Article

A Bottom-Up Understanding of Illegal, Unreported, and Unregulated Fishing in Lake Victoria

Joseph Luomba [1,*], Ratana Chuenpagdee [1] and Andrew M. Song [2,3]

[1] Department of Geography, Memorial University of Newfoundland, St. John's, NL A1B 3X9, Canada; ratanac@mun.ca

[2] ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, QLD 4811, Australia; andrew.song@jcu.edu.au

[3] WorldFish, c/o ARC Centre of Excellence for Coral Reef Studies, Townsville, QLD 4811, Australia

[*] Correspondence: jol373@mun.ca; Tel.: +255-767-206730

Abstract: Illegal, unreported, and unregulated (IUU) fishing is a major concern in fisheries management around the world. Several measures have been taken to address the problem. In Lake Victoria, the alleviation of IUU fishing is implemented through the Regional Plan of Action (RPOA-IUU), which restricts use of certain fishing gear, as well as prohibits fishing in closed areas and during closed seasons. Despite the long-term efforts to monitor and control what goes on in the fisheries, IUU fishing has persisted in Lake Victoria. Inspired by interactive governance theory, this paper argues that the persistence of IUU fishing could be due to different images that stakeholders have about the situation, rather than the lack of management competency. Through structured interviews with 150 fisheries stakeholders on Ijinga Island in the southeastern part of Lake Victoria, Tanzania, using paired comparison questionnaires, the study elicits stakeholders' perspective about the severity of different locally-pertinent fishing-related activities. The results show that while fisheries stakeholder groups agree on their judgments about certain fishing gears, some differences are also apparent. For instance, fisheries managers and scientists do not always agree with fishing people about what activities cause the most damage to fisheries resources and ecosystem. Further, they tend to consider some IUU fishing-related activities less damaging than some non-IUU fishing. Such disparity creates governability challenges, pointing to the need to revisit relevant regulatory measures and to make them consistent with the knowledge and judgments of all stakeholders. Based on these findings, we discuss governing interventions that may contribute to addressing IUU fishing in Lake Victoria and elsewhere.

Keywords: Lake Victoria; IUU fishing; interactive governance; governability; RPOA; image

1. Introduction

Illegal, unreported, and unregulated (IUU) fishing is not only an issue on the high seas but is also a matter of great concern to inshore and coastal areas, where small-scale fisheries operate. Given the importance of the fisheries sector to nutrition, food security, livelihoods, and poverty alleviation—especially in developing countries [1–3], it is imperative that IUU fishing is addressed as it could lead to resource degradation and fisheries unsustainability. As a response to IUU problems, the Fisheries and Agriculture Organization of the United Nations (FAO) drafted an International Plan of Action, with a set of principles guiding member states in their national-level effort to prevent, deter, and eliminate IUU fishing (IPOA-IUU) [4]. Despite the implementation of these measures since 2001, IUU fishing has persisted in several waters. In developing countries, the situation is made worse with the unabated continuation of overfishing and habitat destruction, notwithstanding

numerous scientific warnings [5,6]. A critical view has emerged, however, about the applicability of the IPOA-IUU in small-scale fisheries, given their diversity, complexity, and dynamics [7,8]. IUU fishing falls into the category of the 'wicked problems' in fisheries [9], meaning that it is difficult to understand where and why the problem begins, and how to address it. Therefore, wicked problems cannot be addressed solely using technical measures. Knowledge of how the various aspects of the fishery system relate and interact with each other is critical to understanding and addressing these problems [10–13]. In addition, governing institutions need to be structured in a way that corresponds with the problem that they are intended to address [14–16]. In other words, measures employed to combat IUU fishing need to match with the way the problems are perceived by various stakeholders, at the same time reflecting the diversity, complexity, and dynamics inherent in the social system, as well as in the natural environment [9,17,18].

In the context of IUU fishing, mismatches may occur when fishers do not realize how ecologically damaging their fishing activities are or they do not understand the rationale behind fishing regulations, such as conservation and sustainability. More fundamentally, they may not hold the same images (i.e., perceptions, judgments, and worldviews) regarding management objectives and the problematization of IUU fishing issues by managers or scientists in the first place [19]. Several examples attest to this, Onyango and Jentoft [20] observe that 'fishers in Lake Victoria regard provision of food as God-given entitlement'. For this reason, there should be no control on what is caught and how it is caught. In addition, Jentoft et al. [21] and Voyer et al. [22], in their studies on the establishment of marine protected areas (MPAs) submit that stakeholders do not share the same ideas about what the MPAs are and what they may accomplish. For instance, in some areas local fishers viewed the establishment of MPAs as an attempt to limit their fishing grounds while, in others, fishers felt that they were not adequately informed prior to the MPA establishments. In such cases, compliance to certain management measures, including IUU-alleviating measures, would be a hard sell, rendering any state or regional effort ineffective.

In this study, we explore the level of agreement or dissimilarity in people's judgment about IUU fishing (e.g., between fishers and government officials), and discuss our findings in the context of IUU fishing in Lake Victoria and policy implications more broadly. Specifically, we ask what these stakeholders think about the impact or severity that various fishing activities have on fisheries resources and the lake ecosystem. The study was conducted on a small island on the Tanzanian side of Lake Victoria, where, similar to the rest of the Lake, IUU fishing is known to exist [23,24]. This paper commences by describing global difficulties in tackling IUU fishing and discussing how, according to the interactive governance theory, IUU fishing is considered a governance problem and not merely a technical one. This is followed by a description of the study area, methods used in data collection, and data analysis. Next, the paper presents how different stakeholder groups judge the severity of fishing-related activities, as well as their perception about the causes of IUU fishing, and about suggested actions to tackling the problem. This is followed by a discussion on how these judgments and perceptions may affect efforts to eliminate IUU fishing in Lake Victoria. Finally, the paper concludes by highlighting governance issues that need to be addressed in order to effectively tackle IUU fishing in Lake Victoria and elsewhere.

2. The Interactive Governance Perspective in Addressing IUU Problems

Combating IUU fishing has long been studied and empirical evidence shows that tackling the problem is proving to be a difficult task to international and national organizations [6,7,25,26]. By far, economic profits from illegal operations have been attributed as constituting primary incentives to pursue such activities [27,28]. In other words, IUU fishing is a high-return activity that the offenders will continue to fish illegally as long as they gain profit. Some have also argued that weak governance, poor monitoring and enforcement, overcapacity, overfishing, and corruption can lead to unsustainable fishing behaviors [29–32]. Generally, these observations still regard IUU fishing as a legally- and instrumentally-oriented management problem, which can be tackled through a more robust set of

sanctions and enforcement of fisheries regulatory measures. However, in recent years, over-reliance on a deterrence-based model to address IUU fishing has been questioned. In his analysis, Nielsen [8] reasons that compliance to regulations depends on the legitimacy of the regulatory system in relation to the context and procedure, and the role fisheries management institutions play in the coordination and allocation of resources. Additionally, Hauck [33] relates non-compliance to the processes of law formation and power dynamics embedded in such processes. Moreover, Eggert and Lokina [34], in their study of regulatory compliance in Lake Victoria, reason that compliance is influenced by people's moral obligation to comply, as well as by legitimacy of the regulations, in addition to the probability of detection and punishments. This explanation asserts that IUU fishing is not only an economic and a management issue, but a more complex one that closely links to the social and political aspects, i.e., legitimacy of the laws and norms upholding them. In light of these observations, this study finds inspiration from the interactive governance theory, which posits that fisheries governance is essentially about an interplay between the governing system and the system-to-be-governed [9,10]. The governing system is a constructed politico-administrative system, consisting of institutions, management mechanisms and instruments that guide planning and management processes. The system-to-be-governed is both natural and social. The natural part includes the ecological system and the resources it contains, while the social part consists of resource users and stakeholders who form political coalitions and user associations [10,11]. The relationship, and the interaction, between these two systems defines what governance is and how it functions. According to the interactive governance theory, these systems are diverse, complex, dynamic, and operate at various scales [10,11]. Understanding and addressing a problem, then, requires a systematic and comprehensive examination of the whole fishery system, taking into account the socio-economic and political aspects, as well as the interplay between them [9,10].

The interactive governance theory recognizes that "images" held by stakeholders have a significant influence on the outcome of governance measures [15,22]. Images are a representation of ideas about 'what is and what should be' [15] (p. 1316). It is an extensive term that can encompass other similar ideas, such as mental models, worldview, and beliefs. In this paper, we adopt 'image' as a judgment or perception of stakeholders about what constitutes IUU fishing and the actions required to address it. As such, differences in images between the stakeholders are likely to make a problem persist and also contribute to lower governability [15]. Conversely, this should not be translated that stakeholders in the governing process should have only one image to rely on. As Jentoft et al. [21] argue, stakeholders should be made aware of the present images, their origins, variations, or concurrences, and the prospects they hold. Similarly, Kooiman et al. [10] state that the images generated should be open and flexible to cope with the diversity, complexity, and dynamics of the objects that need governing. These imply that the governing image should be shared between stakeholders through a communicative and interactive process in order to be understood and acceptable to various stakeholders.

In Lake Victoria, as with many other water bodies, the concepts of conservation and sustainability are promoted in fisheries. As such, various regulatory and technical measures have been adopted to address issues undermining sustainable fisheries, such as IUU fishing [35]. For example, there are regulations that prohibit the use of gillnets with mesh sizes smaller than six inches, uses of beach seine and monofilament nets, and fishing in breeding areas or during closed seasons. However, with the persistence of the IUU fishing, it is plausible to posit that the crux of the problem lies in the unexplored (and unresolved) differences in the images of various fisheries stakeholders on the causes of the IUU fishing and the possible actions taken to address it. For example, the belief among managers, governments, and development agencies that the key to tackling IUU fishing is to induce strict restrictions on fishing gears and methods [23,24] may not be shared by fishers and other resource users. In such instances, governance initiatives overlooking this disparity may face on-the-ground resistance, rendering the system less governable. Moreover, fishers' responses to the changes in the natural system, such as vertically joining of fishing nets in reaction to depleting stocks may be inconsistent with the images of the managers, thus adding challenges to governance of the lake. Hence, Chuenpagdee and Jentoft [36] reasons that actions or instruments used to address the governing problems need to be based upon images that are considered accurate and legitimate by citizens and

governors. This study focuses on this image aspect, which underpins the way participants in a fisheries system perceive, define, and judge fishing activities. We hypothesize that the persistent IUU fishing in Lake Victoria is due, in significant part, to the unrecognized and under-appreciated existence of disparate images of fishing practices among major fisheries stakeholder groups in the lake.

3. Materials and Methods

3.1. Description of Study Area

Lake Victoria, a trans-boundary water body shared by Kenya, Tanzania, and Uganda, is the largest freshwater lake in Africa (covering an area of about 68,800 km^2) and second only to Lake Superior in the world by surface area. The lake and its fisheries support millions of inhabitants in the region, providing food, income, employment, and foreign exchange earnings. The study focuses on Ijinga Island in Lake Victoria, located in Kahangara ward (an administrative unit comprising several villages in Tanzania, while a village is the lowest administrative unit at the community level) in the Magu district of the Mwanza region, Tanzania. The island is approximately 10 km from Magu town, the district headquarters, along the Mwanza-Musoma highway. The island has five sub-villages which are also the landing sites, namely, Ilago, Igadi, Kashishi, Gambaji, and Mwamalangare, as shown in Figure 1. Maneto, a landing site in another village external to the island, is included in the study because it has high interactions with the island communities by virtue of being located near the foot of the island and serving as an 'entrance' to the island. Ijinga means an island in the native Sukuma language. The other ethnic groups found in the island 'Luo', 'Jita', and 'Kerewe' are immigrants. These sub-villages are named after the first persons who settled in the areas. According to the 2012 population and housing survey conducted by the Tanzanian government, the island has a total of 378 households, with a population of 2516 people, comprising 1245 males and 1271 females. The majority of the households (80%) are engaged in fishing as the main occupation, with farming, livestock rearing, and small business providing additional income. The main crops grown include maize, cassava, and potatoes, while animals reared are cattle, sheep, and goats.

The dominant fish species caught are Nile perch, *Lates niloticus*, and Dagaa, *Rastroenobola argentae*. Other species such as Catfish, *Clarias gariepinus* and *Bagrus docmak*, Nile tilapia, *Oreochromis niloticus*, and Haplochromines constitute small quantities of landed fish. Fishing is mainly carried out in small canoes (three and 10 meters long), and rafts (averaging three meters in length). The main fishing gears are gillnets, hooks, dagaa seine, and beach seine. Fishing is dominated by men, while women participate in post-harvest activities.
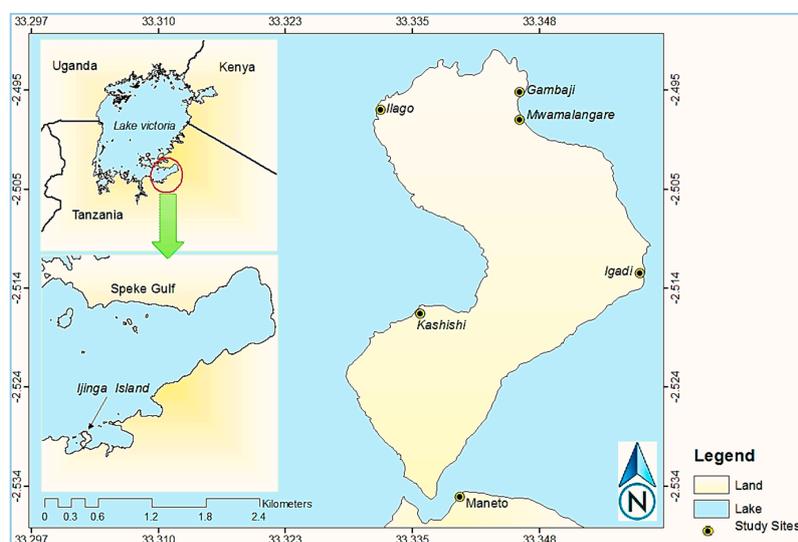

Figure 1. Map of Ijinga Island showing surveyed landing sites.

3.2. Research Methodology

The study employed mixed methods comprising a literature review, direct observation and in-person questionnaire survey. The review of literature involved both published journal articles and unpublished government reports and materials, and guided the study design, development of the questionnaire and analysis. A preliminary visit to the study site was made in July 2015, during which informal discussions with the target population occurred to help build rapport with the potential study respondents, and to pre-test the questionnaire for wording clarity and comprehension. The main data collection commenced in August through October 2015.

A questionnaire survey was the main study tool employed in this study, which is considered an appropriate method for conducting structured interviews in which a similar set of questions are asked to respondents and a limited set of responses are expected in return. The questionnaire contained three parts. The first part asked for demographic and fishery background information, such as gender, number of years in a fishery-related occupation, contribution of fisheries to household income, type of fishing gear owned, and size of the gear. The second part of the questionnaire involved a use of a paired-comparison method to gauge the relative judgment of respondents on the impact of various fishing activities on the lake fisheries. Eight fishing activities were included for the paired comparisons, resulting in a total of 28 pairs for each respondent to consider. The respondents were asked, for each pair, which activity they considered to be more damaging. Of the eight activities, four are formally considered as IUU fishing according to regional and national regulations. The other four are not IUU but could potentially have adverse effects on the resources and ecosystems according to scientific and managerial community and previous studies. These activities, listed in Table 1, were developed based on a review of fisheries laws governing Lake Victoria and discussions with fishery experts and key informants to adequately capture the official concerns in the region. Pair comparison is a simple and cognitively less-demanding method to elicit subjective judgments between multiple variables [37]. It is particularly useful when the subjects in the study are sensitive to literacy needs and when relative judgments or order of preferences are sufficient to provide insightful information [38,39]. The method has been successfully applied to study fisheries and coastal issues in several locations and contexts, including Malawi, Mexico, and Thailand [19,38]. An example of a paired comparison used in the study is displayed in Figure 2. The final section of the questionnaire asked respondents their opinions about actions that can improve fishery management and help achieve conservation and sustainability. This research was approved by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) of the host university (Memorial University, St. John's, NL, Canada). The key ethical consideration was the confidentiality and anonymity of the respondents. Names of the respondents were not recorded and subjects' consent was obtained before they completed the questionnaires. Subjects were also informed about the purpose of the study, the procedures that would be used to collect the data, and assured that there were no potential risks or costs involved. Generally, most of the respondents approached were willing to participate in the study. However, three members of the fishers group and seven local residents declined to participate in the study. After the data collection, all questionnaires were assigned unique ID numbers, which were then used when entering and analyzing data.

In this study, it was important that images of the main stakeholders in the fishery are sought. Thus, the survey respondents comprised three main groups; (1) fishers group, including people involved in harvest and post-harvest fishing activities; (2) fisheries managers/scientists; and (3) local residents (not involved in fishing). This categorization was made to obtain the judgment of the key groups involved in the fish chain. The respondents in the fishers group were selected based on their occupation in the fishery, i.e., boat owners, fishing crews, and fish traders/processors. A boat owner is a 'fisher' who owns fishing equipment. Although a boat owner rarely goes out fishing, he/she is always present at the landing site when the boat arrives from the fishing grounds. Fishing crews are those employed to work in fishing boats, while fish processors and traders buy fish from fishing boats and sell them to consumers. The fishing crews determine where to fish. Local residents were included in the survey because they represent consumers and, as such, may influence what happens in the fishing chain.

Purposive sampling was used to target the three groups with a minimum number of 30 respondents in each group. The sample size of 30 for each group follows the protocol of previous studies of similar nature, which have reported that interviewing 25 to 30 respondents per group based on a quota-based and purposively drawn sampling strategy provides an adequate sample size for establishing in-group consistency and, therefore, conducting statistical comparisons between the groups [37,38,40,41]

Solicitation of survey participants for the fishers group followed a common practice in Lake Victoria where potential respondents are approached before the boat has arrived at the landing site. The local residents were approached at their homes. Conducted during daytime at the landing sites and in homes, the questionnaires for the fishers group and local residents were completed in-person with the first author asking the questions and recording the data in Kiswahili, which is his native tongue. In the case of managers/scientists the questionnaire was completed through self-administration. On average, each survey took about 35–50 min to complete. A total of 150 questionnaires were completed, 90 of which were from fishers group (boat owners, fishing crew, processors and traders) and the other two groups completed 30 each (see Table 2).

Table 1. List of fishing activities.

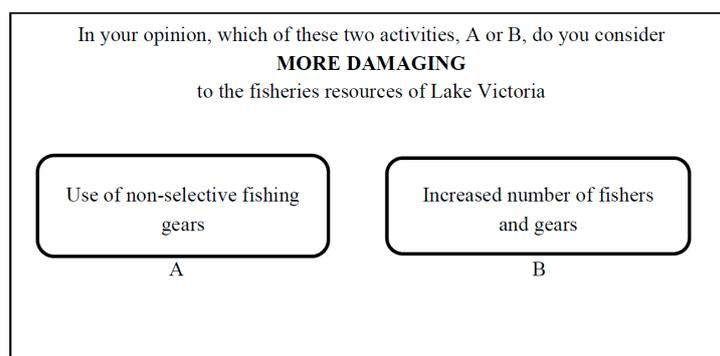| IUU Fishing	Non-IUU Fishing
Using non-selective fishing gears	Fishing around breeding areas
Fishing in breeding areas	Fishing for longer hours
Fishing without license	Many fishers targeting single fish species
Landing fish in non-gazetted site	Increased number of fishers and gears

Figure 2. An example of paired fishing activities.

3.3. Data Analysis

Descriptive analyses including percentage and frequency distributions of the demographic information, including fishers' gender, years in fishery, contribution of fisheries to household income, and fishing gears owned by the boat owner, were calculated. A series of pre-determined steps using Microsoft Excel were taken to analyze the paired comparison responses [19]. First, the number of times an activity was chosen by respondents over the others was tallied to obtain aggregated scores for each activity according to each respondent group. Next, the scores were normalized to a scale of 0–100, before assigning an ordinal ranking of 1 (most damaging) to the activity with the highest score and 8 (least damaging) to the one with the lowest score. Once this was done, Kendall Tau rank correlation analysis was conducted to measure the degree of correspondence between respondent groups, as well as between gender. All statistical tests were considered at the significance levels higher than 0.05. Kendall tau is an appropriate nonparametric method for ordinal rank data [42]. It is also suitable for smaller sample sizes and statistical hypothesis testing that establishes an association between respondent groups and measured variables [43,44]. We also performed the chi-square test to check whether the responses were significant different according to the following variables: demographic

(e.g., the respondent's gender, occupation, and time spent in fisheries), reasons for using destructive fishing gears, and actions required to improve the fisheries. The significant level of all statistical tests was either at 0.05 or 0.001.

4. Results

4.1. Demographic Characteristics

As shown in Table 2, the majority of the fishers surveyed were men, while the processors and traders were women, reflecting the demography of the fishing population in Lake Victoria [45]. Table 2 also shows an interesting pattern in fisheries experience, with the majority of the respondents being either very experienced or relatively new to the fisheries. Fisheries contributed to more than 50% of the household income, according to 72 out of 90 of fishers' respondent group. Similar to the rest of Lake Victoria [46–49], gillnets were the most commonly used gear on the island, targeting Nile perch. Furthermore, direct field observation revealed that about a half of the boat owners interviewed use gears that are considered illegal by the fisheries regulation, i.e., gillnet with less than a six inch mesh size, hook size outside of the legal range (size 4–9), or dagaa seine <8 mm mesh size.

Table 2. Demographic characteristics of the respondents.

Variables	Respondent Category				
	Boat Owner	FISHING CREW	Processor/ Trader	Local Resident	Manager/ Scientist
Landing site					
Kashishi	14	7	10	4	
Ilago	4	11	3	2	
Igadi/Gambaji	7	0	0	12	
Mwamalangare	5	12	2	5	
Maneto	0	0	15	7	
Total	30	30	30	30	30
Gender					
Number of males	30	30	8	30	22
Number of females	0	0	22	0	8
Total	30	30	30	30	30
Fishing experience (years)					
1–5	19	16	17		
6–10	4	4	3		
Over 10	7	10	10		
Total	30	30	30		
Contribution of fisheries to household income (%)					
1–50	1	8	9		
51–100	29	22	21		
Total	30	30	30		
Fishing gear owned					
Gillnet	25				
Hook	2				
Beach seine	2				
Dagaa seine	1				
Total	30				

4.2. Stakehoders Judgement on Damaging Fishing Activities

An agreement was found among respondents in the consideration about the two most damaging fishing-related activities, which are also among those considered IUU fishing by law. The "use of non-selective fishing gear" was considered the most damaging fishing activities by all stakeholder groups, as shown in Table 3, with normalized scores of 74 or higher (out of 100). This was followed by "fishing in breeding areas" with a score of 64 and above across all the groups. Aside from these two, however, judgments on other activities showed variations among groups. For example, boat owners, fishing crews, and processors and traders considered "many fishers targeting single fish species"

least damaging, whereas local residents and fisheries managers/scientists considered it moderately damaging. Interestingly, fisheries managers and scientists considered two activities considered IUU by law, i.e., "fishing without a license" and "landing fish in a non-gazetted site" to be least damaging with rankings of 7 and 8, respectively. At the same time, the boat owners and local residents considered "fishing without a license" moderately damaging with a rank of 4, similar to the fishing crew and processors/traders, who ranked it at 3. Boat owners and local residents agreed with managers and scientists about the low ranking of "landing fish in a non-gazetted site," while fishing crews and processors/traders ranked it higher. The only non-IUU fishing considered potentially damaging by a significant proportion of respondents was "increased number of fishers and gears". Kendall tau rank correlation analysis revealed a strong positive association among the three resource users' groups (boat owner and fishing crews, processors and traders) (p = 0.01), while the relationship between local residents and the boat owners, and between fishing crews and processors and traders were still significant, at a 95% confidence level (see Table 4). Furthermore, there was a strong association (p < 0.001) between males and females on how they judged the damaging fishing activities. However, while the boat owners were found to have a strong association with the managers/scientists, fishers and fish workers in the villages did not share similar views about the damaging effect of fishing activities with the managers/scientists in the region. These findings diverge from those of [19] who found significant correlation between resource users and managers/scientists in their study of illegal fishing in Lake Nyasa (or Lake Malawi).

Table 3. Aggregated preference normalized scores for damaging fishing activities by stakeholders' groups in the fisheries (Ranking in parentheses).

Fishing Activity	Boat Owner	Fishing Crew	Proc./ Trader	Local Resident	Managers/ Scientist
Using non selective fishing gears *	80 (1)	81 (1)	74 (1)	83 (1)	75 (1)
Fishing in breeding areas *	69 (2)	77 (2)	64 (2)	74 (2)	73 (2)
Increased number of fishers and gears	57 (3)	51 (5)	43 (6)	56 (3)	70 (3)
Fishing without license *	50 (4)	58 (3)	54 (3)	47 (4)	29 (7)
Fishing around breeding areas	44 (5)	42 (6)	41 (7)	33 (8)	53 (4)
Landing fish in non-gazetted site *	41 (6)	57 (4)	53(4)	34 (7)	19 (8)
Fishing for longer hours	32 (7)	21 (7)	50(5)	37 (5)	36 (6)
Many fishers targeting single species	25 (8)	13 (8)	21(8)	35 (6)	44 (5)

The ranking levels denote: 1 = most damaging while 8 = least damaging; * denotes activities considered IUU according to the regulations.

Table 4. Kendall tau correlation coefficient analysis for stakeholders' groups.

	Boat Owner	Fishing Crew	Proc./Trader	Local Resident	Managers/Scientist
Boat owner					
Fishing crew	0.786 **				
Proc./Trader	0.643 *	0.857 **			
Local resident	0.643 *	0.571 *	0.571 *		
Manager/Scientist	0.571 *	0.357	0.214	0.5	

** denotes significant correlation at p = 0.01; * denotes significant correlation at p = 0.05.

4.3. Reasons for Using Destructive Fishing Gear

About one-third of the respondents in each category indicated poverty as a major reason for using destructive fishing gear. Other reasons showed greater variation between the respondents (see Table 5). For example, boat owners, fishing crews, processors/traders, and local residents considered 'high costs of buying legal gear' as the second most significant cause, whereas managers/scientists considered 'insufficient penalties/fines' to be the secondary reason after poverty. Interestingly, fisheries managers and scientists considered 'corruption' the third biggest cause according to 17 out of the 30 respondents. This was different from the boat owners, fishing crews, and local residents who considered 'good returns from using small fishing gear' to be the third cause with approval from between five to eight

respondents. While no significant difference was found in the reasons for using destructive fishing gears between gender ($n = 150$, $p = 0.823$), the analysis showed that years spent in fisheries ($n = 150$, $p < 0.05$) and occupations ($n = 150$, $p < 0.001$) had significant effects on the reasons about the use of destructive gears, i.e., managers/scientists and fishers differ in their consideration about why destructive fishing gear was used. All in all, our findings concur with other recent studies of illegal fishing [34,50,51], which show that economic conditions and management issues may contribute to non-compliance of fisheries regulations.

Table 5. Distribution of reasons for using destructive fishing gears by stakeholders' groups (multiple selection was allowed).

Reason	Boat Owner	Fishing Crew	Proc./ Trader	Local Resident	Manager/ Scientist
Poverty	24	22	26	26	24
Legal gears are expensive	8	6	5	6	8
Good returns from small gear	5	5	3	5	10
Inadequate regulation knowledge	4	1	4	3	12
Corruption	4	5	4	3	17
Insufficient penalties/fines	3	4	2	3	19

4.4. Suggested Actions to Improve Conservation

Table 6 displays the suggestions by respondents about preferred actions to improve conservation. The findings indicate an agreement between stakeholders, with exception of the local resident group on the two most preferred actions to improve conservation. 'Strengthening of enforcement measures' was considered the most preferred action with 16 respondents and above by the fishers group and managers/scientists, whereas local residents considered 'need for continuous awareness to fishers' a priority. The order was the reverse, with the second preferred action being 'need for continuous awareness to fishers' for the fishers group and managers/scientists, while 'strengthening of enforcement measures' was of lower priority for the local residents. Still, the top answers converged on these two actions—strengthening enforcement and raising awareness. In particular, the suggestion to strengthen enforcement efforts to combat IUU fishing affirms the conventional belief of the general international and scientific community, which is also the action most implemented in the region. Additionally, the managers/scientists group indicated that they would also like to see local leadership more greatly involved in the enforcement of regulations. However, this was not preferred by the fishers' group and local residents, which could be due to mistrust with local leadership. Chi-square test results between gender and years spent in fisheries revealed no significant difference across all suggested actions required to improve conservation at $p = 0.853$ and $p = 0.990$, respectively. However, significant difference was found on this question between managers/scientist and other respondents ($n = 150$, $p < 0.05$), highlighting again the existence of a crucial group distinction based on occupation. Generally, the most preferred actions to improve conservation provide important clues on conservation strategies that may receive wider fishing community support. In advocating for strengthened enforcement efforts, the managers/scientists were categorical that the efforts need to be continuous and not periodic, as they are currently undertaken.

Table 6. Distribution of suggested actions to improve conservation by stakeholder groups (multiple selections was allowed).

	Boat Owner	Fishing Crew	Proc./ Trader	Local Residents	Managers/ Scientists
Strengthen enforcement measures	16	25	18	12	21
Continuous awareness/education to fishers	11	5	12	20	18
Subsidies on the cost of legal gear	5	3	5	11	13
Change fisheries regulations	5	1	2	4	8
Use local leadership to enforce regulations	3	1	1	5	16

5. Discussion

The IPOA-IUU adopted in 2001, which many states began implementing through national legislations, provides specific measures to address IUU fishing globally. So, too, is the case for Lake Victoria, which adopted the Regional Plan of Action (RPOA-IUU) in 2004. The major goal of this plan is to develop and implement coordinated, harmonized, unified, and effective management measures to prevent, deter and eliminate IUU fishing in Lake Victoria and its basin. In line with this objective, the plan defined the scope and nature of IUU fishing activities. As a riparian state, Tanzania has committed to tackling IUU fishing through implementation and enforcement of this plan. However, despite two decades of RPOA-IUU informed effort, IUU fishing has remained a challenge. The regulation and enforcement-based measures continue to be promoted and implemented, but it is insufficiently understood why they have been unsuccessful in effecting the desired change.

In this research, we look into this predicament though an examination of fisheries stakeholders' judgements about a range of fishing activities in terms of their impacts on the fisheries resources and the lake ecosystem. The level of agreement or disagreement, along with the reasons for engaging in IUU fishing provided by the surveyed stakeholders, generate insights into the persistence of IUU fishing and enable discussion into possible governance interventions to address the situation. In this regard, our findings reveal several positive developments. First, all respondent groups equally considered the "use of non-selective fishing gear" and "fishing in breeding areas" to be more ecologically damaging than other fishing activities. This clearly indicates a shared understanding among the surveyed fishery stakeholders on two of the IUU fishing activities. In addition, this understanding is consistent with the common knowledge of fishing gears and practices widely perceived to have a sizable impact on the fisheries resources, towards which much effort in the region is also directed [46,47,51]. Furthermore, strong association was found between the fishers group and the local residents, and even a stronger one between the boat owners and the managers/scientists. The latter could be because boat owners interact more with the managers on issues related to regulations, like paying for boat licenses and registrations. While the marked differences between certain stakeholder groups offer potential for improving IUU governance, they do pose some challenges. For instance, fishing crews and processors/traders tend to differ from the other groups in their judgements about the severity of fishing activities and other aspects. Understanding why this difference occurs is important since fishing crews dominate the fishery in number [47], and determine where to fish. They also interact directly with other actors on fishery-related matters and are often highly mobile in the search for better catches, prices, and improved access to markets [52]. This interaction and their social status (they are often less educated and poorer than boat owners) may explain why their judgments and images may influence each other.

For example, one local resident stated that "there should be no regulation on the size of fishing gear as fish is God given". This particular image could be attributed to the one advanced by the fishing crew that 'illegal fishing or increase in the number of gears and fishers cannot lead to resource depletion–the scientists' warnings are just to scare away people from fishing'. In this way, the linkages of images between stakeholders are likely to become a norm within a larger group. This creates a lasting impact on the implementation and enforcement of measures that they view differently, hence, shaping the level of governability in Lake Victoria. Studies have shown that social acceptance of fisheries management measures by fishers is a crucial factor that may influence management outcomes and the success of legislation [22,53]. Probing further in the fisheries governance literature, it is argued that images, instruments, and actions are closely connected [16,17]. In the case of tackling IUU fishing in Lake Victoria, this implies that the measures and actions taken towards IUU fishing should reflect on how the problem is perceived or understood by the different stakeholders in the fisheries, i.e., the images that are formed in their minds [15,22]. However, as observed, the images of the fishers and managers are not necessarily compatible. At the same time, the influence of demographic parameters on the reasons for using destructive fishing gears and actions required to improve fishery may create further governance and governability challenges.

Further, challenges to governability are also evident from the managers' judgements. In this survey, they expressed some of the IUU fishing activities "fishing without a license" and "landing fish in a non-gazetted site" as less or least damaging, which, by virtue of their official positions, they are supposed to enforce. This may lead to patchy implementation and enforcement of some measures subsequently creating room for non-compliance from fishers. Even though these two fishing activities may not be seen to pose a high concern for sustainability among some respondents, they are still problematic because they can undermine the legitimacy of governance. Together, these perspectives provide insights into explaining why much effort or emphasis has been placed on controlling the use of unwanted fishing gears, and prohibiting fishing in closed seasons and areas within the region, over other IUU-defined fishing activities. This further complicates governance because it is not only the resource users' images that do not conform to the regulations but even those of the governors. In this case, the enforcers are also contributing to the problem or hindering attempts to solve the problem. Such selective attitudes of governors towards fisheries regulations have an influence on the governability because it can be transmitted to fishers whose actions are also based on what they see and experience from those in governing positions. In fact, some studies have found that lack of enforcement or selective enforcement of laws and other legal instruments in natural resources management hampers conservation [26,32,53]. Thus, any attempt to tackle IUU fishing should also take into account the observed differences between stakeholder groups.

Our findings also show that, despite relatively high conservation understanding among fishers, the persistent use of destructive fishing gear [23,24] clearly implies that having a better conservation knowledge does not automatically translate into subsequent rule compliance. This finding corroborates [19] who found a low inclination of resource users towards conservation measures despite having high conservation awareness. Here we found poverty to be a major reason for the use of destructive fishing gear, also supported by other findings [49,54,55]. Poverty can manifest itself through a lack of income generating opportunities or a lack of alternative employment. In this way, many fishers find themselves in a poverty trap where, despite the declining fish catches, they do not want to exit the fishery and sometimes they engage in many unsanctioned practices, including IUU fishing, in order to make ends meet. In so doing they contribute to unsustainable utilization of the fisheries resources which then leads to a cycle of poverty. It is also important to note that poverty is not restricted to the fishing community alone; it is a pervasive issue within the region [20,56,57]. One fisher confessed, 'I know the fisheries officer can arrest me if he finds me with this fishing gear, but I only use the gear to catch fish in order to feed my family because farming is unpredictable these days'. This reveals a difficult reality that engenders the gap between one's judgment and ensuing action. When faced with two options, i.e., sustaining fisheries and alleviating livelihood concerns, the fishers are likely to consider livelihood concerns first and foremost. This clearly suggests that tackling IUU fishing without first addressing the issue of poverty may not help to effectively deal with the IUU problem.

6. Conclusions

IUU fishing is a serious challenge that threatens the conservation of fisheries resources, as well as livelihoods of fisheries-dependent communities. Due to its negative consequences, various alleviation strategies have been adopted and implemented in many water bodies, but with mixed results. This study examines the persistent IUU fishing in Lake Victoria so as to understand why the problem persists, and how to approach its resolution in ways that are reflective of the local context. In light of this, the findings from the study area provide insights that can assist policy-makers in tackling the IUU fishing issue in Lake Victoria. First, it highlights disparities in how the severity of impacts of both permitted and prohibited fishing activities are judged and, therefore, how IUU fishing is perceived, by different fisheries stakeholders. An understanding of why these disparities exist is imperative to successfully address IUU fishing. Second, it suggests a need to review some of the regulatory measures, to better align with the knowledge of the stakeholders and the characteristics of the natural system-to-be-governed. At the same time, multipronged approaches are required to address the complex, but unique, issues and concerns associated with the problem. For example,

a greater emphasis should be placed on addressing the drivers of violations and non-compliance, such as poverty. To do this, there is a need to invest more in programs that provide alternative livelihoods to the fishers' communities. However, more meaningful discussion and better-informed awareness and education to stakeholders could be an appropriate initial strategy to tackle other IUU fishing activities that are considered less damaging (thus, less prioritized) such as "fishing without a license" and "landing fish in a non-gazetted site". This should also be directed towards tackling specific issues, such as low literacy levels among the fishing crews. Finally, it calls for consideration of stakeholders' judgments about non-IUU fishing activity considered to be potentially damaging, such as "increased number of fishers and fishing gears," in fisheries regulatory measures. This can help enhance legitimacy of the regulations and bolster support from the fishing communities. Overall, the results of this study have demonstrated that IUU fishing is clearly a governance issue that cannot only be tackled by technical approaches. Therefore, addressing it requires a multi-faceted and nuanced governance approach that pays careful attention to the fundamental differences between fishers and other stakeholder groups, and government managers, in their knowledge and interpretation of fishing rules and regulations. How other social factors, such as poverty, interact with fisheries situations is also important to understand. We submit that this finding and the methodological approach presented in this paper can serve as a useful point of departure for the study of IUU fishing in other areas of Lake Victoria and elsewhere in the world.

Author Contributions: All authors contributed to the development of the manuscript. The lead author designed the study, collected and analyzed the data, and prepared the manuscript. The second author also contributed to the design of the study, in addition to providing general guidance and editorial oversight throughout the process. The third author also assisted in the analysis and revision of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest. The study sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

References

1. Béné, C.; Macfadyen, G.; Allison, E.H. Increasing the Contribution of Small-Scale Fisheries to Poverty Alleviation and Food Security. Available online: https://books.google.co.tz/ (accessed on 29 July 2016).
2. Salas, S.; Chuenpagdee, R.; Seijo, J.C.; Charles, A. Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean. *Fish. Res.* **2007**, *87*, 5–16. [CrossRef]
3. Garcia, S.M.; Rosenberg, A.A. Food security and marine capture fisheries: Characteristics, trends, drivers and future perspectives. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* **2010**, *365*, 2869–2880. [CrossRef] [PubMed]
4. Food and Agriculture Organization. International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing. Available online: http://www.fao.org/docrep/003/y1224e/y1224e00.htm (accessed on 26 June 2016).
5. Duda, A.M.; Sherman, K. A new imperative for improving management of large marine ecosystems. *Ocean Coast. Manag.* **2002**, *45*, 797–833. [CrossRef]
6. Vince, J. Policy responses to IUU fishing in Northern Australian waters. *Ocean Coast. Manag.* **2007**, *50*, 683–698. [CrossRef]
7. Kolding, J.; van Zwieten, P.A. The Tragedy of Our Legacy: How Do Global Management Discourses Affect Small-Scale Fisheries in the South? *Forum Dev. Stud.* **2011**, *38*, 267–297. [CrossRef]
8. Nielsen, J.R. An analytical framework for studying: Compliance and legitimacy in fisheries management. *Mar. Policy* **2003**, *27*, 425–432. [CrossRef]
9. Jentoft, S.; Chuenpagdee, R. Fisheries and coastal governance as a wicked problem. *Mar. Policy* **2009**, *33*, 553–560. [CrossRef]
10. Kooiman, J.; Bavinck, M.; Jentoft, S.; Pullin, R. *Fish for Life: Interactive Governance for Fisheries*; Amsterdam University Press: Amsterdam, The Netherlands, 2005; pp. 342–349.

11. Bavinck, M.; Chuenpagdee, R.; Jentoft, S.; Kooiman, J. *Governability of Fisheries and Aquaculture: Theory and Applications*; Springer: Dordrecht, The Netherlands, 2013; pp. 4–15.

12. Chuenpagdee, R. Interactive governance for marine conservation: An illustration. *Bull. Mar. Sci.* **2011**, *87*, 197–211. [CrossRef]

13. Song, A.M.; Chuenpagdee, R.; Jentoft, S. Values, images, and principles: What they represent and how they may improve fisheries governance. *Mar. Policy* **2013**, *40*, 167–175. [CrossRef]

14. Jentoft, S. Limits of governability: Institutional implications for fisheries and coastal governance. *Mar. Policy* **2007**, *31*, 360–370. [CrossRef]

15. Jentoft, S.; Chuenpagdee, R.; Bundy, A.; Mahon, R. Pyramids and roses: Alternative images for the governance of fisheries systems. *Mar. Policy* **2010**, *34*, 1315–1321. [CrossRef]

16. Chuenpagdee, R.; Kooiman, J.; Pullin, R. Assessing governability in capture fisheries, aquaculture and coastal zones. *J. Transdiscipl. Environ. Stud.* **2008**, *7*, 1–20.

17. Bavinck, M.; Salagrama, V. Assessing the governability of capture fisheries in the Bay of Bengal—A conceptual enquiry. *J. Transdiscipl. Environ. Stud.* **2008**, *7*, 1–13.

18. Song, A.M. Towards a governable co-management in South Korean small-scale fisheries: Interactions of institutions and stakeholders' mindset. In *Interactive Governance for Small-Scale Fisheries: Global Reflections*; Jentoft, S., Chuenpagdee, R., Eds.; Springer: Dordrecht, The Netherlands, 2015; pp. 687–704.

19. Song, A.M.; Chuenpagdee, R. Conservation principle: A normative imperative in addressing illegal fishing in Lake Malawi. *Marit. Stud.* **2011**, *10*, 5–30.

20. Onyango, P.; Jentoft, S. Assessing poverty in small-scale fisheries in Lake Victoria, Tanzania. *Fish Fish.* **2010**, *11*, 250–263. [CrossRef]

21. Jentoft, S.; Pascual-Fernandez, J.J.; De la Cruz Modino, R.; Gonzalez-Ramallal, M.; Chuenpagdee, R. What stakeholders think about marine protected areas: Case studies from Spain. *Hum. Ecol.* **2012**, *40*, 185–197. [CrossRef]

22. Voyer, M.; Gollan, N.; Barclay, K.; Gladstone, W. 'It's part of me'; understanding the values, images and principles of coastal users and their influence on the social acceptability of MPAs. *Mar. Policy* **2015**, *52*, 93–102. [CrossRef]

23. Njiru, M.; Kazungu, J.; Ngugi, C.C.; Gichuki, J.; Muhoozi, L. An overview of the current status of Lake Victoria fishery: Opportunities, challenges and management strategies. *Lakes Reserv. Res. Manag.* **2008**, *13*, 1–12. [CrossRef]

24. Ikwaput-Nyeko, J.; Kirema-Mukasa, C.; Odende, T.; Mahatane, A. Management of Fishing Capacity in the Nile Perch Fishery of Lake Victoria. *Afr. J. Trop. Hydrobiol. Fish.* **2009**, *12*, 67–73. [CrossRef]

25. Schmidt, C.C. Economic drivers of illegal, unreported and unregulated (IUU) fishing. *Int. J. Mar. Coast. Law* **2005**, *20*, 479–507. [CrossRef]

26. Alabsi, N.; Komatsu, T. Characterization of fisheries management in Yemen: A case study of a developing country's management regime. *Mar. Policy* **2014**, *50*, 89–95. [CrossRef]

27. Sumaila, U.R.; Alder, J.; Keith, H. Global scope and economics of illegal fishing. *Mar. Policy* **2006**, *30*, 696–703. [CrossRef]

28. Le Gallic, B.; Cox, A. An economic analysis of illegal, unreported and unregulated (IUU) fishing: Key drivers and possible solutions. *Mar. Policy* **2006**, *30*, 689–695. [CrossRef]

29. Pauly, D.; Christensen, V.; Guenette, S.; Pitcher, T.J.; Sumaila, U.R.; Walters, C.J.; Zeller, D. Towards sustainability in world fisheries. *Nature* **2002**, *418*, 689–695. [CrossRef] [PubMed]

30. Österblom, H.; Sumaila, U.R.; Bodin, Ö.; Sundberg, J.H.; Press, A.J. Adapting to regional enforcement: Fishing down the governance index. *PLoS ONE* **2010**, *5*, e12832. [CrossRef] [PubMed]

31. Sundström, A. Covenants with broken swords: Corruption and law enforcement in governance of the commons. *Glob. Environ. Chang.* **2015**, *31*, 253–262. [CrossRef]

32. Sundström, A. Corruption and violations of conservation rules: A survey experiment with resource users. *World Dev.* **2016**, *85*, 73–83. [CrossRef]

33. Hauck, M. Rethinking small-scale fisheries compliance. *Mar. Policy* **2008**, *32*, 635–642. [CrossRef]

34. Eggert, H.; Lokina, R.B. Regulatory compliance in Lake Victoria fisheries. *Environ. Dev. Econ.* **2010**, *15*, 197–217. [CrossRef]

35. Lake Victoria Fisheries Organization. Regional Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated (IUU) Fishing on Lake Victoria and its Basin. 2004, p. 14. Available online: http://www.lvfo.org/index.php/documents/ (accessed on 2 May 2015).

36. Chuenpagdee, R.; Jentoft, S. Assessing governability–What's next. In *Governability of Fisheries and Aquaculture: Theory and Applications*; Bavinck, M.R., Chuenpagdee, R., Jentoft, S., Kooiman, J., Eds.; Springer: Dordrecht, The Netherlands, 2013; pp. 335–349.

37. Chuenpagdee, R.; Knetsch, J.L.; Brown, T.C. Coastal management using public judgments, importance scales, and predetermined schedule. *Coast. Manag.* **2001**, *29*, 253–270.

38. Chuenpagdee, R. Scales of Relative Importance and Damage Schedules: A Non-Monetary Valuation Approach for Natural Resource Management. Ph.D. Thesis, University of British Columbia, Vancouver, BC, Canada, 1998.

39. Song, A.M.; Chuenpagdee, R. Exploring stakeholders' images of coastal fisheries: A case study from South Korea. *Ocean Coast. Manag.* **2014**, *10*, 10–19. [CrossRef]

40. Peterson, G.L.; Brown, T.C. Economic valuation by the method of paired comparison, with emphasis on tests of the transitivity axiom. *Land Econ.* **1998**, *74*, 240–261. [CrossRef]

41. Opaluch, J.E.; Swallow, S.; Weaver, T. Evaluating impacts from noxious facilities: Including public preferences in current siting mechanisms. *J. Environ. Econ. Manag.* **1993**, *24*, 41–59. [CrossRef]

42. Noether, G.E. Why Kendall tau. *Teach. Stat.* **1981**, *3*, 41–43. [CrossRef]

43. Helsel, D.R.; Frans, L.M. Regional Kendall test for trend. *Environ. Sci. Technol.* **2006**, *40*, 4066–4073. [CrossRef] [PubMed]

44. Gibbons, J.D.; Chakraborti, S. *Nonparametric Statistical Inference*; Springer: Berlin/Heidelberg, Germany, 2011; pp. 977–979.

45. Lwenya, C.; Mbilingi, B.; Luomba, J.; Yongo, E. Gender integration in the management of the Lake Victoria Fisheries. *Afr. J. Trop. Hydrobiol. Fish.* **2009**, *12*, 59–66. [CrossRef]

46. Chitamwebwa, D.; Kamanyi, J.; Kayungi, J.; Nabbongo, H.; Ogolla, A.; Ojuok, J. The present status of the hook fishery and its impact on the fish stocks of Lake Victoria. *Afr. J. Trop. Hydrobiol. Fish.* **2009**, *12*, 78–82.

47. Lake Victoria Fisheries Organization. Regional Lake Victoria Frame Survey Report. 2012, p. 64. Available online: http://www.lvfo.org/index.php/documents/ (accessed on 2 May 2015).

48. Cowx, I.G.; van der Knaap, M.; Muhoozi, L.I.; Othina, A. Improving fishery catch statistics for Lake Victoria. *Aquat. Ecosyst. Health Manag.* **2003**, *6*, 299–310. [CrossRef]

49. Etiegni, C.A.; Ostrovskaya, E.; Leentvaar, J.; Eizinga, F. Mitigation of illegal fishing activities: Enhancing compliance with fisheries regulation in Lake Victoria (Kenya). *Reg. Environ. Chang.* **2011**, *11*, 323–334. [CrossRef]

50. Daliri, M.; Kamrani, E.; Jentoft, S.; Paighambari, S.Y. Why is illegal fishing occurring in the Persian Gulf? A case study from the Hormozgan province of Iran. *Ocean Coast. Manag.* **2016**, *120*, 127–134. [CrossRef]

51. Msuku, B.S.; Mrosso, H.D.J.; Nsinda, P.E. A critical look at the current gillnets regulations meant to protect the Nile Perch stocks in Lake Victoria. *Aquat. Ecosyst. Health Manag.* **2011**, *14*, 252–259. [CrossRef]

52. Nunan, F.; Luomba, J.; Lwenya, C.; Yongo, E.; Odongkara, K.; Ntambi, B. Finding space for participation: Fisherfolk mobility and co-management of Lake Victoria fisheries. *Environ. Manag.* **2012**, *50*, 204–216. [CrossRef] [PubMed]

53. Fulton, E.A.; Smith, A.D.; Smith, D.C.; van Putten, I.E. Human behaviour: The key source of uncertainty in fisheries management. *Fish Fish.* **2011**, *12*, 2–17. [CrossRef]

54. Eisma, R.L.V.; Christie, P.; Hershman, M. Legal issues affecting sustainability of integrated coastal management in the Philippines. *Ocean Coast. Manag.* **2005**, *48*, 336–359. [CrossRef]

55. Abila, R.O.; Omwega, R.N.; Lwenya, C. Fishing and poverty levels around Lake Victoria Kenya. In Proceedings of the 11th World Lakes Conference, Nairobi, Kenya, 31 October–4 November 2005.

56. Abila, R.O. Fish Trade and Food Security: Are They Reconcilable in Lake Victoria. Kenya Marine and Fisheries, 2003; p. 31. Available online: https://www.researchgate.net/ (accessed on 21 June 2016).

57. Olago, D.; Marshall, M.; Wandiga, S.O.; Opondo, M.; Yanda, P.Z.; Kangalawe, R.; Kirumira, E. Climatic, socio-economic, and health factors affecting human vulnerability to cholera in the Lake Victoria basin, East Africa. *AMBIO J. Hum. Environ.* **2007**, *36*, 350–358. [CrossRef]