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‘A pond with crocodiles never dries up’: a frame analysis of human–crocodile relationships in agro-pastoral dams in Northern Benin

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Crocodiles, a protected species, share ecosystem services with local communities in agro-pastoral dams in Northern Benin. Using a comparative case study conducted in three villages and a framing perspective, this study aims to elucidate how stakeholders frame the presence of crocodiles, and how they use formal and informal institutions to deal with them. Respondents framed the presence of the crocodiles as problematic because of their negative effects on local livelihoods and people’s tranquillity. Both causes and solutions are, however, framed differently in the three communities. Whereas in Nikki and Sakabansi, respondents seek solutions in changing the ecological environment, requiring others (the council, fishermen, and crocodiles) to change their behaviour, Fombawi respondents seek to adapt their own behaviour by respecting and applying traditional and practical rules for sharing their dam. Damage per crocodile is the highest in Nikki and the lowest in Fombawi, suggesting that the crocodiles in Nikki behave more aggressively than those in Fombawi. Further investigation is merited to determine whether or not crocodiles behave less aggressively when dealt with according to specific institutions. Intensive communication among stakeholders in the three villages is recommended to exchange experiences and ideas that may support a peaceful human–crocodile relationship inspired by existing institutional solutions.

Keywords: water resources management; human–crocodile interaction; framing; formal and informal rules; competing claims on natural resources

1. Introduction

To address the deterioration of the hydro-climate (Diop *et al.* 2009, Venot *et al.* 2012), West African governments have constructed dams to increase water storage capacity and regulate water courses. These agro-pastoral dams (APDs) have led to the extension of wetlands and favourable ecosystems (Bazin *et al.* 2011). The APDs are for public use and can thus be considered as a common good (Hardin 1968, Ostrom 2011). A diagnostic study carried out in

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Northern Benin (Kpéra *et al.* 2012) revealed that APDs are used for multiple purposes such as drinking water for livestock and people, fishing, vegetable growing, swimming, bathing, washing, road and house construction, food cropping, and cotton farming. The study identified various stakeholders using the dams with different interests, knowledge, and opportunities, making APD management a complex and conflictive matter. Crocodiles (protected species) have made themselves at home in these APDs where they share space and resources (ecosystem services) with humans. Crocodiles are known to have positive effects on their environment as keystone species that maintain ecosystem structures and functions, including selective predation on fish and aquatic invertebrates, the recycling of nutrients, and the maintenance of wet refugia during periods of drought (Thorbjarnarson *et al.* 1992). However, the presence of crocodiles in the APDs adds a dimension of human–wildlife conflict to the already complex situation. People who use the APDs have seen their water resources jeopardized by the crocodiles preying on fish and livestock, destroying fishing equipment and dam infrastructures, and injuring people (Kpéra and Sinsin 2010, Kpéra *et al.* 2012).

Human–wildlife conflict is a global concern and a critical threat to the existence of several endangered species such as lions, crocodiles, leopards, bears, elephants, and so forth, as well as human beings (Lamarque *et al.* 2009, Bhattacharjee and Parthasarathy 2013). Human–wildlife conflicts occur when the requirements of wildlife overlap with those of human populations. Conflicts are more intense in areas where both human populations and wildlife live and share ecosystem services. The implications of conflicts are manifold, ranging from psychological manifestations, such as fear, right up to fatal attacks (Bhattacharjee and Parthasarathy 2013, Jhamvar-Shingote and Schuett 2013).

Because of crocodiles' international and national endangered status (Kpéra *et al.* 2011, International Union for Nature Conservation (IUCN) 2012) and their role as keystone species (Mazzotti *et al.* 2009, Fujisaki *et al.* 2012), the improvement of APD management should address the human–crocodile relationships in such a way that both humans and crocodiles can benefit from the diverse APD ecosystem functions. Improving APD management entails changes that would allow stakeholders to live in peace with crocodiles and thereby improve their livelihoods. These stakeholders may diverge substantially in how they define what is at stake (Dewulf *et al.* 2005).

The aim of our study is to sharpen our understanding of:

- (1) how stakeholders in different communities frame the presence of crocodiles in terms of problems and solutions,
- (2) the formal and informal institutions they use to deal with crocodiles, and
- (3) what this means for their relationship with the crocodiles.

Section 2 outlines the research approach based on a conceptual elaboration of frames and framing, institutions, and change. The research setting and methods of data collection and analysis are described in the methodology section. The results section presents stakeholders' framing of problems relating to the existence of crocodiles in the APDs, including the framing of causes and solutions. The formal and informal rules people use to deal with the crocodiles are also presented. It is shown that stakeholders in the different communities frame problems and solutions differently, refer to different kinds of formal and informal institutions, and consequently deal with crocodiles in different – more or less – peaceful ways.

2. Conceptual framework

To examine human–crocodile relationships, we developed a conceptual framework starting from three inter-related concepts: frames and framing, institutions, and institutional change.

2.1. *Frames and framing*

A main starting point of our research is the idea that realities are constructed through communication among people (Gray 2003, Aarts and van Woerkum 2006, Dewulf *et al.* 2009). As problems are created by individuals and groups in society, a multiplicity of perspectives on these problems – including their causes – and possible solutions may exist, and thus a frame-reflective approach may be an appropriate mechanism to deal with them (Rein and Schön 1996). Framing has to do with making sense, interpreting, and giving meaning to what is happening in the ongoing world (Weick 1995). Frames are structured, shared ways of speaking, thinking, interpreting, and (re)presenting social realities in the world (Webler *et al.* 2001). Entman (1993, p. 52) argued that framing means selecting ‘some aspects of a perceived reality and making them more salient in a communicating context, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described’. As Yanow (2000, p. 11) explained: ‘That which is highlighted or included is often that which the framing group values.’ Consequently, the framing of a problem is the result of processes of interaction and negotiations between different actors (Idrissou *et al.* 2011, van Lieshout *et al.* 2012). Stakeholders involved in APDs thus are likely to construct realities in interactions by using specific frames relating to the presence of crocodiles.

To explain human–crocodile relationships, we focused on the framing of the issue at stake and the relationships involved. Issue frames reflect the meanings attached to events, phenomena, or problems in the relevant domain or context. Issue frames may contain problem, cause, and solution frames – in this case relating to humans and crocodiles sharing a dam – and are constructed to define the causes of problems as well as solutions for living together. When talking about the issue at stake, stakeholders disclose their own identities and their characterizations of others in their expressions. Identity frames are statements about one’s own identity in relation to the problem at stake (Gray 2003). These frames are expressed in interaction and are the answers to the questions: Who am I? and What is my role? Individuals may, for instance, frame themselves as champions of a particular cause or as victims of others’ actions or policies (Dewulf *et al.* 2009). Characterization frames are statements about ‘the other’, who may be an individual or a specific group (Gray 2003). Stakeholders rely on characterization frames as shorthand ways of describing people and making judgements about them (Shmueli *et al.* 2006). In the case of human–crocodile relationships, characterization frames are expressions about crocodiles and about other stakeholders who may affect human–crocodile relationships.

2.2. *Institutions and institutional change*

By institutions, we mean the informal and formal rules and regulations that govern human interaction (North 1990, Hounkonnou *et al.* 2012). Woodhill (2008) described institutions as formal and informal rules that enable and structure all forms of social interaction and create stability and order in society. Institutions may include different forms of organization, regular patterns of behaviour, language, laws, customs, beliefs, and values.

The involvement of many interdependent stakeholders in the management of APDs poses numerous challenges for those interested in inducing change in the complex problem situation (Aarts and van Woerkum 2006). Therefore, barriers need to be crossed, and bridges need to be built among different human stakeholders (characterized by different identities, interests, cultures, and beliefs) and – in this case – between human and non-human stakeholders (crocodiles). The space for meaningful change is regularly inhibited by the fact that many organizations, institutional arrangements, networks, and actors (including those at higher levels) are involved (Aarts and van Woerkum 2006, Idrissou *et al.* 2011). When such constraints are removed, lifted, or transformed, space for change may emerge (Leeuwis and Aarts 2011, Hounkonnou

et al. 2012). Framing dynamics in the interactions among and between stakeholder communities may play decisive roles for constructing such space (Ford and Ford 1995).

3. Methodology

3.1. Research area

The research area covers the local communities living around three APDs (Nikki, Sakabansi, and Fombawi) in Nikki District in Borgou Department located in north-eastern Benin.

Covering an area of 3171 km² and lying between 9°56' 2N and 3°12' 16E, Nikki District has 20 APDs constructed by the national government as watering holes for local, national, and international livestock, and for agricultural sector development. These infrastructures aim to enhance users' incomes by improving and supporting agricultural production (Capo-Chichi *et al.* 2009). Local communities engage mainly in mixed crop–livestock farming, herding, fishing, and earn a cash income from trading their produce. To grow their crops and livestock, they use water from the dams. In addition, the water is used for fishing, washing, and swimming.

The APDs in the villages Nikki, Sakabansi, and Fombawi were selected because they differ in terms of numbers of crocodiles that live in and near the dams and in terms of local traditions and beliefs of the people who use the dams. At the same time, the villages are comparable in terms of location (all in Nikki District), types of livelihood supports, and the diversity of stakeholders. The local stakeholders involved in the dams not only differ in the way in which they make use of the dam, they also practice different religions – Animism, Islam, and Christianity – and belong to different ethnic groups. Local and transhumant herders, for instance, belong to the Peul ethnic group, whereas the other stakeholders are of mixed ethnicity. Table 1 summarizes the main features of the three APDs (Capo-Chichi *et al.* 2009, Kpéra *et al.* 2012).

3.2. Case study design

Case studies enable the development of richly textured information that can be used to explain complex patterns and correlations, causal links in real-life situations, and to describe the real-life context in which interventions take place. They allow for analytical generalization rather than statistical generalization, meaning that previously developed theory is used as a template against which to compare the empirical results of the case study (Yin 2002, Thatcher 2006).

A comparative case study approach was used as the overarching research design of this study. The case study method is suitable for this research because we are trying to illuminate a phenomenon in its natural setting using multiple data collection methods to gather information from one or a few entities (people, groups, and organizations) (Eisendhardt 1989). The comparative aspect of the case study facilitates a better understanding of how and why three communities act differently in broadly similar circumstances.

3.3. Data collection and analysis

Data were collected from 2009 to 2012 through interviews and informal talks with 107 respondents in the three villages, using an interview guide. The respondents consist of members of dam management committees (CoGes), local herders, transhumant herders, vegetable growers, farmers, daily users of the APDs, fishermen, members of Nikki Council, children, and members of the Centre for Agriculture Promotion (CeCPA), of the Forests and Natural Resources Service (DGFRN), and of the Participative Artisanal Fisheries Development Programme (PADPPA). In addition, 13 focus group discussions (FGDs) were conducted with members drawn from each of the stakeholder categories identified in the three villages (yielding four FGDs in Nikki, five in Sakabansi, and four in Fombawi). The FGD participants included

Table 1. Main features of the three cases: Nikki, Sakabansi, and Fombawi APDs.

	Nikki	Sakabansi	Fombawi
Population (inhabitants)	31,661	2072	1490
Ethnic groups	Bariba, Boo, Peul, and Dendi	Boo, Bariba, and Peul	Boo and Peul
Year of construction	1972 and renovated in 1996	1985	1989
Capacity (m ³)	257,000	200,000	170,000
Watershed area (km ²)	120	20	2.4
Distance of the dam from the village (km)	2	3	0.3
Main uses (in order of priority)	Fish farming, vegetable growing, livestock, household use	Livestock, fish farming, household use (washing + cleaning), vegetable growing	Livestock, household use, fish farming
Number of crocodiles	<20	>100	>300
Main issues around the APD	Herder–farmer conflicts Crocodiles as constraint for fish farming	Recurrent farmer–herder conflicts Crocodiles as constraint for fish farming	Crocodiles as constraint for fish farming
Human–crocodile relationships	In between	Conflict	Collaboration

Sources: Compiled from interviews, Capo-Chichi (2009), and Kpéra *et al.* (2012).

farmers, vegetable growers, herders, dam management committee members, Nikki Council, children who swim in the dams, daily women users of the APDs, and people who worship crocodiles. The participants (interviews and FGDs) were selected using a snowball technique (Biernacki and Waldford 1981) guided by the criteria that they (1) have a stake in the issue and (2) differ as much as possible in gender, age, and occupation. Each respondent giving a reply in one of the villages was counted as one. All interviews were tape-recorded, transcribed, translated into French (the native language of the researcher), and then translated into English. Finally, policy documents relating to APD management in Nikki Council were studied.

The analysis started with various rounds of intensively reading the 254 pages of text with the aim of identifying problem, cause, solution, identity, and characterization frames, as well as frames referring to formal and/or informal institutions. Next, we looked for patterns of specific frames that were repeatedly expressed. Finally, specific frames were selected as most illustrative of the patterns found. The data were analysed using discourse analysis methods (Hodges *et al.* 2008). Discourse analysis considers that using language is a form of action (Hammersley 2003): when people talk, they not only represent realities, but also create realities (Ford 1999, Te Molder and Potter 2005). Discourse analysis methods create sensitivity for the way people construct credibility in interaction, by naming, blaming, and – in many cases implicitly – showing who they think is accountable at a certain juncture.

4. Results

4.1. Framing problems and causes

When people were asked for their personal experiences with crocodiles, they all were eager to share them. Table 2 summarizes the problem frames as constructed by the respondents at the Nikki, Sakabansi, and Fombawi APDs.

Table 2. Problem and cause frames relating to living with crocodiles as constructed by the stakeholders in the APDs.

Villages	Problem frames	Cause frames
Nikki	<ul style="list-style-type: none"> • Fear of crocodiles • Aggressiveness of crocodiles • Attacks on livestock and dogs • Predation on valuable fish • Damage to fishing equipment • Digging holes in the dykes 	<ul style="list-style-type: none"> • Illegal hunting of crocodiles • Human population growth • Deforestation around the dams • Food shortage for crocodiles during the dry season • Crocodiles and dogs are enemies
Sakabansi	<ul style="list-style-type: none"> • Fear of crocodiles • Predation on valuable fish • Attacks on livestock and dogs • Damage to fishing equipment • Digging holes in the dykes 	<ul style="list-style-type: none"> • Large specimens • People's negative behaviour towards crocodiles • Illegal hunting of crocodiles • Fishermen's selfishness • Incompatibility between fish farming and crocodile conservation
Fombawi	<ul style="list-style-type: none"> • Injuries to children • Predation on fish species • Attacks on livestock and dogs • Digging holes in the dykes 	<ul style="list-style-type: none"> • Non-respect of traditional rules relating to crocodiles

Source: Based on stakeholder interviews.

4.1.1. *Blaming crocodiles*

All respondents in the interviews and the FGDs initially framed crocodiles in a negative way. In Nikki, Sakabansi, and Fombawi, the respondents agreed that crocodiles prey on fish, damage fishing equipment, attack dogs, sheep, and goats, and dig holes in the dykes. Fishermen complained about crocodiles because they adversely affected their livelihoods, as highlighted in the next statement:

They destroy our fishing nets and eat big size fish species. They eat the bodies of the fish and leave the heads for us. In addition, they dig holes in the dyke, destabilising the dam infrastructure. (Fisherman, Nikki 2011)

A closer examination of this statement reveals several identity and characterization frames. The fishermen presented themselves as ultimate victims of the situation while blaming the crocodiles.

Herders who regularly visit dams to drench their flocks of cattle, sheep, and goats expressed similar worries about crocodiles, as illustrated by the secretary of the herders' association:

Crocodiles are becoming more and more aggressive. They attack and eat our sheep and goats. I suppose that the next step will be the attack of our cattle, and why not the herders? (Local herder, Nikki 2010)

In addition to the problems mentioned above, in Nikki and Sakabansi people expressed worries about crocodiles because of their aggressiveness and the fear they instil. All women who use the dams on a daily basis and the vegetable growers we met at the two dams claimed that crocodiles were a serious problem:

We fear them. Six people died in the dam when they were swimming, and their deaths have been attributed to crocodiles that may have drowned their victims. (Housewife, Nikki 2010)

Interestingly, the latter part of this quote indicates a more careful and less explicit blaming of the crocodiles.

According to the daily women users of the Sakabansi dam, the dam contains more than a hundred – mainly big specimen – crocodiles. Similar to respondents from Nikki, they considered the presence of the crocodiles as problematic:

There are many big crocodiles in the water. They attack and kill our dogs and small ruminants when they come to drink. This happens mainly during the dry season. Often crocodiles bite people when they are swimming in the dam. Besides, they fight among themselves, and this reaction makes people fearful. (A daily user, Sakabansi 2010)

Credibility is often constructed with reference to a personal experience, as is the case in the following quote:

... One day, when I was collecting water, a crocodile pulled my bowl out of my hands and plunged into the water. I ran away. (A daily user, Sakabansi 2010)

In all these testimonies, the crocodiles are blamed for the problems that people experience because of the presence of crocodiles in the APDs.

4.1.2. *Blaming people*

It was not only crocodiles that were blamed; human behaviour towards crocodiles was also criticized. In the next quote, for instance, the fishermen are blamed for the situation:

When fishermen come to fish, they collect all the big fish species from the dam so that crocodiles cannot find food and start killing our livestock. Conflicts then arise between humans and crocodiles. (A daily user, Sakabansi 2012)

In Fombawi, one of the women who regularly clean shea butter nuts at the water's edge blamed people who neglected the rules and thus created a problematic relationship with crocodiles:

Crocodiles have been living in this village for many generations. Our grandfather told us that his own grandfather was not able to tell him when they came to the village. They roamed in the village like sheep and goats, and they never attacked either people or livestock. In turn, people did not kill them because they are sacred animals. Today, although crocodiles remain holy, they attack village dogs, sheep, and goats that come to drink in the dam. Crocodiles also bite children when they are swimming. They become aggressive because people, mainly young people, do not respect the traditional rules relating to the sacred crocodiles. When we reprimand them, they don't even listen to us. (Woman daily user of the APD, Fombawi 2010)

Implicitly, the speaker identified herself and the other women as the ones who knew what should be done (i.e. follow the traditional rules).

Interestingly, in Fombawi, a fisherman, who in Nikki had framed crocodiles as a bottleneck for fish farming, extensively explained how peacefully crocodiles can be dealt with when their holiness is respected:

Although there are many crocodiles, fishing parties are easy for us because of the collaboration of the local communities with the crocodiles. ... Before we start fishing, the head of the village prays and

requests the holy crocodiles to allow us to fish. After the praying, crocodiles leave the dam and run into their holes located in the vegetation and into the dyke. We then start fishing. Young crocodiles, however, are sometimes caught in our nets, and we return them into the water after fishing. (Fisherman, Nikki 2011)

Both the praying activity and the habit of throwing back into the water young crocodiles caught by accident are informal institutions that are apparently collectively agreed upon in Fombawi. The fact that these rules were articulated only in Fombawi shows the relevance of context to the construction of specific frames.

To show the relation between frames and the context in which they are constructed, [Figure 1](#) presents the incidences caused by crocodiles in the three APDs from 2009 to 2013. This figure shows that, besides similarities, there are also differences. Apart from the fact that nobody seems to be bitten by crocodiles in Nikki, the number of other kinds of incidences is generally higher there than in Sakabansi and Fombawi.

At first sight, the number of fishing nets destroyed is lowest in Fombawi ([Figure 1](#)), which has more crocodiles (300) than Sakabansi (100) and Nikki (20). It may be that praying before fishing is effective. The high number of crocodile holes in Fombawi APD is in line with the relatively high number of crocodiles and the proximity of the dam to the village. In addition, some people from Nikki intimated that six people may have been drowned by crocodiles, although from 2009 to 2012 there is no record of people being killed or bitten.

The absolute damage caused by crocodiles is higher in Fombawi; however, as there are more crocodiles, the relative amount of damage per crocodile ([Figure 2](#)) is lower. This may imply that the crocodiles in Fombawi are less aggressive than in Nikki and Sakabansi, and/or that the Fombawi inhabitants are more tolerant towards crocodiles.

To summarize, respondents experience similar problems in the three villages but with different intensities, and they frame the causes differently. Problems between humans and crocodiles as framed by stakeholders in the three villages are attributed to crocodiles (through damage that they caused) and to stakeholders' behaviours (fishermen's 'selfishness'; non-compliance with traditional rules).

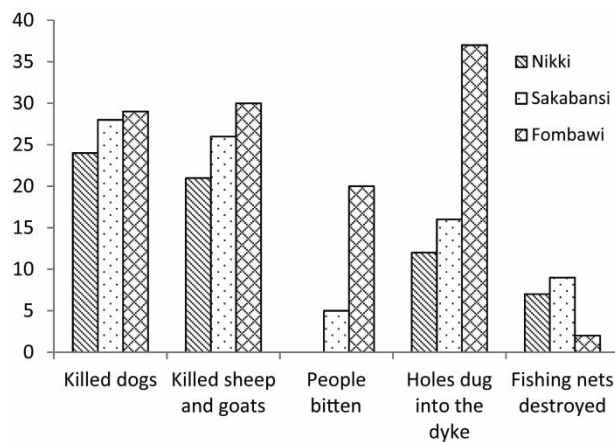


Figure 1. Number of different types of damage caused by crocodiles in Nikki, Sakabansi, and Fombawi dams from August 2009 to December 2012.

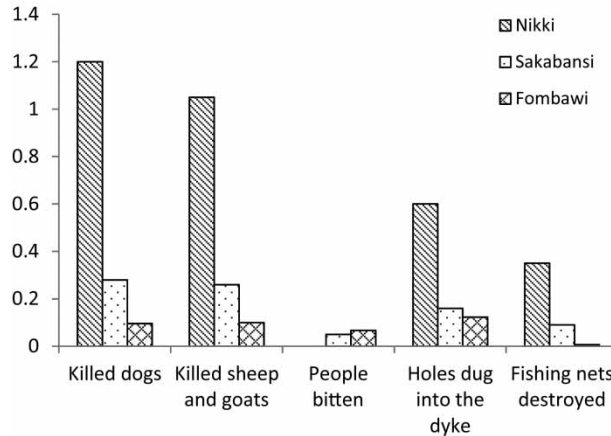


Figure 2. Number of different types of damage divided by the number of crocodiles in Nikki, Sakabansi, and Fombawi dams from August 2009 to December 2012.

4.2. The role of institutions

In this section, we present the way respondents refer to formal (written) and informal (unwritten) institutions relating to crocodiles.

4.2.1. The role of formal institutions

Formal institutions for protecting crocodiles have been formulated at both national and international level (Table 3).

Apart from the respondents from the DGFRN and from the PADPPA who acknowledged these international rules and indicated that communities have been informed about them, stakeholders expressed unawareness of these formal rules, as illustrated by the next quote:

We don't know the specific content of these rules about wild animals. (Farmer, Nikki 2012)

Although some respondents expressed ignorance of formal regulations, according to others, they know perfectly well that crocodile species are protected and should not be killed.

Everybody in the village knows that crocodiles are protected by the State of Benin. However, they kill them. If you go to the market, you will see all the products and body parts of the animal for sale. (Dam users, Nikki 2011)

One of the respondents showed awareness of the formal regulations by explicitly contesting the rule that crocodiles should be protected:

We are living with a carnivore that can kill humans at any time. For me, the law is incomplete because it should also say what to do in the case of damage and attacks on people. (Vegetable grower, Sakabansi 2012)

Interestingly, instead of referring to the formal protection rules, several respondents referred to another factor that supports the protection of crocodiles, namely, the low prices offered for

Table 3. Formal institutions at international and national level relating to human–crocodile relationships.

Level	Formal institutions	Content of the rules
International level	Convention on Biological Diversity	<ul style="list-style-type: none"> • Goals: conservation of biodiversity, sustainable use of biodiversity, fair and equitable sharing of the benefits arising from the use of genetic resources
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	<ul style="list-style-type: none"> • Goals: to ensure that international trade in specimens of wild animals and plants does not threaten their survival • The CITES convention does not allow the trade of skins of Benin crocodile species
	IUCN Red List of African crocodile species	<ul style="list-style-type: none"> • The most comprehensive information source on the status of wild species and their links to livelihoods. The IUCN Red List of Threatened Species Version 2012.1 classed <i>Crocodylus niloticus</i> as lower risk/least concern, <i>Oesteolaemus tretraspis</i> as vulnerable, and <i>Mecistops cataphractus</i> as data deficient
National level	Law N°97-029, article 84107, on decentralization in Benin	<ul style="list-style-type: none"> • From 2005 onwards, decentralization gives local people the power to manage their own region; Nikki Council has the right to manage all the APDs in Nikki District • The incomes generated by these infrastructures should serve local development
	Law N°2010-44 relative to water management in Benin	<ul style="list-style-type: none"> • All the rivers and water holes, including the APDs, belong to the public domain. Articles 13–14 forbid all types of water pollution, and article 57 allows for decrees to be issued concerning rules governing agricultural and pastoral activities
	Law N°2002-016 relative to wildlife management in Benin Red List for Benin	<ul style="list-style-type: none"> • Crocodiles are a fully protected species and should not be hunted • In 2011, scientists designed at national level a Red List of Threatened Species. The Nile crocodile (<i>Crocodylus niloticus</i>) is classed as vulnerable (VU), the African dwarf crocodile (<i>Oesteolaemus tretraspis</i>) as endangered, and the African Slender-snouted Crocodile (<i>Mecistops cataphractus</i>) as critically endangered (CR)

Sources: Compiled from IUCN Red List of Threatened Species Version 2012.1, Benin Red List of threatened species (Kpéra et al. 2011), Benin laws relating to water and wildlife management and decentralization (Kpéra et al. 2012).

crocodile leather, which discourages people from killing crocodiles, thus contributing to the increase in the number of crocodiles invading the dams:

Before coming to Nikki, I fished and hunted crocodiles in the Niger River on both the Benin and Niger side. At that time, one could earn 50,000 to 100,000 FCFA (Franc- Financial Community of Africa, Franc- Communauté Financière d’Afrique) (€76.30 to €152.60) depending on the size of the animal. Because of the fall in the international price of leather, we have all abandoned the activity. . . . If the price of crocodile skin was still high, you would not see any crocodiles in agro-pastoral dams. Those who kill them here do it for meat and some body parts that are used in traditional medicine. (Fisherman, Nikki 2012)

4.2.2. *The role of informal institutions*

Informal institutions consist of (1) rules set by Nikki Council about the management of the APDs, (2) common beliefs relating to crocodiles, and (3) traditional rules relating to the sacred crocodiles in Fombawi. These rules have not been written down, but instead developed and kept alive by people constantly communicating and applying them. Informal institutions, as articulated by the respondents, are presented in Table 4.

The APD management rules set by Nikki Council focus on the way activities should be carried out in/around the dams and their surroundings and on the main functions of the CoGes (dam management). We noted from the interviews that these rules were well known by the dam users, but this does not mean that they are automatically or universally obeyed. They appear to guide stakeholders' behaviour in the APDs to some extent. As given in Table 4, crocodiles are not mentioned in the rules, neither are sanctions that people will face if they do not respect the rules.

A belief shared by all respondents in the three villages is that 'The crocodile is the heart of the water. A pond with crocodiles never dries up' (Respondents in Nikki, Sakabansi, and Fombawi 2010). This shows that people associate the presence of crocodiles with a healthy dam ecosystem. The belief should thus prevent the killing of crocodiles in the three villages if people want to maintain water in the dams.

Traditional rules that support living peacefully together with the crocodiles, based on the belief that crocodiles are sacred creatures, were articulated only in Fombawi (Table 4). According to the respondents, most people in Fombawi, even those belonging to different religions, respected these rules:

Crocodiles were living in a small pond located 80 m from the dam. They invaded the dam because of the presence of fish and the large water area. They are the protectors of our village, and annually all the inhabitants of the village go to the pond to fulfil one of the rules: the sacrifice to the sacred pond and the holy crocodiles. The village head is the one who leads praying at the pond. Furthermore, when one has particular intentions, one can go and see the traditional chief who will conduct you to the pond for sacrifices, and it works. (Dam user, Fombawi 2010)

It can be concluded that most respondents are aware of the key message of national and international regulations and laws, which is that killing crocodiles is forbidden. In Fombawi, informal institutions were constructed and respected to live peacefully with the crocodiles. In Nikki and Sakabansi, the killing of crocodiles was made acceptable by means of rhetorical devices, as given in the next section.

4.3. *Framing solutions*

Table 5 summarizes the solution frames for living with crocodiles as constructed by the respondents.

Two kinds of solution to the problem can be identified from the interviews: (1) changing the ecological environment and (2) changing institutions.

4.3.1. *Changing the ecological environment*

Killing crocodiles has been mentioned as a solution to the problem, especially in Nikki and in Sakabansi. This entails finding ways to cope with cognitive dissonance (Festinger 1957) because people know that killing crocodiles is prohibited. Such is reflected in the following

Table 4. Informal institutions at Nikki District level relating to APD management and to human–crocodile relationships.

Level	Informal institutions	Content of the rules
Nikki District level	Rules set by Nikki Council relative to the management of the APDs	<ul style="list-style-type: none"> • Fees for the use of the APDs: house construction 2000 FCFA (€3.04) per house; transhumant herders: 50 FCFA (€0.07) per animal • Access to the dams from the dyke by humans and livestock is banned • Movement corridors are identified and livestock should remain within the corridors to access the dams • Establishment of farms within 1000 m of the edge of a dam is forbidden • Vegetable growing and washing are authorized only downstream of the dams • No swimming in the dams • Vegetation fires may be lit only from 15 October to 30 November • Fishing is allowed only under the conditions and rules set by the town council • The income from fish farming is divided between the fishermen, the town council, and the dam management committee members (CoGes: Comité de Gestion du barrage) • Income from the dam is to be used for local development • The CoGes members are selected by Nikki Council at a general assembly, and its main functions are to clean periodically the dams and the surrounding area, open transhumance corridors, prevent robbery of the fish, and control activities that contribute to the silting up of the dams and to water pollution – the CoGes should take care of the dams and in compensation benefit from a recompense (amounting to 2/3 of the fish farming per fishing session)
Nikki, Sakabansi, and Fombawi village level	Common belief relative to crocodiles	‘The crocodile is the heart of the water’
Fombawi village level	Traditional rules relative to sacred crocodiles in Fombawi	<ul style="list-style-type: none"> • Crocodiles are treated as sacred animals and should not be killed • Every year sacrifices must be made to the sacred pond and the crocodiles, and every household must prepare food and bring it as a sacrifice • Before carrying out any activity at the dam, people must ask crocodiles for permission • Any crocodile that dies is buried only after burial ceremonies, headed by the traditional chief • Any woman in menses does not have the right to collect water from the dam

Source: Based on stakeholder interviews.

Table 5. Solution frames relating to living with crocodiles as constructed by the stakeholders in the APDs.

Villages	Solution frames
Nikki	<ul style="list-style-type: none"> • Collect and cage all the crocodiles for tourism • Make clear rules and regulations relating to dam use • Killing of crocodiles (hidden solution)
Sakabansi	<ul style="list-style-type: none"> • Fishermen should leave some fish for crocodiles • Nikki Council should give compensation to those whose livestock and dogs are killed by crocodiles • Killing of crocodiles (hidden solution) • Collective action: weekly livestock market provides income for regular cleaning/upkeep of the dam
Fombawi	<ul style="list-style-type: none"> • Swimming in groups • Making noise while swimming • Praying, communicating with the crocodiles, and other ceremonies • Regularly reminding people about the traditional rules

Source: Based on stakeholder interviews.

quote of a former crocodile hunter in Nikki, who shifts responsibility for killing crocodiles to God who gave him the talent to kill:

I can't count the number of crocodiles I killed in my life. When God gives you a talent to do something, you should use it as you want. (Former crocodile hunter, Nikki, November 2010)

The oldest and main fisherman in Sakabansi confessed:

We know that crocodiles are natural resources. We have to protect them for new generations. In many villages, crocodiles are disappearing because of poaching. In this village, we just shoot adult crocodiles that cause damage and leave sub-adults and young animals. We do not have any solution apart from killing them because they affect our livelihood. (Fisherman, Sakabansi, December 2009)

This quotation also shows an ambivalent attitude towards crocodiles: on the one hand, fishermen in Sakabansi do not feel comfortable about killing crocodiles; on the other hand, they do not want them in their dams.

In Nikki, several daily dam users, as well as members of the Nikki dam CoGes, suggested ecological solutions relating to a new dam design, to be carried out by Nikki Council:

A new dam with a fence should be constructed and all the crocodiles infesting our dams will be parked there. This place will serve for tourism based on crocodiles. This new activity should bring money to the whole district. (CoGes member, FGD, Nikki 2010)

In Sakabansi, women daily users of the Sakabansi dam, suggested reorganizing the accessibility of the dam:

To avoid any attack and fear caused by crocodiles, it is necessary to have only one entrance to the dam. Furthermore, each type of activity carried out around the dam should have a particular place depending on its effect on water quality. (Housewife, Sakabansi 2011)

Fishermen in Sakabansi suggested a technological solution, as illustrated by the following quotation:

The PADPPA offered two floating cages and 5000 small fish to promote fish farming in Nikki. If we can find a project that will help us to install a floating cage for fish production in Sakabansi, this will

largely prevent crocodile predation on our fish species and increase our income. (Fisherman, Sakabansi 2011)

Local herders in Nikki and Sakabansi complained about the fishermen, as they framed their behaviour as the main cause of the problem:

Fishermen should not catch all big fish species. They should leave some to crocodiles as food. Then, the crocodiles would not attack our livestock. (Herder, Sakabansi 2011)

4.3.2. *Changing institutions*

In addition to solutions that relate to changing the ecological environment, suggestions were made to change institutions, for instance to change formal rules by introducing monetary compensation:

Since the council sells fish from dams and collects money from transhumant herders and from those who use water for road and house construction, it should give compensation to herders whose livestock have been killed by crocodiles. (Local herder, Nikki 2012)

And:

The employment of a security guard by Nikki Council, which is the manager of the dam, should oblige people to respect rules relating to the use of the dam and prevent them messing around. (Housewife, Sakabansi 2011)

In both solutions, Nikki Council is framed as being responsible for developing new rules, as well for ensuring that people will not ignore them.

In contrast to Nikki and Sakabansi, the Fombawi respondents framed the solution to the problem as the construction and application of rules that ensure a peaceful relationship with the crocodiles. During one of the FGDs, female vegetable growers suggested:

When people strictly respected traditional rules, crocodiles did not attack either livestock or humans. Why not return to strict respect for these rules? (Vegetable grower, Fombawi 2012)

Children added practical rules that they apply when swimming:

Crocodiles attack people when they swim alone. Therefore we swim in a group and avoid going into the middle of the dam, which is the deepest part. We also make a lot of noise to move crocodiles away from us. (Children bitten by crocodiles, Fombawi 2012)

Whereas the respondents from Nikki and Sakabansi preferred changing the ecological environment, the Fombawi respondents suggested changing informal institutions to allow peaceful co-existence with crocodiles. Another striking difference concerns who should be responsible for solving the problem. In Nikki and Sakabansi, the solutions suggested by the respondents shifted responsibility to the council. The Fombawi respondents stated that they themselves should take the responsibility for dealing peacefully with crocodiles by respecting supporting institutions, which have been ignored for a long time.

5. Discussion

Our study revealed that the respondents in the three villages framed the presence of the crocodiles as a problem because of their negative effects on local livelihoods and people's tranquillity. Both

causes and solutions were, however, framed differently in the three communities. This shows the relevance of specific contexts for the development of shared knowledge, rules, and behaviours.

In Nikki and Sakabansi, the causes of the problems revolved mainly around blaming both crocodiles and other stakeholders involved in the dam. To solve the problems, respondents in Nikki suggested separating the crocodiles into their own dam and letting them play a role in tourism (Table 5). Another solution was to construct legitimacy to kill crocodiles (Table 5) – a solution that is, however, contrary to national and international regulation (IUCN 2012) and thus generates uncomfortable feelings among respondents. The third solution mentioned by the Nikki respondents was to make clear rules and regulations relating to dam management. In Sakabansi, respondents suggested that fishermen should leave some fish for the crocodiles, that Nikki Council should compensate those whose livestock and dogs were killed by crocodiles, and that big and aggressive crocodiles should be killed (Table 5).

Although Fombawi respondents experienced similar problems, their solutions were quite different. Whereas in Nikki and Sakabansi, stakeholders seek solutions in changing the ecological environment, which requires others (the council, fishermen, and crocodiles) to change their behaviour, people in Fombawi seek to change their own behaviour by respecting and applying traditional and practical rules for peacefully sharing the dam with crocodiles. Examples of such rules are praying and similar ceremonies, and communicating with the crocodiles. Interestingly, the research shows that the damage per crocodile is the highest in Nikki and the lowest in Fombawi, suggesting that the crocodiles in Nikki behave more aggressively than those in Fombawi. Further investigation is merited to determine whether or not crocodiles indeed behave less aggressively when dealt with in specific ways, as is the case in Fombawi.

The different solution frames articulated by respondents are worthy of further exploration and discussion. The idea of financial compensation for crocodile attack victims is a general solution proposed by wildlife managers in Africa, as indicated by Lamarque *et al.* (2009). However, Lucherini and Merino (2008) and Bhattacharjee and Parthasarathy (2013) have suggested that financial compensation can weaken conservation efforts, leading to retaliatory killing of wild animals that threaten local people's livelihoods.

The belief-related solutions in Fombawi reflect the important role of institutions that relate to human behaviour towards crocodiles, in combination with specific knowledge about crocodile behaviour, which people in Fombawi have developed over time. Similar experiences confirm the relevance of institutions that guide peaceful human–crocodile relationships (Luo *et al.* 2009, Jimoh *et al.* 2012, Mukul *et al.* 2012). Interestingly, such institutional solutions already exist in Fombawi, probably because the community was already living near a smaller pond with crocodiles before the dam was built. Thus, instead of assuming that appropriate institutions are lacking and need to be designed (Houkonnou *et al.* 2012), it is important to capitalize on the institutional variation that already exists (Sherwood *et al.* 2012, Leeuwis 2013).

As argued by Zaffron (1995) and Bohm (1996), intentionally constructed conversations in which participants engage in a sustained and collaborative investigation of assumptions and backgrounds that underlie their everyday practices and interactions can be very useful for creating new contexts that allow for new rules and practices. It is therefore recommended that the stakeholders in the three communities should discuss their different solutions to the problem, including the traditional and practical institutions of the Fombawi people, with the aim of finding out whether these could also be effective in the contexts of Nikki and Sakabansi.

6. Conclusion

Although people in the three communities studied in Northern Benin are all confronted with crocodiles on a daily basis, they deal with them in different ways, including applying both formal and

informal institutions that support a more or less peaceful co-existence with the crocodiles. Accessing the frames of diverse stakeholder groups has resulted in new and useful insights that elucidate the contextuality of human–crocodile interactions around APDs. It appears that the behaviour of wildlife – at least to a certain extent – is constructed in interaction, both between people and crocodiles and among people. Our study has shown the relevance of ongoing daily actions and interactions in specific contexts for developing specific human–crocodile relationships. Since changing actions and institutions is shaped in changing conversations, and vice versa (Ford 1999), the different ways people deal with crocodiles in the three communities may be a good starting point for a dialogue focused on finding ways to manage wildlife effectively in the APDs.

This conclusion forms the basis for recommending intensive communication between stakeholders from the different villages in order to exchange experiences, practices, and ideas for peacefully dealing with the crocodiles, capitalizing on existing institutional diversity as the inspiration for change.

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