

Conflict Resolution and Management between Local Fishers and Tour Operators in the Okavango Delta's Panhandle, Botswana

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Abstract

Conflicts among different fisher groups are a global concern, and the Okavango Delta fishery is no exception, which is composed of commercial, subsistence and recreational fishers. Possibly due to conflicting value/use systems, and ill-defined user rights, there have been documented cases of conflict between commercial and recreational fishers, which may affect livelihoods for local fishers. Therefore, this study's aim was to identify causes of conflict between these groups and to propose management inventions. Primary data collected in three fishing villages showed that lack of access, misconceptions about each other, and overlapping use were identified as some of the major causes of conflict. Subsequently, this paper proposes a spatial and temporal zoning of fishing grounds as a management tool towards conflict resolution. One proposal is that recreational fishers can utilize the main channel, commercial fishers the floodplains and lagoons, while basket fishers can utilize the fringes of floodplains, lagoons and river channel. Moreover, a co-management regime has also been developed in the fishery, upon which a code of conduct was developed to also reduce conflict in the fishery. It is envisaged that this approach will reduce conflict and create an enabling environment for efficient and sustainable fish utilization in the Delta.

Keywords

Conflict, Co-Management, Livelihoods, Fisheries Management

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1. Introduction

One of the fundamental issues bedeviling fisheries around the world (especially inland fisheries), and contributing to conflict among different stakeholders, is lack of well-defined property rights. Therefore the outcome of fisheries management regimes is to create social institutions [1] [2] “that are meant to guard the sustainability of the resource” [1]. These social institutions ultimately determine the allocation of resources among and between users over time [3]. Arnason [2] argues that these “social institutions” should endeavor to solve “the fisheries problem” (economic inefficiency) caused by common property regimes which characterizes most fisheries. According to Arnason [2] therefore, there are several remedies towards alleviating the fisheries problem (see **Figure 1**): 1) fishing licenses, 2) sole ownership, 3) territorial use rights in fisheries (TURFS), 4) individual catch quotas, and 5) community fishing rights. These then provide the basic framework for an analysis of conflict resolution and management in fisheries. Furthermore, Boisneau and Mennesson-Boisneau [4] advocate for a fisheries co-management paradigm (which includes administrators, recreational fishers and commercial fishers at the catchment level) as an answer to the complex fisheries management issues facing inland fisheries management. Since Sipponen and Grevobal [5] highlight that lack of communication and mutual understanding contribute to conflict between recreational and commercial fishers, we argue that co-management can assist in the creation of a forum for communication between these two stakeholders.

The Okavango Delta fishery, although it is not (yet) over-exploited [6], is characterized by conflict [7]. Cases of conflict between tour operators and the local fishermen in the Okavango Delta’s panhandle been documented [7]. According to Mosepele [7], tour operators alleged that commercial gill net fishers were over-exploiting the fish resource, while commercial fishers alleged that tour operators denied them access to the resource. Tweddle *et al.* [8] also observed that there was conflict between tour operators and commercial fishermen over fish exploitation in the Okavango Delta. Tour operators expressed concern that commercial fishermen were over-exploiting some fish species while commercial fishers complained that tour operators were destroying their fishing gear. Perhaps the major striking feature that was highlighted in Tweddle *et al.* [8] was ignorance about the value of the fishery to each other displayed by the key actors (local fishers vs. tour operators) in the Delta’s fishery. This ignorance agreed with Mosepele’s [6] observations that the conflict in the Delta’s fishery emanated more from lack of communication among the key stakeholders than from issues related to fish stock over-exploitation.

This study examines ways of resolving conflicts among different fisher groups in Botswana’s Okavango Delta. The specific research objectives of this study were: 1) To determine the nature and magnitude of conflict among stakeholders; 2) To assess the causes of conflict among these stakeholders and; 3) To propose management approaches as conflict resolution measures. It is intended that this study will contribute to the debate and policy on sustainable fisheries management in floodplain fisheries.

2. Materials and Methods

2.1. Study Area

The study areas for this research were the villages of Samochima, Mohembo West, and Ngarange, situated in the Okavango Delta’s panhandle (see **Figure 2**). The Okavango Delta is the largest fresh water body in Botswana [9] and supports the largest fishery in the country [10]. Furthermore, the panhandle has the highest density of fishers in the Delta [11]. The Delta is possibly an extension of the African Rift Valley system [12], covering an area of 16,835 km² [13]. It is a major tourist attraction [14] [15] and the main water source for north central Botswana [13]. The Okavango River crosses the Botswana border at Mohembo as a single broad river from Namibia with

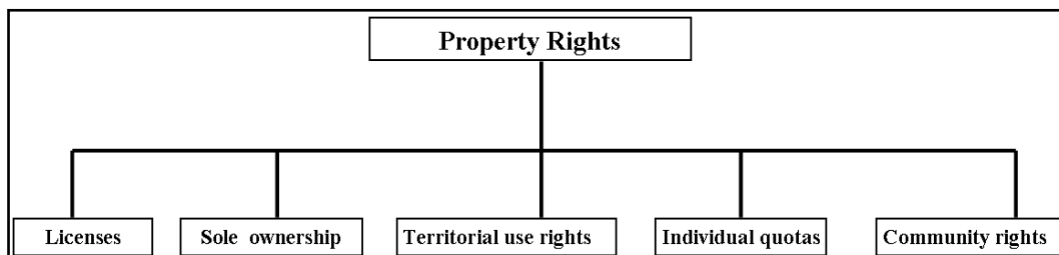


Figure 1. Types of property rights regimes (Source: [2]).

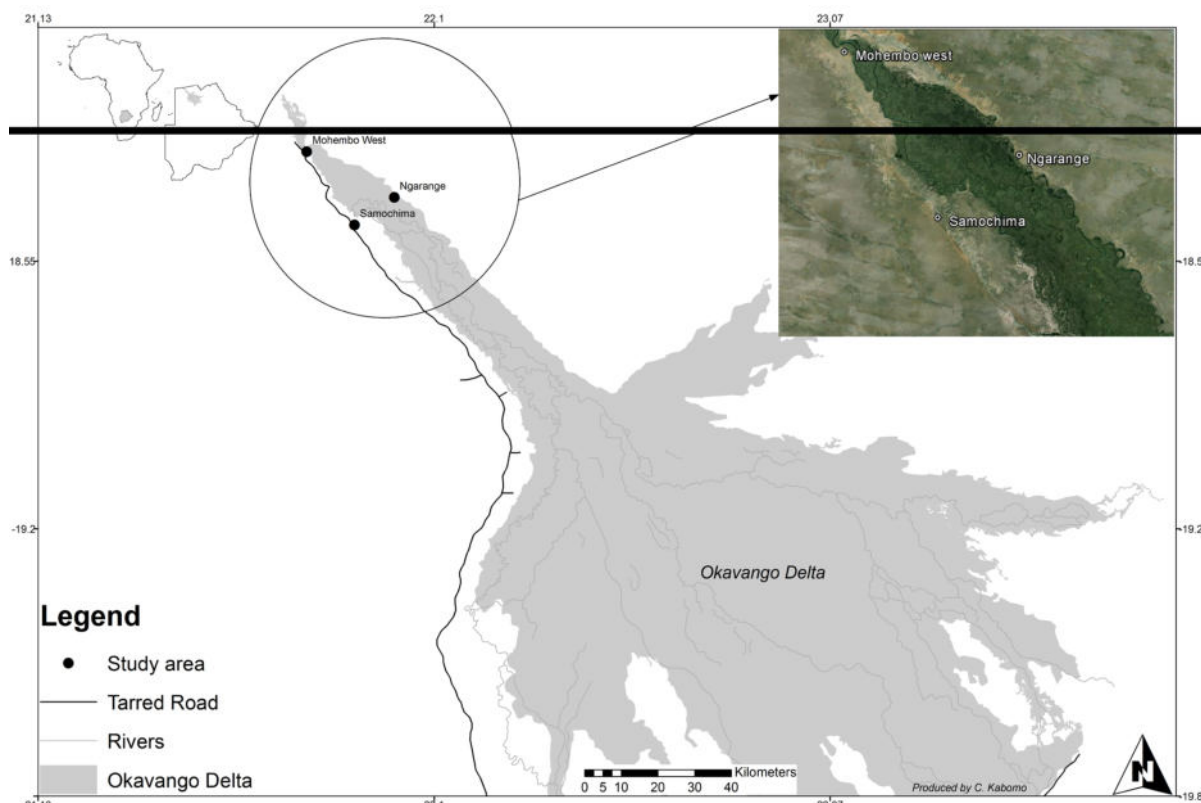


Figure 2. Map of the Okavango Delta showing the three study villages.

its origin in Angola, where it is created by the confluence of the Cubango and Cuito Rivers [13]. The annual floodwaters from Angola arrive in the northern panhandle around December/January [16]. The Okavango Delta is characterized by a semi-arid climate, with a mean rainfall of approximately $490 \text{ mm}\cdot\text{yr}^{-1}$ occurring between November and March [17].

According to the 2001 census [18], Ngarange village has a population of 948 people; Samochima village has a total population of 847 people while Mohembo West has a population of 1299 people. Essentially, the Delta's panhandle supports the highest density of fishers [10] and several tourism facilities [14] all within a relatively small area. The fishing season is open from March 1 until December 31 [19], which coincides with peak fishing effort in the Delta when most fishers return to fishing from arable farming activities [6]. This period also coincides with the tourism season when the lodges in the panhandle receive regional and international tourists.

2.2. Data Collection

A structured questionnaire was used to collect primary data on fisheries management and conflict issues in the three study villages (Samochima, Ngarange and Mohembo West) from commercial, basket fishers and tour operators. The research team consisted of one researcher, one associate researcher and two research assistants. Before administering the questionnaire, the research assistant and the associate research were trained in the survey design by pre-testing it in one village outside the study area. This helped the assistants to gain confidence and proficiency in administering the questionnaire, and also allowed for the team to edit and update the survey instrument. Questions were administered among the respondents using their local language, while English was used among the tour operators because they were English speaking. The total population method was used where all the commercial fishers in the study villages were interviewed (Samochima = 16; Mohembo West = 9; Ngarange = 9). However, a random sample of fifteen basket fishers in each study village was determined, resulting in a total of 45 basket fishers therefore 48 respondents were interviewed. According to Mosepele [11], there are 47 basket fishers in Ngarange, 118 in Mohembo West and 66 in Samochima. Socio-economic and demographic data on commercial and basket fishers was derived from two comprehensive surveys (*i.e.* using the

total count method) conducted by Mosepele [11] in 1998 and Bokhutlo *et al.* [20] in 2006. Three tour operators, who happened to be the only ones in the study area (during the 2007 field survey), were also interviewed.

2.3. Data Analysis

All data from structured questionnaires was entered into a Microsoft Excel database for analysis. Frequencies were then calculated to identify the possible causes and remedial measures for conflicts in the panhandle. Relative proportions were also calculated to establish various variables such as age distribution, income distribution, level of sharing of fishing grounds, preferred fishing grounds, and incidence of conflicts as a function of season. A Spearman Rank order correlation implemented in STATISTICA [21] was also used to explore the relationship between conflicts' incidences and other variables such as flooding and fishing season. Significance levels were set at 90% confidence level for all statistical analysis.

3. Results

3.1. Demographic Structure

Figure 3 illustrates age distribution of basket and commercial fishers in the panhandle where the youngest fishers were found in Samochima and Ngarange while the older fishers were found in Mohembo West. Samochima commercial fishers have the widest range of age among the study villages. Notwithstanding, the majority of commercial fishers in both Samochima and Ngarange were younger than Mohembo West where most commercial fishers were older.

There were spatial variations in the marital status of basket fishers among the study villages (**Table 1**). The highest proportion of unmarried basket fishers was observed in Mohembo West while Samochima had the highest proportion of married basket fishers. Furthermore, **Table 1** also shows that while the dominant family size in Samochima villages was 5 - 9 people per household, the largest family size of over 15 people per household was also found in this village. Incidentally, the dominant family size in all the three study villages was 5 - 9 people per household.

The majority of commercial fishers in the study villages were married. Commercial fishers in Samochima village had the highest proportion of married fishers (87%), while Mohembo West had both the lowest proportion (40%) of married commercial fishers and the highest proportion (20%) of unmarried commercial fishers among the study villages. Conversely, Ngarange had the lowest proportion of unmarried commercial fishers among the study villages (**Table 1**). As summarized in **Table 1**, the common household size for commercial fishers in all the study villages was a family size of 5 - 9 people. Furthermore, a relatively high proportion of the fishers also had a family size of over 15 people, even though Ngarange commercial fishers had the highest proportion of family size of over 15 people.

In terms of income, **Table 2** shows that all the basket fishers had an income of less than US\$ 85.00 month⁻¹

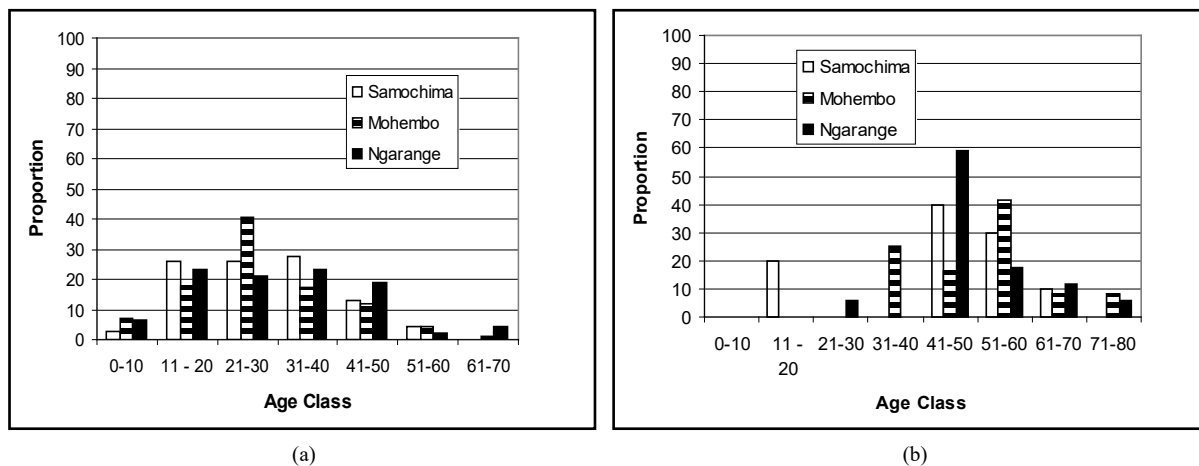


Figure 3. (a) Proportion of basket fishers by age class in each of the study villages; (b) Proportion of commercial fishers by age class in each of the study villages.

Table 1. Categorization of fishers (basket and commercial) by marital status and family size based on proportions (*i.e.* %).

Village	Marital Status						Family size							
	Single		Married		Divorced		0 - 4		5 - 9		10 - 14		≥15	
	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²
Ngarange	7	6.7	26	54.	0	0	40	0	40	44	20	22	0	33
Samochima	40	13	60	87	-	0	27	6	33	56	13	25	26.7	13
Mohembo West	53.	20	47	40	0	0	27	11	67	44	6.7	33	0	11

Where: 1 = Basket fishers; 2 = Commercial fishers.

Table 2. Categorization of fishers (basket and commercial) by socio-economic activities in (%).

Village	Monthly Income		Livelihoods								Value of fishing					
	<85(%)		Fishing		Crops		Livestock		Pension		Other		Very important		Important	
	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²	B ¹	C ²
Ngarange	100	100	60	53	53	6.7	47	6.7	7	6.7	0	86.7	60	13.3	40	
Samochima	100	100	100	66.7	93	6.7	40	6.7	13	33.3	7	100	100	0	0	
Mohembo West	100	73	60	13.3	53	0	13	13.3	7	0	13	100	60	0	40	

Where: 1 = Basket fishers; 2 = Commercial fishers.

(using the 2007 BWP vs. US\$ exchange rate). Notwithstanding, the basket fishers in the three study villages had diverse livelihood activities. The majority of basket fishers in all study villages indicated that fishing is their major livelihood activity. The second most important livelihood activity in all the three villages was arable agriculture, while pastoral farming and the government's old age pension scheme were marginally important.

All commercial fishers in the three villages earned more than US\$ 85.00 month⁻¹. More than 60% of commercial fishers in the three study villages perceived fishing as their major source of income. More than 53% of commercial fishers in the three study villages also practiced arable agriculture, while a substantial proportion of fishers in Samochima and Ngarange practiced pastoral farming. A small proportion (<13%) depended on the old age pension scheme while another small proportion of fishers were engaged in other livelihood activities. Furthermore, more than 60% of fishers in the three villages regarded fishing as a very important activity (**Table 2**).

3.2. Preference for Fishing Grounds

As summarized in **Table 3**, basket fishers in the three villages had a higher preference for lagoon and floodplain habitats, while only a small proportion preferred fishing from the main river channel. Commercial fishers had a higher preference for all the three habitats (*i.e.* lagoon, floodplain and channel) while tour operators showed a higher preference for lagoon and channel habitats only. Perhaps due to preference for similar fishing habitats, **Table 3** also shows that there were high levels of interaction among these different fisher groups in their preferred habits.

3.3. Causes of Conflict

The majority of all the fisher groups in the study villages (except for Samochima basket fishers) indicated that they had full access to their preferred fishing areas. However, a small proportion of Samochima commercial fishers (13%) indicated that they do not have unfettered access to their fishing grounds. The majority of Samochima basket fishers (60%) indicated that they did not have full access to their preferred fishing grounds (**Table 4**), while a small proportion (13%) of Samochima commercial fishers indicated the same (12% of commercial fishers did not respond to the questions). The majority of Samochima commercial fishers and basket fishers indicated that access was the major source of fishing conflict in their area, while a small proportion of Samochima commercial fishers indicated gear destruction by tour operators as a major source of conflict (**Table 5**).

Table 3. Types of fishing grounds preferred by all the different fisher groups and levels of sharing in %.

<i>Fishing grounds</i>											
Village	Commercial	T/O	Baskets	Commercial	Baskets	Commercial	T/O	Baskets	Commercial	Baskets	
	lagoon			Floodplain		Channel			other		
Ngarange	60	-	100	60	100	53	-	7	0	0	
Samochima	100	100	100	100	93	100	100	13	0	26	
Mohembo West	60	-	100	60	93	60	-	53	0	33	

<i>Level of sharing</i>												
Village	Commercial	T/O	Baskets	Commercial	T/O	Baskets	Commercial	T/O	Baskets	Commercial	T/O	Baskets
	Commercial fishers			Subsistence Fishers			Tour operators			others		
Ngarange	60	-	100	60	-	100	60	-	7	13	-	-
Samochima	100	100	93	100	100	93	100	100	40	33	33	27
Mohembo West	60	-	100	60	-	100	60	-	20	0	-	-

Note: T/O = Tour operators.

Table 4. Access to fishing grounds by the different groups based on proportions (%).

Village	Commercial			Tour Operators			Baskets			Commercial			Baskets					
	Yes						No											
Ngarange	100						-						93					
Samochima	75						100						40					
Mohembo West	100						-						87					

Table 5. Types of conflicts experienced by the different fisher groups based on proportions (%).

Village	Access to fishing areas		Gear destruction by tour operators		Other	
	Commercial	Baskets	Commercial	Baskets	Commercial	Baskets
Ngarange	0	0	0	0	0	0
Samochima	75	53	19	0	13	0
Mohembo West	0	13	0	0	0	0

Note: Tour operators indicated that they did not experience any type of conflicts during this survey.

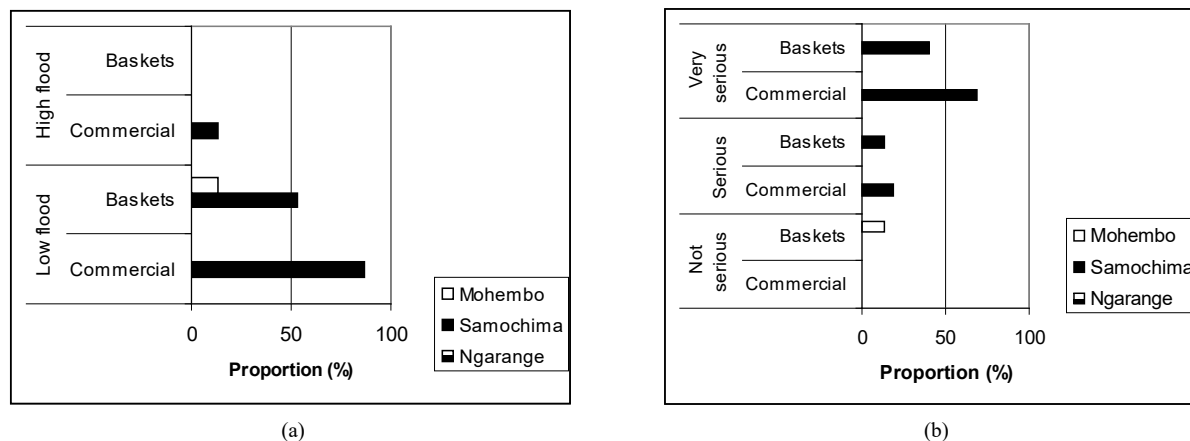
Some commercial fishers in Samochima and Mohembo West felt that basket fishing was detrimental to fish stocks (Table 6). Moreover, Table 6 also shows that a large proportion of tour operators, and smaller proportions of commercial and basket fishers felt that drive fishing is detrimental to fish stocks. Tour operators and basket fishers in all the study villages, with a higher proportion of basket fishers at Samochima felt that drive fishing is detrimental to fish stocks. About a third of Mohembo West commercial fishers (33%) and a tenth of Ngarange commercial fishers (11%) indicated that mosquito nets were detrimental to fish stocks. Two thirds of the tour operators also indicated that mosquito nets were detrimental to fish stocks, while some basket fishers from Mohembo West and Samochima expressed similar concerns. Some commercial fishers and tour operators also indicated that hook and line fishing was detrimental to fish stocks (Table 6).

More than 50% of Samochima commercial fishers and basket fishers indicated that they experience conflicts during the low flood period in the Delta, while only a very small proportion (<50%) of commercial fishers indicated that they experienced conflict at high flood periods (Figure 4). These two fisher groups from Samochima

Table 6. Summary of perceptions of fishers on different types of detrimental types of fishing/fishing gear based on proportions (%).

Village	Baskets			Drive fishing			Mosquito nets			Hook and line		
	Commercial	Commercial	T/O	Baskets	Commercial	T/O	Baskets	Commercial	T/O	Baskets		
Ngarange	11	22	-	7	11	-	0	22	-	0		
Samochima	26	6	67	20	0	67	7	26	33	0		
Mohembo West	33	22	-	7	33	-	13	22	-	0		

Note: T/O = Tour operators.

**Figure 4.** (a) Time of conflicts experienced by the different fishery groups; (b) Perceptions on the level of conflicts experienced by the different fishery groups.

felt that the conflicts were very serious. Furthermore, a small proportion of Mohembo West basket fishers also indicated that they experience conflicts at low floods as illustrated in **Figure 4**, though they felt that these were not serious. **Table 7** shows that while conflict incidences and flooding are significant at a 90% confidence level ($p = 0.051$), there is nonetheless a strong negative relationship between conflict and flooding in the panhandle.

The majority of fishers in all the villages indicated that summer is the best fishing season while most of them felt that winter is the worst fishing season (**Figure 5**). However, a proportion of commercial fishers from Samochima and Ngarange felt that winter was a good fishing season.

3.4. Conflict Resolution

The majority of all fisher groups in all the study villages indicated that a spatial zoning of fishing grounds is not a feasible management tool because of limited fishing grounds (**Figure 6**). Nonetheless, the majority of fishers (*i.e.* commercial and basket fishers) felt that the Delta's fisheries need to be regulated by both government and traditional authority (**Table 8**).

4. Discussion

4.1. Conflict, Causes

According to this study, commercial and basket fishers from Samochima experience more conflict in the Delta's panhandle, compared to the two other villages. This conflict is caused by the high interaction between the three major fisher groups (small-scale commercial, subsistence and recreational) in their main fishing grounds (*i.e.* lagoons, main channel, etc.). This observation makes sense, taking into account that the major contributing factor to this conflict is lack of access, while gear destruction is experienced by a relatively small proportion of commercial fishers. The fact that most of the conflict occurs during the low flood season suggests that there is increased competition for limited space which subsequently accentuates access (due to competition) as the major cause of conflict at Samochima. Tweddle *et al.* [8] also found that commercial and recreational fishers in the

Table 7. Effect of flooding on conflict incidences and also on fishing season in the three study villages.

Test	Spearman R	T(N-2)	p-level
Flooding vs. conflicts	-0.95	-4.24	0.051
Flooding vs. season	-0.29	-0.95	0.366

Table 8. Summary of fisher perceptions on management of the fisheries from the study villages.

Fisher Group	Should fisheries be regulated?		Who should regulate fisheries?		
	Yes	No	Traditional authority	Government	Both
Basket	50	31	5	20	29
Commercial	77	20	16	24	40

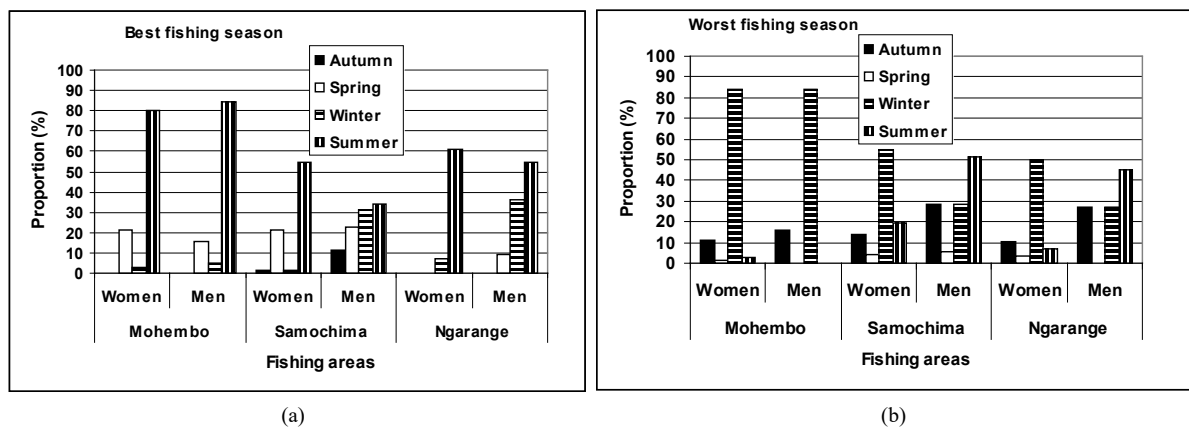


Figure 5. Best and worst fishing seasons experienced by both types of fishers in the study area.

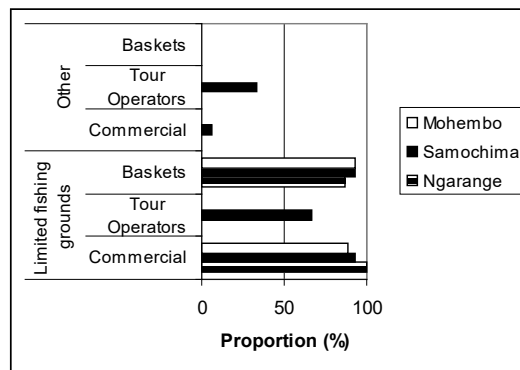


Figure 6. Summary of reasons for not zoning by the different fisher groups.

Delta compete for the same space and resource. Furthermore, Mosepele *et al.* [22] observed that recreational and commercial fishers target the same fish species, the former targeting trophy sized individuals, and the latter target market sized fish. Exploiting the same species also creates conflict among fishers.

Furthermore, several conflict issues highlighted by tour operators in the Delta [8] suggest the existence of a fishing conflict caused by contradictory multi-use of water which has been observed in other fisheries elsewhere [23] [24]. Understandably, Welcomme [25] observed that recreational fishers normally come from “a wealthy professional urbanite” group that does not depend on fish as a source of livelihoods but regard it as a recreational activity. Therefore, it is on the basis of divergent philosophical orientations [26] that the most intense conflict

in fisheries occurs between recreational and commercial fishers [27]. Nybacka [28] also found that there was a seasonal variation in conflict between recreational fishers and the rest of the fishery (in Finland) where conflict normally occurs during the warm summer vacation months. However, conflict between commercial and recreational fishers can also develop due to lack of communication [5], which agrees with findings from this study for the Okavango Delta fishers.

The perception by commercial fishers that the use of fishing baskets is detrimental to fish stocks, especially by the Mohebo commercial fishers, coupled with some low level conflict experienced by Mohebo basket fishers suggests the existence of some conflict between these two groups. It is possible that commercial fishers (gill net fishers) could be concerned about potential recruitment overfishing of their target species because, by their nature, fishing baskets harvest smaller sized species (but not juveniles of commercial species) as observed by Mosepele *et al.* [22]. This type of conflict might be based on what Haraldsdottir [29] describes as gender-based resource tenure issues where women's "*de facto* rights" are trampled by men's "*de jure* rights". Past research in the Delta [22] [30] showed that basket fishers target smaller-sized species in shallow water on the fringes of lagoons and channel habitats. Therefore, while basket fishing is a major source of household nutrition especially during times of food scarcity [30] its value is being compromised through conflict.

Generally, conflict is an intrinsic attribute of multiple-gear fisheries that share the same space and time, or compete for the same species, or both. According to Hilborn [26], conflicts in fisheries can also be caused by the four objectives of fisheries management (social, economic, political, and biological) outlined in Hilborn and Walters [31]. Hilborn [26] argues against one of the basic tenets of classical fisheries management which advocates for fishery exploitation levels to achieve maximum sustainable yields (MSY). He argues that fishing to achieve MSY generally contributes to over-capitalization in some fisheries, which is created by government subsidies as a socio-economic objective (of job creation). Similar observations were made in the Delta with the advent of funding for fishing activities through the Financial Assistance Policy in Botswana. This effectively commercialized the Delta's fishery through the provision of grants to purchase modern fishing equipment [32]. Increased capitalization increased competition and access issues which contributed to conflict, especially at low flood levels when there are limited fishing areas. This argument is based on the observation that Samochima commercial fishers cover large distances in their fishing expeditions [8] ostensibly in search of "better" fishing grounds due to localized *over-fishing*. Inevitably, they encroach on other fishing grounds downstream, which might be frowned upon by resident fishers (despite the prevailing open access regime).

4.2. Conflict Resolution Mechanisms and Management

The current legal framework in the Delta's fishery is based on a classical paradigm [33] that does not however, address conflict resolution in its entirety. Furthermore, fisheries management in Botswana is an institutionalized top-down approach [34] that has not worked effectively in most fisheries elsewhere. While it is possible that the lack of a national fisheries policy [33] might contribute towards the existence of conflict in the fishery, it is equally possible that the lack of well-defined user rights and lack of a holistic management approach that includes most or all of the stakeholders is also a major contributor.

Three main conflict issues have been identified in this study. Firstly, the level/intensity of conflict is flood pulse driven and characterized by seasonality due to the flood regime. Secondly, the observed conflict between commercial (*i.e.* gill net) fishers and basket fishers is possibly caused by misguided concerns based on fishing gear used. Lastly; the recreational fishers' aversion to *drive fishing* is possibly based on concerns of potential over-exploitation due to the high catches normally associated with drive fishing (see [34]). Different approaches can be used to manage these three major conflicts in the fishery. In other conflict-ridden fisheries, conflict is resolved through spatial zoning of fishing grounds as a self-regulatory measure [35]. A similar observation was made by van Ginkel and Steins [24] that fishers sometimes use self-regulation (based on *informal regulations*) for spatial zoning as a conflict resolution mechanism.

4.3. Spatio-Temporal Zoning

For the Delta, a spatio-temporal zoning pattern is proposed as a conflict resolution mechanism, taking into consideration the additional factor of the flood pulse. Recreational fishers can use the main channel and the large lagoons immediately adjacent to the main channel for their fishing activities at low floods, while commercial fishers can fish in the large floodplain lagoons and side channels during this period.

This proposed approach can be based upon a co-management paradigm as the main conflict resolution tool for the Delta's fishery. This approach is based upon the FAO Code of Conduct for Responsible Fisheries [36] that advocates the inclusion of local communities in management of their fisheries resources. Subsequently, co-management is used extensively to achieve a more holistic approach to fisheries issues [37] even though Caddy [38] acknowledges that setting up a "decision-making process" is the most difficult (and yet important) aspect of the fisheries management process. Sipponen and Greboval [5] highlight that a forum based on a co-management paradigm can be created for commercial and recreational fishers to communicate as a conflict resolution mechanism. One such involving and highly democratic approach was adopted in Samoa by King and Faasili [39] which culminated in a village fisheries management plan which was developed by most community groups, including women. Therefore, co-management has indeed "become the buzzword of contemporary fisheries management" [40] and has subsequently been adopted/proposed as a major strategy towards a holistic management paradigm in fisheries around the world (e.g. [5]).

Jul-Larsen *et al.* [41] argue that co-management is one of the best tools for conflict resolution in African freshwater fisheries. Moreover, van Ginkel and Steins [24] highlight that compliance for regulations to solve multiple-use conflicts can be sought and negotiated at the local level before these can be eventually codified into law, which agrees with Overby [35] about the eventual integration of zoning (based on self-regulation) into federal law in the Gulf of Mexico. A more fundamental step towards co-management is to recognise the interests of groups that have been historically disadvantaged, such as women fisher groups [29]. Indeed women basket fishers in the Delta are not organized in any formal grouping and are therefore not part of any management process [42]. While subsistence fishing is a major source of livelihoods in the Delta's communities [43], especially basket fishers to whom fishing is also a form of cultural expression [30], their concerns need to be integrated into the proposed co-management paradigm.

4.4. Holistic Management

According to Siar *et al.* [44], educational attainment is positively related to the attainment of fishing communities towards territorial user rights in fisheries management. Therefore, this suggests that intense education campaigns are critical towards a successful implementation of a co-management fisheries regime and should therefore be done in the Delta to increase the probability of success of this initiative. Mosepele [11] observed that conflict in the fishery was also caused by lack of a common understanding and appreciation of the value of the fishery to each stakeholder in the fishery. This conclusion was based on Mosepele's [6] observation that access and property rights were the major precursors of conflict in the fishery and not fish stock over-exploitation. Therefore, Mosepele *et al.* [45] through the BOKAVANGO project [46] created a committee whose mandate was to implement an adaptive co-management regime in the fishery. The basic philosophy behind this adaptive management regime was to create a feed-back system whereby the committee would get feedback on its management interventions through a dynamic process.

The Okavango Fisheries Management Committee (OFMC), formed in the Delta's panhandle during the BOKAVANGO project [45], is similar to Boisneau and Mennesson-Boisneau's [4] intervention, which advocates for a participatory fisheries management regime that includes all the major stakeholders. This Committee essentially creates a forum that enhances communication between tour operators (recreational/sport fishers), local fishers (commercial and subsistence) and the regulatory authorities (key government departments) in the Delta's panhandle. This management intervention is also aligned to Sipponen and Greboval's [5] analysis that lack of communication is usually the root cause of conflict in fisheries. The OFMC then developed a Code of Conduct as a conflict resolution tool through a democratic process (the process leading to the development of the OFMC is described fully in Mosepele *et al.* [45]). It is hoped that this participatory approach to fisheries management will contribute towards a sustainable utilization of the resource that will benefit all the stakeholders. According to Soma [47], sustainable development of natural resources can be achieved through the inclusion of all stakeholders through a participatory approach. It is envisaged that the OFMC is the vehicle for that participatory approach in the Delta's fishery.

5. Conclusions

This study has shown that conflict is still a major management challenge in the Okavango Delta fishery. It is evident, however, that most of the conflict emanates from lack of understanding between the two major compet-

itors (*i.e.* local fishers vs. tour operators). This observation is premised on the fact that there is little/if any dialogue between the different user groups in the Delta's fishery. Therefore, one major recommendation from this study is to, within the co-management framework and using the FAO Code of Conduct for Responsible Fisheries [36] approach, mainstream the OFMC into fisheries legislation to promote dialogue between the stakeholders. This committee (*i.e.* the OFMC) will, with advice from technical experts (*i.e.* fisheries biologists, etc.), develop an adaptive management plan to address the conflict issues and any other fisheries management related issues.

Stakeholders can agree on spatial zoning based on a temporal scale to ensure that there is minimal competition/contact among them during the low flood level period. The main river channel and large lagoons which are connected directly to the main channel can be zoned for recreational fishers because that is where their preferred species (e.g. *Hydrocynus vittatus*, *Serranochromis robustus* etc.) are found. Similarly, floodplain lagoons and side channels can be zoned for commercial fishing, because that is where their preferred species (e.g. *Oreochromis andersonii*, *O. macrochir*, etc.) are found, while basket fishers can then fish on the fringes of all of these habitats (*i.e.* main channel, lagoons, etc.) for their preferred species (e.g. cyprinids, mormyrids, etc.). There should also be proper and consistent dissemination of scientific research results to stakeholders. This information can include issues like, fish breeding, distribution and abundance, the effect of flood regimes (high or low) and drought on fish productivity and availability. There is need to sensitize user groups on the importance of the fishery to other stakeholders. Furthermore commercial and basket fishers need to understand the importance of recreational fishing to tour operators and, tour operators need to understand the contribution of the fishery to commercial and basket fishers' livelihoods. Hopefully, this temporal zoning, while it might not necessarily remove all conflicts, will nonetheless reduce tension among the different fisher groups with a consequent reduction in conflict in the fishery.

It is also envisaged that the OFMC can provide a forum which encourages dialogue among stakeholders and hence inculcate mutual respect and understanding among the fishers. One of the key observations made during the process of the formation of the OFMC and the development of the Code of Conduct was that stakeholders began to show a bit more restraint and respect towards each other. This was most obvious between the local small-scale commercial fishers and tour operators who had hitherto been sworn enemies [48]. Moreover, some of the key concerns highlighted during various meetings of the OFMC were that stakeholders felt they were not part of the management process [45]. Therefore, making stakeholders' part of the management process is a critical step towards conflict resolution and hence achieving sustainable development of the Delta's fish resources.

This study has shown that fishing is a major livelihood activity for fishing households. This agrees with the fact that previous research in the Delta is a key source of food (Mosepele *et al.*, 2006) and nutrition (Nnyepi *et al.*, 2007) security for riparian communities. We argue that optimal utilization of this resource can only be achieved through comprehensive conflict resolution and management in the fishery. If managed well, fish resources can assist developing countries to achieve some of their Millennium Development Goals (MDG's).

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References

- [1] Wilson, D. and Jentoft, S. (1999) Structure, Agency and Embeddedness: Sociological Approaches to Fisheries Management Institutions. In: Symes, D., Ed., *Alternative Management Systems for Fisheries*, Blackwell Science, Oxford.
- [2] Arnason, R. (2007) Fisheries Management and Operations Research. *European Journal of Operational Research*, **193**, 741-751. <http://dx.doi.org/10.1016/j.ejor.2007.07.028>
- [3] Viswanathan, K.K. and Ahmed, M. (2002) Communities and Institutions for Common Property. *Fisheries Co-Management News*, No. 1, 8 p.
- [4] Boisneau, P. and Mennesson-Bosneau, C. (2001) Inland commercial fisheries management in France. *Fisheries Management and Ecology*, **8**, 303-310. <http://dx.doi.org/10.1046/j.1365-2400.2001.00255.x>
- [5] Sipponen, M. and Greboval, D. (2001) Social, Economic and Cultural Perspectives of European Inland Fisheries: Review of the EIFAC Symposium on Fisheries and Society. *Fisheries Management and Ecology*, **8**, 283-293. <http://dx.doi.org/10.1046/j.1365-2400.2001.00280.x>

- [6] Mosepele, K. and Kolding, J. (2003) Fish Stock Assessment in the Okavango Delta, Botswana—Preliminary Results from a Length Based Analysis. In: Bernard, T., Mosepele, K. and Ramberg, L., Eds., *Environmental Monitoring of Tropical and Subtropical Wetlands*, University of Botswana, Maun and University of Florida, Gainesville, 363-390.
- [7] Mosepele, K. (2000) Preliminary Length Based Stock Assessment of the Main Exploited Stocks of the Okavango Delta fishery. Mphil Thesis, University of Bergen, Bergen.
- [8] Tweddle, D., Bills, R., van der Waal, B., Skelton, P., Kolding, J. and Nengu, S. (2003) Fish Diversity and Fisheries in the Okavango Delta, Botswana. In: Alonso, L.E. and Nordin, L., Eds., *A Rapid Biological Assessment of the Aquatic Systems of the Okavango Delta*, High Water Survey, Botswana, RAP Bulletin of Biological Assessment, 97-110.
- [9] Merron, G.S. (1991) The Ecology and Management of the Fishes of the Okavango Delta, Botswana, with Particular Reference to the Role of the Seasonal Floods. PhD Thesis, Rhodes University, Grahamstown.
- [10] Mosepele, K. and Mosepele, B. (2005) Spatial and Temporal Variability in Fishery and Fish Community Structure in the Okavango Delta, Botswana: Implications towards Fisheries Management. *Botswana Notes and Records*, **37**, 280-291.
- [11] Mosepele, K. (2001) Preliminary Description of the Okavango Delta Fishery. Fisheries Section, Ministry of Agriculture, Botswana.
- [12] Gieske, A. (1996) Modelling Surface Outflow from the Okavango. *Botswana Notes and Records*, **28**, 165-192.
- [13] McCarthy, T.S. (1992) Physical and Biological Processes Controlling the Okavango Delta—A Review of Recent Research. *Botswana Notes and Records*, **24**, 57-86.
- [14] Kolding, J. (1996) Feasibility Study and Appraisal of Fish Stocks Management Plan in Okavango. University of Bergen, Bergen.
- [15] Mbaiwa, J.E. (2002) The Socio-Economic and Environmental Impacts of Tourism Development in the Okavango Delta, Botswana. A Base Line Study. Harry Oppenheimer Okavango Research Centre, University of Botswana, Maun.
- [16] Mendelsohn, J.M., vanderPost, C., Ramberg, L., Murray-Hudson, M., Wolski, P. and Mosepele, K. (2010) Okavango Delta: Floods of Life. RAISON, Windhoek.
- [17] Gondwe, M.J. and Masamba, W.R.L. (2014) Spatial and Temporal Dynamics of Diffusive Methane Emissions in the Okavango Delta, Northern Botswana, Africa. *Wetlands Ecology and Management*, <http://dx.doi.org/10.1007/s11273-013-9323-5>
- [18] Central Statistics Office (2002) Population of Towns, Villages and Associated Localities. Government Printer, Gaborone.
- [19] Botswana Government (2008) Fish Protection Regulations. Government Printing and Publishing Services Gaborone, Botswana.
- [20] Bokhutlo, T., Kootsositse, M.V. and Mosepele, K. (2007) Okavango Delta Fishery Frame Survey. Department of Wildlife and National Parks, Gaborone.
- [21] Statsoft (1999) STATISTICA. Statsoft Inc., USA. www.statsoft.com
- [22] Mosepele, K., Mmopelwa, T.G. and Mosepele, B. (2003) Characterization and Monitoring of the Okavango Delta Artisanal Fishery. In: Bernard, T., Mosepele, K. and Ramberg, L., Eds., *Environmental Monitoring of Tropical and Subtropical Wetlands*, University of Botswana, Maun and University of Florida, Gainesville, 391-413.
- [23] Van Ginkel, R. (2001) The Netherlands. In: Symes, D. and Phillipson, J., Eds., *Inshore Fisheries Management*, Kluwer Academic Publishers, Dordrecht, 79-96. http://dx.doi.org/10.1007/978-94-017-1892-9_5
- [24] Van Ginkel, R. and Steins, N. (2001) Multi-Use Conflicts in Inshore Waters. In: Symes, D. and Phillipson, J., Eds., *Inshore Fisheries Management*, Kluwer Academic Publishers, Dordrecht, 257-273. http://dx.doi.org/10.1007/978-94-017-1892-9_15
- [25] Welcomme, R.L. (2001) Inland Fisheries: Ecology and Management. Blackwell Science, Oxford. <http://dx.doi.org/10.1002/9780470995693>
- [26] Hilborn, R. (2007) Defining Success in Fisheries and Conflicts in Objectives. *Marine Policy*, **31**, 153-158. <http://dx.doi.org/10.1016/j.marpol.2006.05.014>
- [27] Koenig, E.C. (2005) Cultures and Ecologies: A Native Fishing Conflict on the Saugeen-Bruce Peninsula. University of Toronto Press, Toronto.
- [28] Nybacka, K. (2001) Finland. In: Symes, D. and Phillipson, J., Eds., *Inshore Fisheries Management*, Kluwer Academic Publishers, Dordrecht, 27-42. http://dx.doi.org/10.1007/978-94-017-1892-9_2
- [29] Haraldsdottir, G. (2000) Tradition, Co-Management, Diversity, in Small-Scale Inland Fisheries in Africa. In: Durrenberger, E.P. and King, T.D., Eds., *State and Community in Fisheries Management; Power, Policy and Practice*, Bergin and Garvey, Westport, 131-148.
- [30] Mmopelwa, G., Mosepele, K., Mosepele, B., Moleele, N. and Ngwenya, B. (2009) Environmental Variability and the

- Fishery Dynamics of the Okavango Delta, Botswana: The Case of Subsistence Fishing. *African Journal of Ecology*, **47**, 119-127. <http://dx.doi.org/10.1111/j.1365-2028.2008.01058.x>
- [31] Hilborn, R. and Walters, C.J. (1992) Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty. Chapman and Hall, Boston. <http://dx.doi.org/10.1007/978-1-4615-3598-0>
- [32] Nengu, S.M. (1995) Status of Fisheries in Wetlands. In: Masundire, H.H., Eyeson, K.N. and Mphuchane, S.F., Eds., *Wetlands Management in Botswana*, Wetlands Coordinating Committee, Botswana.
- [33] Mosepele, K. (2008) Flood Pulse in a Subtropical Floodplain Fishery and the Consequences for Steady State Management. *Proceedings of the 2nd IASTED African Conference on Water Resource Management: Science and Technology Innovation for Sustainable Development*, Botswana, 8-10 September 2008, 56-62.
- [34] Kolding, J., Ticheler, H.J. and Chanda, B. (1996) Assessment of the Bangweulu Swamps Fisheries. WWF Bangweulu Wetlands Project, Final Report.
- [35] Overby, M.M. (2000) Resolving the Stone Crab-Shrimp Fisheries Conflict: A Case of Implicit Co-Management. In: Durrenberger, E.P. and King, T.D., Eds., *State and Community in Fisheries Management: Power, Policy and Practice*, Bergin and Garvey, Westport, 169-186.
- [36] FAO (1995) Code of Conduct for Responsible Fisheries. FAO, Rome.
- [37] Jul-Larsen, E. and van Zwieten, P. (2002) African Freshwater Fisheries: What Needs to Be Managed? *Naga*, **25**, 35-40.
- [38] Caddy, J.F. (2002) Limit Reference Points, Traffic Lights, and Holistic Approaches to Fisheries Management with Minimal Stock Assessment Input. *Fisheries Research*, **56**, 133-137. [http://dx.doi.org/10.1016/S0165-7836\(01\)00343-5](http://dx.doi.org/10.1016/S0165-7836(01)00343-5)
- [39] King, M. and Faasili, U. (1999) Community-Based Management of Subsistence Fisheries in Samoa. *Fisheries Management and Ecology*, **6**, 133-144. <http://dx.doi.org/10.1046/j.1365-2400.1999.00136.x>
- [40] Schreiber, D.K. (2001) Co-Management without Involvement: The Plight of Fishing Communities. *Fish and Fisheries*, **2**, 376-384. <http://dx.doi.org/10.1046/j.1467-2960.2001.00057.x>
- [41] Jul-Larsen, E., Kolding, J., Overa, R., Nielsen, J.R. and van Zwieten, P.A.M. (2003) Management, Co-Management or No Management? Major Dilemmas in Southern African Freshwater Fisheries. Part 1: Synthesis Report. FAO Fisheries Technical Paper 426/1, Rome.
- [42] Ngwenya, B.N., Mosepele, K. and Magole, L. (2012) A Case for Gender Equity in Governance of the Okavango Delta Fisheries in Botswana. *Natural Resources Forum*, **36**, 109-122. <http://dx.doi.org/10.1111/j.1477-8947.2012.001450.x>
- [43] Mosepele, K., Ngwenya, B.N. and Bernard, T. (2006) Artisanal Fishing and Food Security in the Okavango Delta, Botswana. In: Ahmed, A., Ed., *World Sustainable Development Outlook: Global and Local Resources in Achieving Sustainable Development*, Inderscience, Geneva, 159-168.
- [44] Siar, S.V., Agbayani, R.F. and Valera, J.B. (1992) Acceptability of Territorial Use Rights in Fisheries: Towards Community-Based Management of Small-Scale Fisheries in the Philippines. *Fisheries Research*, **14**, 295-304. [http://dx.doi.org/10.1016/0165-7836\(92\)90038-U](http://dx.doi.org/10.1016/0165-7836(92)90038-U)
- [45] Mosepele, B., Mosepele, K., Mogotsi, S. and Thamage, D. (2014) Fisheries Co-Management in the Okavango Delta's Panhandle: The Okavango Fisheries Management Committee (OFMC) Case Study. In: Sowman, M. and Wynberg, R., Eds., *Governance for Justice and Environmental Sustainability: Lessons across Natural Resource Sectors in Sub-Saharan Africa*, Routledge Publishers, London, 180-199.
- [46] GEF (2006) Building Local Capacity for Conservation and Sustainable Use of Biodiversity in the Okavango Delta. Global Environment Facility, Washington DC.
- [47] Soma, K. (2003) How to Involve Stakeholders in Fisheries Management—A Country Case Study in Trinidad and Tobago. *Marine Policy*, **27**, 47-58. [http://dx.doi.org/10.1016/S0308-597X\(02\)00050-7](http://dx.doi.org/10.1016/S0308-597X(02)00050-7)
- [48] Ramberg, L. and van der Waal, B., Eds. (1997) Fisheries Management in the Okavango Delta. Report of a Workshop Organised by Fisheries Section, Ministry of Agriculture, Botswana.