strategies are important (threats and opportunities) and have their own internal qualities or characteristics (strengths and weaknesses). The participatory workshop provided a general overview of existing issues, from which the research proposal was drafted and analyzing tools were identified. Following these preparations, I conducted a pilot survey, in which several topics related to this dissertation were initially examined, at several levels of the floodplain communities.

The pilot survey encompassed an interview survey in 91 villages of the Waza Logone floodplain (Annex 1). All permanent *mares* and waterholes were marked by GPS. In each village nine persons (3 adult men, 3 adult women and 3 younger persons around 18 years of age) as well as all the traditional authorities were interviewed about the consequences of the drying out of the Logomatya creek and the role of the Maga dam and the Zilim containment dyke on the livelihoods of the population. The main results are presented in Chapter 2.

Based on the results of the pilot census, household heads were then interviewed in order to better understand conflicts among fishers and subsequent conflict mitigation and management. The details and results of this survey are presented in Chapters 6 and 7.

From August 2008 to June 2009, 13 fishing locations were selected in order to monitor the number of fishermen, the number of canoes, and the type of fishing materials they used. During the monitoring activities, 18 young fishermen (20-30 years of age) were involved as research assistants. They were

trained in interviewing techniques prior to the survey. Figure 2.2 provides more information concerning their position in the study area.

Whenever waterholes were used for community fishing, data on catches were collected. Catch size (weight), fish composition of each catch, the tools that were used and the number of fishermen involved in a catch were recorded once a week, and per fishing location. Some of the dominant fish species were measured (total length, weight) and the number of fish per species, their sex and sexual maturity were documented.

I began by counting fishing channels along the Logomatya River, the Lorome Mazera River and around the Abana natural pond. Thirteen of these channels were selected for a more detailed survey; in the villages of Zina, Zilim, Mazera and Moukak, which were surveyed during the fishing seasons (December to February) from 2008 to 2011. Recorded characteristics of the fishing channels involved measurements on length, depth and level of connection to the river.

Between December 2008 and February 2011 some of the waterholes and *mares* were subjected to some experimental fishing activities, during which biological data were collected. The weight, standard length and biological status were measured for seven species (*Clarias gariepinus, Clarias anguilaris, Schilbe intermedius, Oreochromis niloticus, Sarotherodon sp, Petrocephalus bovei* and *Brienmyrus niger*). These species were selected based on their assumed abundance in the catches. Individual fish were identified using Leveque and Paugy (2006), Paugy *et al.* (2004), Leveque *et al.* (1988) and Durand and Leveque (1980).

In the dry season of 2009, I also conducted a topographic assessment of man-made waterholes and *mares* in the Waza National Park (Tchikam), and surroundings (Lougue/Tchede).

As described earlier, a further 18 young fishermen were involved in data collection. For the survey on conflicts, I worked with Khari Boukar, a student from the Faculty of Agronomy and Agricultural Sciences, University of Dschang (Cameroon). I co-supervised his field research entitled 'Socio-economic impact of fisheries conflicts: the case of the Waza Logone floodplain (Far North Cameroon) from 1985 to 2009'.

The major portion of data collected during fieldwork came from direct observations and interviews.

In close collaboration with resource people and stakeholders in the area, three workshops were organized. The first workshop was organized in July 2008 with the four mayors of the Waza Logone Floodplain and representatives of local NGOs. The general objective was to develop a common vision for the management and exploitation of the Waza Logone floodplain. The second workshop was organized in June 2009 with 12 researchers and four

representatives of technical services of the ministries on the learning process during development actions that took place in the Waza Logone floodplain. The third workshop was organized in September 2009 with 33 participants, mainly livestock owners, in order to set up an urgent action plan for Waza National Park.

Three focus group discussions on conflict issues were organized in the villages of Zina, Malazina and Tchede with fishermen, dignitaries and traditional authorities in May 2010 and April 2011.

All data were organized in a single database created in Excel software. Some specific databases were extracted for useful calculation and analysis. Analyses were largely run in SPSS software.

The current thesis further comprises a review of literature and secondary sources, including official regulations and workshop reports. The discussions I had with specific stakeholders at the national level (decision-makers) and regional level (implementation level) were also used for this analysis.

The currency used to validate fish stock was the FCFA. The FCFA has an invariable value related to the Euro (1 Euro = 655,957 FCFA).

The data used in Chapter 6 originates from fieldwork focusing on the socio-economic impact of fisheries' conflicts in the Waza Logone floodplain.

1.6 Outline of the thesis

The outline of this dissertation is schematically described in Figure 1.4. Based on the framework (Figure 1.4), this dissertation is divided into eight chapters.

Chapter 1 provides general data related to the thesis. It presents the context of the research and is followed by the research objective, the methodology and this thesis outline.

Chapter 2 provides an overview of the study area. The Waza Logone area is presented in terms of climate, vegetation, soils and wildlife. The history of human establishment and data on population surveys are presented in this chapter.

Chapter 3 is dedicated to the fisheries ecology of the Waza Logone floodplain. It gives an overview of fishery resources, fishing materials and fishing methods in the area.

In Chapter 4, I present fish production and fish species composition in space and time in the Waza Logone floodplain. I assess the dynamics of fishery resources in the Waza Logone floodplain and the trends in fish production since 1994. This chapter also discusses a biological analysis of fish species in the Waza Logone floodplain based on previous knowledge.

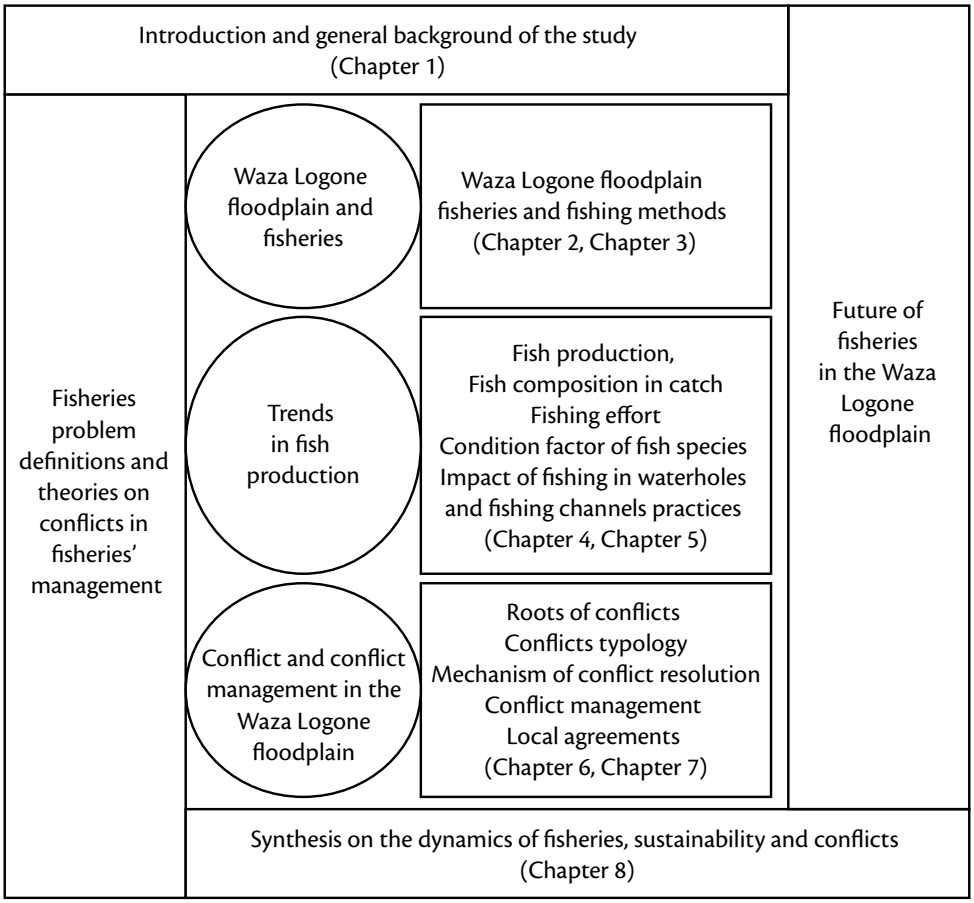

Figure 1.4
Outline of the thesis

Chapter 5 presents the specificity of fishing channels and fishing in waterholes. This chapter provides a physical description of two selected waterholes (one inside the Waza National Park, one outside the park), their link with the draining system and the production of fishes. Their function in terms of the recruitment of sanctuaries for fish in the dry season is also explained in this chapter, as are the main causes and effects of the drying out of fisheries along the Logomatya. This chapter further focuses on destructive methods of fishing in the Waza Logone floodplain. The problem of the fishing channels is presented and discussed.

Chapter 6 mainly focuses on conflicts; more specifically the conflict between the Kotoko and the Musgum in Tchede village. An analysis of the actors, characterization and roots of this conflict is provided at the end of the chapter.

In Chapter 7, I elaborate on the efficiency of conflict resolution mechanisms within the Waza Logone floodplain. Institutions for resolution of conflicts related to fisheries are presented at local, national and supra-national level. It further describes the policies on Cameroonian fishing legislation and the co-management initiatives that have been implemented co-jointly with local agreements for managing fisheries in the Waza Logone floodplain. These conventions and their benefits in terms of social cohesion, economic income for the people, and ecological effects on fish production are also presented here. The final chapter (Chapter 8) provides a broad analysis and synthesis. The answers to my research questions will be translated into recommendations for the research community, the government and local organizations/NGOs. I will conclude by giving my point of view on possible actions that could improve the sustainability of fisheries and enhance the well-being of people living in the Waza Logone floodplain communities.