Illegal, Unreported and Unregulated (IUU) Fishing as a Governability Problem: A Case Study of Lake Victoria, Tanzania

by

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Abstract

This thesis employs interactive governance theory and governability assessment framework to examine why illegal, unreported and unregulated (IUU) fishing is persistent in Lake Victoria, despite efforts to combat it. IUU fishing threatens sustainable management of fish stocks and livelihoods of fisheries dependent communities. At the same time, inadequacies of the technical and regulatory measures implemented to control it have resulted in calls for alternative approaches. This thesis takes a whole system approach to examine underlying governance issues that pose challenges to tackling IUU problems. The study involved two parts. First, it evaluated the extent to which the properties of the system-to-be-governed, the governing system and the governing interactions contribute to fisheries governance challenges. Second, a survey using paired comparison questionnaires was undertaken to determine fisheries stakeholders' judgements about the level of damages associated with different fishing-related activities. The investigation reveals that diversity, complexity, dynamics and scale issues in the system-to-be-governed, the governing system and the governing interaction challenges efforts to tackle IUU fishing. In addition, the study shows that there are some inconsistencies in the way fishers and managers judge the impact of some fishing-related activities including those that are officially considered IUU fishing. For example, managers consider IUU fishing activities such as 'fishing without license' and 'landing fish in non-gazetted site' to be least damaging while fishers consider them to have higher impact. These mismatches between the system-to-be-governed and the governing system need to be addressed, before IUU fishing can be tackled. The thesis offers alternative explanations about why IUU problem persists in Lake Victoria, broadening thus the

possibility on how to combat it. The methodological approach and findings of the thesis can be applied in other fisheries to help understand and address similar governance challenges.

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List of abbreviation and symbols

BMU: Beach Management Unit

CAG: Controller and Auditor General

CCRF: Code of Conduct for Responsible Fisheries

DED: District Executive Director

EAC: East African Community

EAFM: Ecosystem Approach to Fishery Management

EU: European Union

FAO: Food and Agriculture Organization

ICEHR: Interdisciplinary Committee on Ethics in Human Research

IPOA: International Plan of Action

IUU: Illegal Unreported and Unregulated

LVFO: Lake Victoria Fisheries Organization

MCS: Monitoring Control and Surveillance

MUN: Memorial University of Newfoundland

RPOA: Regional Plan of Action

SIDA: Swedish International Development Agency

SSF: Voluntary Guideline for Securing Sustainable Small-scale Fisheries

SSHRC: Social Sciences and Humanities Research Council

TAFIRI: Tanzania Fisheries Research Institute

TBTI: Too Big To Ignore

USD: United States Dollar

Chapter 1: Introduction

This chapter introduces the study by presenting the issues related to illegal, unreported and unregulated (IUU) fishing, its impacts and causes, and inherent challenges in alleviating it. In particular, it aims to illustrate that IUU is a 'wicked' governance issue that requires systematic and comprehensive examination to understand and address. The research statement, objectives, hypotheses, questions, as well as the theoretical framework that guide this study, are deliberated in this chapter. The chapter concludes with the thesis layout.

1.1 Describing the problem: IUU fishing

Fisheries resources are very important to the survival of fishing families, communities and states, which depend on fish for food, income, and livelihoods. Such dependency is stronger in many developing countries than in developed ones (FAO 2014). However, as has been documented around the world, wild fisheries resources are declining at an alarming rate in terms of abundance and diversity (Pauly et al. 2002; Worm et al. 2009). Estimates show, for instance, that of the total number of wild fishery assessed in 2013, 58% are fully fished stocks while 26% are exploited at unsustainable levels, and only 16% are considered moderately and/or under-exploited (FAO 2016). This decline has been attributed to a number of interrelated factors, including overfishing (Pauly et al. 2002; Worm et al. 2009), over capacity (Sumaila et al. 2007), and unsustainable fishing practices, which include use of non-selective fishing gears that negatively affects juvenile fish and destroys habitats (Le Gallic and Cox 2006; Agnew et al. 2009). Many of these factors fall within the description of IUU fishing, which is considered to have the greatest

impact on fisheries resources, posing major barriers to achieving sustainable fisheries (Plaganyi et al. 2011; Pollachek 2012; UNGA 2015). IUU fishing practices take many forms, both within nationally controlled waters and the high seas (Plaganyi et al. 2011). The Food and Agriculture Organization's International Plan of Action to Prevent, Deter and Eliminate IUU fishing (IPOA-IUU) provides broad definitions of IUU fishing, in nature and scope. Illegal fishing implies fishing activities conducted by national or foreign vessels in waters under the jurisdiction of a state without the permission of that state, or in violation of national laws or international obligations. Unreported fishing means fishing, which has not been reported, or has been misreported, to the relevant national authority, in contravention of national laws and regulations. Unregulated fishing implies fishing in areas or for fish stocks in relation to which there are no applicable conservation or management measures and where such fishing is conducted in a manner that is inconsistent with state responsibilities for the conservation of living marine resources under international law (FAO 2001).

1.2 Impacts and causes of IUU fishing

Concerns related to IUU fishing are due to their ecological, social and economic impacts on fisheries and fishing communities. For example, Agnew et al. (2009) document that IUU fishing can lead to the collapse of fisheries resources or can seriously affect efforts to rebuild fish stocks. Further, the global annual loss as a result of IUU fishing is considered to be between 11 and 26 million tonnes and estimated at USD 4 to 23.5 billion (Agnew et al. 2009; Haken 2011). In some important fisheries, IUU fishing accounts for

30% of the total, and in some ports, as much as 50% of the landings (Swan and Doulman 2012). According to Marine Resources Assessment Group (MRAG 2009), IUU fishing is responsible for between 10% and 30% of total global fish production. In this regard, IUU fishing undermines the conservation and enforcement efforts (FAO 2012), and distorts trade and prices in export markets (De Coning 2011). Moreover, IUU fishing threatens the availability of fish as source of food to meet the world's growing population, which is projected to reach 9.6 billion people in 2050 (FAO 2014).

However, studies have shown that IUU fishing is more persistent in developing countries (Mwikya 2006; MRAG 2005; Alabsi and Komatsu 2014). This poses a major threat given that more than 90% of world's fishers and millions of poor people live in developing countries (Béné et al. 2007; Pomeroy and Andrew 2011). One fishery where IUU fishing is a major concern is Lake Victoria, Africa's largest and most important waterbody that is shared by three states, i.e. Tanzania (51% of area), Uganda (43% of area) and Kenya (6% of area). The lake is a source of livelihoods to over 30 inhabitants of the basin (World Bank 2009). Fisheries resources from the lake generate substantial income to the riparian states, and provide food to the riparian communities. The major documented impact of IUU fishing in this lake is the decline in fish stocks. For example, it is argued that IUU fishing is the major cause for the decline of Nile perch (*Lates niloticus*) stock from one million tonnes in the 1990s to about 300,000 tonnes in 2000s (Mkumbo and Marshall 2014; Ikwaput-Nyeko et al. 2009; Kayanda et al. 2009). Nile perch is of great importance to this region as a primary source of food and income. The fish accounts for about 60% and 50% of the total fish landed and export values from the lake, respectively (Odongkara

et al. 2009; Mkumbo and Marshall 2014). Thus, its decline does not only deprive the riparian states of substantial revenues (Odongkara et al. 2009), but may also lead to fishery collapse (LVFO 2008). To this end, IUU fishing in Lake Victoria can create serious consequences as it undermines many livelihoods, poverty alleviation efforts, food and nutritional security in the region. This has made tackling IUU fishing a priority within the region and among development partners.

There is a host of explanations that have been given as to why IUU fishing occurs and persists globally. In their review, Sumaila et al. (2006) argue that economic profits from illegal operations constitute incentives to pursue such activities. The reasoning behind this is that 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, and overcapacity and overfishing can lead to unsustainable fishing behaviours, which include IUU fishing, especially in developing countries (Pauly et al. 2002; Le Gallic and Cox 2006; Vince 2007; Osterblom et al. 2010; Garcia and Rosenberg 2010). To add to this, Nielsen (2003), in his analysis of compliance and legitimacy in fisheries management reasons that compliance to regulations depends on the legitimacy of the regulatory system in relation to the context and procedure, to which they are determined; and role played by fisheries management institutions in coordination and allocation of resources. Furthermore, Hauck (2008), relate non-compliance (to regulatory measures) to the processes of law formation and power dynamics influencing such processes. These reasoning assert that IUU fishing is not only an economic issue, but a

more complex one that include the social and political aspects, i.e., legitimacy of the laws and institutions enforcing them.

1.3 Combating IUU fishing: challenges involved

In view of the negative impacts and urgent needs to address IUU fishing, the FAO member states have included this issue in a number of instruments, such as the Code of Conduct for Responsible Fisheries (FAO-CCRF) in 1995; IPOA-IUU in 2001, and the Voluntary Guideline for Securing Sustainable Small-scale Fisheries (SSF-Guidelines) in 2014. In particular, the IPOA-IUU guideline, which has been elaborated within the framework of FAO-CCRF, provides states with comprehensive, effective and transparent measures to combat IUU fishing. These include appropriate regional fisheries management organizations established in accordance with international law to prevent, deter and eliminate IUU fishing (FAO 2001). To date there are various national and regional bodies formed to implement IPOA-IUU (FAO 2014). In addition, the SSF-Guidelines, which were adopted in 2014, call for effective monitoring and enforcement mechanisms to prevent, deter, and eliminate all forms of illegal and/or destructive fishing practices as they relate to small-scale fisheries. Further, the SSF Guidelines emphasize innovation and flexibility for member states to address the root causes of IUU fishing and to adopt combating measures most suitable to their particular circumstances. Generally, these guidelines urge member states to have national and/or regional plans that would ensure addressing all aspects of IUU fishing. Besides these FAO endorsed guidelines, there are other comprehensive management tools that have been used by governments around the world to manage fisheries, such as ecosystem approach to fishery management

(EAFM) (Garcia and Cochrane 2005; Pikitch et al. 2004) and integrated management (Kay and Adler 2005). In addition, a shift from a centralized management system to alternative management regimes such as community-based management and co-management has increased in recent years (Jentoft et al. 1998; Jentoft 2000; 2006; Nielsen et al. 2004; Pomeroy and Rivera-Guieb 2005). While not explicit, the holistic perspective on fisheries management promoted by these alternative schemes recognizes the need to address IUU fishing as part of achieving fisheries sustainability.

In Lake Victoria, the IPOA-IUU guideline is implemented through the Regional Plan of Action (RPOA-IUU). The main suggestions by the RPOA-IUU include restricting the use of certain fishing gear, protecting fish spawning and nursery areas, prohibiting fish landing in undesignated landing sites, and implementing closed seasons. For example, the plan prohibits the use of gillnets with mesh size smaller than 6 inches. Use of beach seine, monofilament nets, and poison and explosives are forbidden. In addition, controls are in place to restrict the use of certain barriers, pots and baskets, spears, dredges, traps, scoop nets, trawl nets, trammel nets/tangle net system, drifting, cast net, and hooks outside the size range of 4-9. Further, two new management units have been established to help address IUU fishing problems. Beach Management Units (BMUs) is a community-based fisheries management organization, registered with a fisheries department and operating at a landing site (see Ogwang' et al. 2009). The other unit, Monitoring Control and Surveillance (MCS), is government-based, and is responsible for collecting fisheries data, developing appropriate management measures and ensuring compliance with the regulatory controls imposed on fishing-related activities. These units collaborate to

enforce fisheries regulations and control fishing-related practices that threaten the sustainability of fisheries resources as well as livelihoods of dependent communities. However, despite these efforts, the deterioration of fish stocks in Lake Victoria has persisted (Njiru et al. 2008; Ikwaput-Nyeko et al. 2009; Ogwang et al. 2009).

The persistence of IUU fishing remains a dilemma to policy makers, managers and stakeholders, also because the strategies and perspectives employed to control it may undermine the basis for livelihoods, employment, food security and nutrition of people depending on fisheries resources. At the same time, several empirical studies report challenges of addressing IUU fishing in small-scale fisheries (Schmidt 2005; Alabsi and Komatsu 2014; Kolding and Zwieten 2011). For instance, Song and Chuenpagdee (2011) provide evidence that illegal fishing is a multidimensional and complex issue, which cannot be tackled with technical fixes. This could be the reason why the suggested policy responses focusing on the enforcement of regulations has produced little impact in dealing with the problem. In this light, the persistent IUU fishing in Lake Victoria can be seen as a governance issue as opposed to a technical problem. Therefore, an alternative approach with a different focus is required to understand and address the persistent IUU fishing problem in Lake Victoria.

This study finds inspiration from interactive governance theory, which posits that fisheries governance is a relationship between the governing system and the system-to-be-governed (Kooiman et al. 2005; Jentoft and Chuenpagdee 2009). The governing system is a constructed social 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 institutions. The interaction between these two systems defines what governance is and how it functions. According to the theory, these systems are diverse, complex, dynamic and operative at various scales (Kooiman et al 2005; Bavinck et al. 2013). At the same time, the theory highlights that fishery governance is confronted with 'wicked' problems, referring to problems that are complex, have no technical solutions, are difficult to solve and often a symptom of greater problems (Jentoft and Chuenpagdee 2009; Rittel and Webber 1973). This type of problem is of social nature, not a technical one, and is often defined and perceived differently by different stakeholders. According to interactive governance theory, understanding and addressing this problem 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 (Kooiman et al. 2005; Jentoft and Chuenpagdee 2009).

As part of this examination, stakeholders' values, norms and principles that may undermine governance measures are assessed (Kooiman and Jentoft 2009). These explanations are supported by the studies conducted in Lake Victoria by Onyango and Jentoft (2010), and in Lake Nyasa by Song and Chuenpagdee (2011). Following these observations, the persistent IUU fishing in Lake Victoria is a governance challenge, resulting mainly from the mismatch between the governing system and the system-to-be-governed. As such, the tendency of the governing system to rely on management

technical fixes to address this problem may be adding more challenges than solving them (Degnbol et al. 2006). The interactive governance approach argues that IUU fishing should be understood as something with various aspects than simply defining it as a problem related mainly to how fisheries are harvested, which leads to measures that restrict what is caught and how it is caught. A governability assessment, which examines what aspects of the governing system and the system-to-be-governed that may make the system less governable (Chuenpagdee and Jentoft 2009), is an analytical framework that can be used to examine IUU fishing. With this lens, an examination of why IUU fishing occurs and persists in Lake Victoria will not only be focused on finding technical measures or adjusting the existing governing structure alone, but will look into the underlying values, images and perspectives of all relevant stakeholders on the issue. In other words, this assessment helps to identify how various stakeholders perceive the problem, examines the characteristics of the system-to-be-governed, the governing system and the governing interactions that may improve or inhibit governability (Chuenpagdee and Jentoft 2013). Governing interactions, in particular, reveal ways and the degree to which various stakeholders' interests and motivations are expressed and included in governance systems (Song et al. 2013).

In the context of Lake Victoria, the theory argues that the causes of IUU fishing and ways to address it may be found within and between the system-to-be-governed, the governing system, and their interactions and that an examination of stakeholders' perception of the problem can help in understanding of what they think about the problem and what is done to address it (Jentoft et al 2010; 2012; Song and Chuenpagdee 2014; Voyer et al. 2015).

These perceptions or understandings are conceptualized as ‘image’ in interactive governance theory (Kooiman et al. 2005), and are considered to have significant influences on the outcome of the governance measures (Jentoft et al. 2010; Chuenpagdee and Jentoft 2013; Song et al. 2013). This is to say that the existence of different images between fishers and managers in Lake Victoria about the level of damages of different fishing-related activities, and actions employed to address IUU fishing is likely to contribute to governability challenges. In developing this argument further, a fishing activity is judged to be damaging or not based on individual values and norms or those defined by the social group to which he/she belongs. And this influences how one interacts with nature, responds to, and judge the compliance measures.

This thesis applies the governability assessment framework to examine IUU fishing situation in one fishing village in Lake Victoria Tanzania, Ijinga Island located in Magu district of Mwanza region. Specifically, the thesis describes the characteristics of the fisheries system in this village, examines the structure and functions of different management units forming the governing system, and assesses the extent of their interactions. Further, as an attempt to explain the underlying reasons for the persistence of IUU fishing, it explores the fisheries stakeholders’ judgement about the level of damages of different fishing-related activities. The thesis contributes to addressing IUU fishing problems in Lake Victoria and elsewhere by providing a methodological approach to exploring how the images held by the different fisheries stakeholders can be a barrier to addressing IUU fishing. In addition, the analysis of the system characteristics helps in

identifying the areas or aspects that allow the problem to persist and potential opportunities for improving governability.

1. 4 Research statement, objectives and questions

IUU fishing is a challenge in Lake Victoria. The alleviation efforts based on regulating the use of certain fishing gears and methods, and prohibiting fishing activities in some areas have been mostly unsuccessful. The main purpose of this study is to examine why IUU fishing has persisted in Lake Victoria, despite the strategies directed at its alleviation and to discuss alternative approaches, which may be helpful to alleviating IUU fishing. Following interactive governance perspective and the governability assessment framework discussed above, this study is based on two hypotheses. First, there are characteristics of the system-to-be-governed, the governing system and the governing interactions in Lake Victoria that permit IUU problem to occur and persist. Second, there are different understandings or images of the problem by the different fisheries stakeholders. Based on this, the following specific research questions were formulated.

1. What characteristics of the system-to-be-governed, the governing system, and the governing interactions may be the underlying reasons for persistence in IUU fishing?
2. Do fisheries stakeholders differ in their ‘images’ and considerations about the level of impacts of fishing-related activities, including those considered IUU fishing? If so, how?

3. What could be alternative governance approaches for Lake Victoria, which may help address IUU fishing?

The first question aims to identify the characteristics of the system, i.e., diversity, complexity, dynamics and scale issues that contribute to IUU fishing. In addition, it assesses part of the system where such problem is to be found and potential opportunities for improving governability. The second question aims to determine whether there are different images or judgements between fisheries stakeholders about the level of impacts on fishing-related activities, and how these differences may affect efforts to tackle IUU fishing. The final question identifies governance approaches to addressing IUU fishing in Lake Victoria, with discussion about implications elsewhere.

1. 5 Thesis outline

This thesis is made up of four chapters, with chapters two and three written as scientific articles for peer-reviewed journals. The first article (chapter 2) describes the Lake Victoria's fisheries systems and identifies governability challenges in addressing IUU fishing. The second article (chapter 3) provides the empirical evidence on stakeholders' images of the damaging fishing-related activities including those that are regarded as IUU fishing problem in the context of Lake Victoria fishery. This chapter employs paired comparison methods to examine judgements of stakeholders on ecologically damaging fishing-related activities as they relate to IUU fishing. The final chapter provides a summary and conclusions of the research findings as well as policy implications and recommendations for addressing IUU fishing in the lake.

1. 6 Co-authorship statement

I am the lead author of chapters 2 and 3 and I took primary responsibility for the design, data collection, analysis and thesis writing. The 2nd author of both papers is the thesis supervisor, who contributed to the design of the study, in addition to providing general guidance and editorial oversight throughout the process. The 3rd author of the second paper is a committee member, who assisted with the study design and provided constructive feedback in the revision of the manuscript.

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Chapter 2: Examination of Illegal, Unreported and Unregulated Fishing in Lake Victoria as a Wicked Problem

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Abstract

Illegal, unreported and unregulated (IUU) fishing is a challenge to the sustainability of Lake Victoria fisheries. It reduces fish stocks, and erodes the benefits to the people whose livelihoods, income generation and food security depend on the fishery. Management strategies directed at its alleviation have been largely unsuccessful, and different explanations have been given for the persistence of IUU fishing. This suggests that IUU fishing may be a 'wicked problem,' which explains why the situation persists and how it cannot be solved using technical fixes. Using Lake Victoria small-scale fishery in Tanzania as an illustrative case, this paper applies the interactive governance framework to identify the characteristics of the fishery systems, as well as limits of, and conditions for, governability, and how these properties affect IUU fishing. First, we examine the natural environment, the fisheries resource users and the governing system in terms of diversity, complexity, dynamics and scale. We also identify interactions between these various groups, and discuss whether IUU fishing is indeed a 'wicked problem' that is difficult to govern. The paper ends with discussion about how comprehensive and systematic framework like governability assessment can help address IUU fishing problems.

Key words: Interactive governance, governability, small-scale fisheries, Lake Victoria, IUU fishing, 'wicked' problem.

Introduction

Small-scale fisheries are important for nutrition, food security, sustainable livelihoods, and poverty alleviation to many people, especially in developing countries (FAO 2014). For example, they employ nearly 40 million people, and produce around half of the world's fish that is designated to human consumption. Thus, sustainability of small-scale fisheries has been, and is still, a priority for fisheries management. Managing small-scale fisheries is a challenging task, however, for many reasons, one of which is related to illegal, unreported and unregulated (IUU) fishing. According to FAO (2001), IUU fishing accounts for 30% of the world's fisheries catches. Agnew et al. (2009) estimate global loss due to this problem to be between USD 10-23 billion, which represents between 11-25 million tonnes of fish per annum. For this reason, IUU fishing has been identified as a major threat to the world fish stocks, as well as to livelihoods of fishing people, including small-scale (Le Gallic and Cox 2006; Plaganyi et al. 2011; Pollachek 2012). Developing countries, in particular, face a greater challenge in effectively addressing IUU fishing than in developed countries (Alabsi and Komatsu 2014).

Lake Victoria is Africa's largest water body that is estimated to support the livelihoods of over 30 million inhabitants of the greater lake region (World Bank 2009). The lake is a major source of food, income, employment and foreign exchange earnings, and contributes up to 3% of the gross domestic product of the riparian states. However, these

benefits are threatened by IUU fishing. IUU fishing became a major concern in the region between 1997 and 2000 following the European Union ban on Nile perch (Lates niloticus) after it was discovered that fishers were using organophosphates (acute toxins) to catch these fish (Markovina and Bennett 2013). Although poison fishing ceased, the use of other destructive fishing gears and methods continued (Abila et al. 2005, 2006; Njiru et al. 2007, 2008).

In response, various regional and national strategies such as gears and catch restrictions were adopted and are being implemented to address this concern. In addition, co-management regimes were established and it was anticipated that they would help alleviate the problem. However, IUU fishing has remained a serious threat to fisheries resources as well as fisheries dependent communities (Ogwang' et al. 2009; Ikwaput-Nyeko et al. 2009; Kayanda et al. 2009). This persistence of IUU fishing in small-scale fisheries raises questions with regards to how management mechanisms are formulated and implemented within a broader governance framework. In other words, what kind of relationship exists between IUU fishing and deterrence measures as a management mechanism? Could it be that the perennial IUU is an indication of an overinvestment in technical management rather than *governance*? This paper uses Lake Victoria fishery as an illustrative case to examine whether persistent IUU fishing is a 'wicked' problem that requires a governability lens to better understand and address.

According to Jentoft and Chuenpagdee (2009), fisheries governance is often confronted with 'wicked' problems. Wicked problems are complex, persistent, and often hard to

detect and to fix, partly because they are linked to broader social issues (Rittel and Webber 1973). In addition, Jentoft and Chuenpagdee (2009) argue that effective resolution of wicked problem requires not only attention to good science and management but also attention to socio-economic and political considerations. Chuenpagdee and Jentoft (2013) further submit that in addressing this kind of problem, each context and uniqueness of the problem must be considered. In view of these arguments, the pervasive IUU fishing in Lake Victoria, despite the global and national efforts directed at its eradication, could be best examined from a 'wicked' problem approach. The interactive governance theory and the governability assessment framework provide a structure for examining such a complex problem (Kooiman 2003; Kooiman et al. 2005; Bavinck et al. 2013). The theory posits that complex problems and the governability challenges that they pose are to be identified within each of the three systems, i.e. the system-to-be-governed, governing system and relationships between them. Jentoft (2007) argues that these systems need to be compatible for governance to work. Further, he reasons that there are attributes of the system–to-be-governed that may challenge the capacity of the governing system to perform its function. Thus, addressing IUU fishing in Lake Victoria, and thus improving governability, requires thorough examination of the lake ecosystem, the fisheries resources, resources users, and institutions, rules and regulations being employed.

This paper commences by describing the nature of IUU fishing in Lake Victoria, its impacts on the resources and fishing communities, and how it is being addressed. This is followed by an examination of the Lake Victoria's systems, to identify limits and

conditions that give rise to IUU fishing. Finally, the paper discusses how the governability assessment framework can be used to help improve fisheries governance in Lake Victoria, and elsewhere.

Impacts and causes of IUU fishing

IUU fishing is known to have negative economic, ecological, environmental and social impacts (Agnew et al. 2009; Plaganyi et al. 2011). In Lake Victoria, it is believed that IUU fishing has caused the decline of Nile perch biomass from one million tonnes in the 1990s to about 300,000 tonnes in 2000s (Mkumbo and Marshall 2014; Ikwaput-Nyeko et al 2009; Kayanda et al. 2009). In addition, IUU fishing contributes to lack of accurate statistics about the status of the fishery as most of illegally caught fish are landed in unregulated sites and are not disclosed to the authorities. According to FAO (2003), catches from IUU fishing are 2 to 3 times larger than what is reported in official statistics. At the same time, unregulated fish trade and catch of immature fish reduces the revenues earned by the governments (Kariuki and Markovina 2012). This limits the governments' ability to garner resources to support some of the fisheries management measures and other activities that depend on fisheries income. Moreover, IUU fishing can lead to high levels of by-catch of both juvenile fish and non-target species, resulting in decline in fish stocks contributing to food insecurity (Abila and Kisumu 2003). Finally, IUU fishing can lead to social inequalities as the illegal gears make the legal fishers lose catches, which they could have harvested had the young fish reached maturity.

Numerous social and economic factors have been cited as "drivers" of IUU fishing. They include high cost of legal gears, open access nature of the fisheries, and existing local market for juvenile fish (Johnson 2014; Katurole 2012). Others point to poverty within the fishing communities, partial involvement of communities in management and decision making (Johnson 2014; Njiru et al. 2007), and weak enforcement of regulations (Ntiba 2001; Etiegeni et al. 2011; Eggert and Lokina 2010). The economic school of thought argues that IUU fishing is incentive-driven, governed by economic principles of supply and demand. In other words, the more valuable the trade, the more likely participants will engage in illegal actions. Increases in human population offer demand, while poor fisheries management and control mechanisms (especially of developing countries) present loopholes (Markovina and Bennert 2013; Alabsi and Komatsu 2014).

Strategies used to address IUU fishing

Because of the enormity of issues and negative consequences associated with it, addressing IUU fishing has become a priority for fisheries management in the East African Community (EAC) region. EAC member states (Kenya, Tanzania and Uganda) adopted a Regional Plan of Action (RPOA-IUU) in 2002, which is guided by the International Plan of Action (IPOA-IUU). Measures used to alleviate IUU fishing are shown in Table 1. In addition, the Fisheries Management Plan (2002) was approved by the EAC and is being implemented by member countries, including Tanzania. This plan calls for increased collaboration between enforcement teams around the lake, and requires the Beach Management Units (BMUs) to enhance compliance with fishery rules and regulations (Ogwang et al. 2009; Ikwaput-Nyeko et al. 2009). Furthermore, in 2008 the

fish processing industries initiated self-monitoring and control systems locally known as ‘zero tolerance’, which adheres to the policy of not harvesting Nile perch less than 50 cm in total length. The launching of “Operation Save Nile Perch” (OSNP) by the Lake Victoria Fisheries Organization (LVFO) Council of Ministers followed in November 2009, as well as the establishment of a Regional Fisheries Taskforce (RFT), responsible for leading and coordinating the review and update of the Nile Perch Fishery Management Plan (NPFMP) for 2009–2014. These measures aim largely at protecting the fish stocks. The assumption is that strict penalties and tight enforcement of fisheries regulations will reduce illegal behaviour.

Table 1: Current strategies to alleviate IUU fishing in Lake Victoria

Measures	**Goals**	**Underlying assumption**
Restrict the use of illegal fishing gears and methods; including gillnets <5 inches' mesh size, use of cast nets, monofilaments nets, beach seine, and fish poison	Control harvest of immature fish Protection of fish & habitats	Managing fish or the ecosystem through controlling what is caught, how it is caught, and enforcement of laws leads to improved conservation. Tackling IUU fishing requires well structured, resilient institutions and financial support. All these assumptions mainly focus on the ecosystem health assume that stricter penalties will prevent, deter and eliminate IUU fishing.
Nile perch slot size (50-85cm length) Minimum size of Tilapia to be landed 25 cm length	Protect immature and adult fish	
Implement closed areas and closed seasons	Protect fish species during breeding season	
Budgetary provisions for fisheries research, development and management	Ensure sustainable sources of funding to support fisheries development.	
Develop joint licensing mechanisms	Improve compliance and control entry into fishery	
Ensure collection of correct fisheries and socio-economic data, analysis, storage and dissemination	Improve management	

Source: LVFO (2004)

However, the increase in the number of destructive fishing gears and methods reported in frame surveys between 2000 and 2012 raises doubts about the effectiveness of these measures in addressing IUU fishing. For instance, the use of illegal gillnets has increased by more than 90%, while the use of undersized hooks has increased by over 100% in the same period. Moreover, the number of beach seine and monofilament nets, which are considered to be the most destructive, has increased by over 50% (LVFO 2012). Finally, an audit report (2013) by Controller and Auditor General (CAG) for the Tanzania

fisheries sector indicated that over 50% of the vessels in Lake Victoria operate without registration. This implies that a significant percentage of landed fish falls under IUU fishing, an indication that IUU fishing is still a challenge. Despite the inadequacy, these measures have continued to be prioritized to combat IUU fishing (Njiru 2007; 2008; Kayanda et al. 2009; Etiegeni et al. 2011; Mkumbo and Marshall 2014). The persistence of IUU fishing suggests however that the problem may be too complex to be addressed by technical measures. Instead, it requires a systematic and comprehensive examination of the whole fishery system, as illustrated below.

Lake Victoria as a system-to-be-governed

Natural system

With a surface area of 68,800 sq. km, Lake Victoria is the largest of the African Great lakes. The lake is shared by Tanzania (51% of area), Uganda (43%) and Kenya (6%). It has a mean depth of 40m, with the deepest part reaching 84m. The shoreline stretches about 3450 km and the catchment area of 193,000 km^2 extends into Rwanda and Burundi. The lake is irregular in shape and its shores, with an exception of the western side, are deeply indented. It has numerous shallow bays and swamps, including extensive papyrus swamps. Within the lake, a number of rocky habitats, shallow and deep shore fishing grounds, river mouths and gulfs can be found (Witte and Densen 1995). The lake has over 3,000 islands, many of which are inhabited. Moreover, Lake Victoria receives 80% of its water primarily from direct precipitation. The remaining percentage comes from rivers which drain into the surrounding catchment. The largest stream flowing into the lake is the Kagera River, the mouth of which lies on the lake's western shore. Lake Victoria is

drained solely by the Nile River near Jinja, Uganda, on the lake's northern shore. There are also a number of small “satellite” lakes that connect to Lake Victoria, including, Ikimba, Katwe and Burigi in Tanzania (Katunzi and Kishe 2009). The fertility of the lake depends therefore on the rate at which the influent rivers provide nutrients to it. However, as observed by Beauchamp (1954), most of the lake’s nutrients are thought to be locked up on the lake-bottom deposits. Limnological and hydrological studies reveal the lake to be eutrophic (Sitoki et al. 2010). This is attributed to the rapid human population growth around the lake, which has led to deforestation and extensive agriculture within the basin. The effluents from wastewater system and industrial runoff flowing directly into the lake have greatly increased the levels of nitrogen and phosphorus in the lake, causing the growth of exotic water hyacinth. Furthermore, the decrease of endemic fish species, especially the phyto- and zooplanktivorous haplochromines have contributed to increase of algae, thus choking the lake (Sitoki et al. 2010). The increased amount of algae, in turn, increases the amount of detritus (dead plant material) that falls to the deeper portions of the lake before decomposing. This contributes to depletion of oxygen levels in the upper layer of water, thus limiting the existence of fish in the deeper part of the lake (Goldschmidt et al. 1993). In addition, physio-chemical studies reveal that temperature in deeper water has increased; water transparency and chlorophyll concentrations have changed since 1927 and 1960s respectively, due to climatic change (Sitoki et al. 2010). This has impacted ecosystem functioning and fish productivity, thus causing some fish species to diversify their diets (Ogutu-Ohwayo 1990; Olowo and Chapman 1999).

Before the introduction of Nile Perch in 1950s, the lake supported more than 500 endemic fish species, dominated by tilapiine and haplochromines cichlids. Other indigenous species included several catfishes *Bagrus docmak*, *Clarias gariepinus*, *syndontis*, *Schilbe intermedius*, Lungfish *Protopterus aethiopicus*, and carps *Labeo victorianus* (Acere 1985; Kudhongania and Cordone, 1974). Currently, the fishery is dominated by Nile perch, Nile tilapia (Oreochromis niloticus), some catfish species (Synodontis and Claria gariepinus), and the schooling cyprinid *Rastrineobola argentea*, locally known as Dagaa. Of these, Nile perch is mostly targeted for the international market while Dagaa is intended for both the national and regional markets. Tilapia, on the other hand, is mainly used for local consumption. With the declining trend of Nile perch, the once thought extinct fish species such as haplochromines are resurging (Balirwa et al. 2003; Kayanda et al. 2009). In sum, the natural system of Lake Victoria exhibits moderately diverse, but highly complex trophic relationships and dynamics and complicated scale issues that pose challenges to management.

Social system

Fisheries in Lake Victoria are small-scale in nature involving many players using various fishing gears and methods. Frame survey reports, from 2000-2012, (biennial fisheries information) identify the main groups in the fisheries as boat owners, crew members, fish traders/processors, gear makers/repairers, fish agents, and gear sellers. Mkumbo and Marshall (2014) assert that the fisheries employ about 800,000 people on a full time basis, and another 4 million people who are involved as part time fishers and in other fisheries-related activities. This amount of people makes the lake's basin one of the most densely

populated areas in the world (World Bank 2009). The diversity and the complexity of the social system match those of the natural system. For instance, various fishing gears and methods are used. Fish is mostly caught by plank canoes propelled by either an outboard engine or paddles and sails. Some fishers still use dugout canoes and rafts. The plank canoes are generally 4 to 10 meters in length while the dugout canoes average 3 meters. According to 2012 Frame survey, there are 69,500 fishing boats working in the lake, of which 25% are motorized while the remaining are propelled by paddles and sails. Fishers also utilize various gears to catch fish including gillnets, hook and line, beach seine, monofilament, seine nets, and mosquito nets. In other areas, traditional fishing gears and methods such as basket and traps continue to be used. A fishing entity comprises a boat owner and fishing crews. On average, a single boat has three crew members. There are no limits on the number of boats and gears that an individual can own. This has led to some fishers owning up to 1,000 fishing boats and multiple fishing gears (A. Hamad, personal communication, August 20, 2015).

Fishing in Lake Victoria is carried out alongside other activities such as farming, livestock keeping, and small businesses among others (Lwenya et al. 2009), providing thus supplementary income to fishing. At the same time, fishers also engage in other activities within the fishery. For instance, some boat owners also work as fish agents. In addition, some crew members also work as gear makers and vice versa. The fishery is also gender segregated with males dominating in the harvesting sector while women' participation is mainly in post-harvest activities, such as processing and trading of fish in local, regional and national markets (Lwenya et al. 2009). The dependency of male

fishers on women traders/processors adds a layer of complexity to social relationship. Furthermore, there is high mobility of fishers (mostly fishing crews) between landing sites and boats (Nunan et al. 2012). The region is also considered widely affected by HIV/AIDS, poverty and inadequate social services and infrastructure, like roads, electricity, and water supply. These characteristics have far-reaching consequences on the governance of the lake as they increase pressure on the fisheries resources, and limit the capacity of the affected and mobile fishers to participate in the sustainable resource uses (Yongo et al. 2005; Nunan et al. 2012).

The proliferation of Nile perch in 1990s had several consequences, one of which was related to an incorporation of the Lake's fisheries resources into global market, changing thus the Lake Victoria's fishery landscape (Abila 1997; 2003). For instance, an industrial level fishery was developed, characterized by high-level commercialization of production and distribution. This in turn reduced the role of women in Nile perch processing, and created another group in the fisheries-fish agents, who have more influence on what happens along the Nile perch fish chain from capture to factory delivery (Onyango and Jentoft 2010). This group "has a leading role in controlling the mode of fishing, the gear used, the prices paid and other conditions that fishers are subjected to" (Onyango and Jentoft 2010, p. 254). At the same time, the collapse of agriculture in this region has led to increased influx into the fisheries including people that were not originally fishers (Onyango 2004). This has contributed to an increase in number of fishers and fishing gears in the lake (Ikwaput-Nyeko et al. 2009). As a consequence, informal settlements, locally known as "kambi," have mushroomed - a situation where a boat owner, together

with his fishing crews, moves to a new landing site temporarily to catch fish. Further, there have been increased uses of motorized boats and monofilaments nets as well as a shift from gillnet to a long-line fishery. For instance, the number of hooks has increased from thousands into millions from 2000 to 2012 (LVFO 2012; Chitamwebwa et al. 2009). In addition, the increased uses of hooks adversely impact on the biodiversity of the lake as most of the resurging fish species are used as baits for catching Nile perch (Chitamwebwa et al. 2009). In recent years, fishers have also resorted to vertically joining of nets in order to catch more fish, adding thus complications to the governing system. This "innovation" is not only restricted to Nile perch fishery, but also to Dagaa, where small mesh sized seine nets and mosquito nets are used to catch the fish. In addition, most of the women who were involved in the Nile perch processing before the establishment of processing industries have turned to processing and trading Dagaa (Modesta 2005).

There is a very high level of interaction that goes beyond the lake's boundary. For example, fishers interact with other local residents (non-fishers) within these communities. Proceeds from fisheries are invested in other businesses and this provides employment opportunities to many people within the basin. Moreover, people from the lake region working in other areas channel back some money to the lake region. At the same time, there are informal savings and credit groupings among the fishers and especially women (Onyango and Jentoft 2011; Modesta 2005). Labour mobility has increased with fishers moving between landing sites (Nunan et al. 2012), and into other activities such as farming and mining and back to the fisheries. The technological advancement in the telecommunication industry has also necessitated quick exchange of

information among fishers while out fishing and at home, and has provided a medium through which vital information such as fish prices between processing factories are shared. Further, the exportation of fisheries products from the lake has opened up the fishery to regional and international markets. Through donor funding, the latter has since influenced a number of activities around the lake. These descriptions indicate that the social system of the lake is moderately diverse and complex, but highly dynamic and operates at a wide range of scales.

Governing system

The lake is managed through a co-management system in which the government, through various agencies, shares management responsibilities with the fishing communities and other stakeholders. The co-management regime was established in the lake in the 1990s as a response to the failures of centralized management (Hoza and Mahatane 2001). Being a transboundary resource, the fisheries are managed through diverse and complex institutions that operate at various scales. At the regional level, the Lake Victoria Fisheries Organization (LVFO), which is an institution of the East African Community (EAC), are responsible for fisheries management. LVFO was formed in 1994 through the technical assistance from FAO. The Council of Ministers is the supreme body of LVFO, which adopts measures for management and conservation of fisheries. Below the Council of Ministers are various committees, such as a Policy steering committee comprising permanent secretaries from Ministries of Fisheries from the EAC states; Executive committee comprising Director of Fisheries; Scientific committee comprising Directors of Research, and working groups comprising researchers and fisheries managers from

member countries and the private sector. LVFO operations are funded through member countries as well as support from donors. In addition to the LVFO, there is a legislative arm of the EAC, the East Africa Legislative Assembly (EALA), whose core responsibilities are legislating, oversight and representation.

In Tanzania, the fisheries are managed through the Fisheries Division headed by the Director of Fisheries, under the Ministry of Agriculture, Livestock and Fisheries Development. Many actors in other levels and organizations are also involved in fisheries governance. These include fisheries research institutes, fishing communities and private sectors such as civil societies and fish processing industries. The involvement of various actors in governance was made possible following the repeal of Fisheries Act No 6 of 1970, replaced by Fisheries Act No 22 of 2003, which legalized the establishment of the co-management regime. This led to the formation of over 1,000 BMUs around the lake, 430 of which are on the Tanzanian side. Later, BMU Networks and Fisheries Co-management Committees were formed at local, national and regional levels, in order to improve BMUs participation in decision-making, making them thus more effective in fisheries co-management (Ogwang' et al. 2009).

The BMUs are legally responsible for enabling the collection of fisheries planning information, undertaking Monitoring, Control and Surveillance (MCS) in collaboration with the relevant authorities to reduce harmful and illegal fishing practices, participate in vetting of boat owners and fishers for licensing, ensure licenses are granted to those registered with the BMU in collaboration with government officials, identify wider

development interventions at village level from the BMU plan and make financial proposals for their support among many others (URT 2005).

Through decentralization, the district fisheries officers, the ward (administrative unit in a district), fisheries staffs and BMUs work under the jurisdiction of a District Executive Director (DED). The DED works administratively under the Ministry of Local Government and Regional Administration. Within this structure, the two ministries liaise in their governance efforts because some of the functions such as revenue collections, establishing landing sites, boat registration and fishing licenses are decentralized. Moreover, because landing sites are located in the villages, the BMUs are supposed to work under the village leadership, but independently. For instance, one of the BMU committee members is supposed to be a member in the village council committee to represent fishers. This is to ensure that fisheries issues are discussed in the village council meetings, and in turn fishers benefit from development projects undertaken in the village. While this has yet to be implemented in all areas, it has created tension between BMUs and the village authority in some locations. The village authority appears politically stronger partly due to the legislative powers granted by the Local Government Authorities Act 1982, among others. This act gives village committees authority to address socio-economic and political issues at the village level. Moreover, there are claims of political interferences from politicians, which have impacted the BMUs performance, given the power and influence these groups have at the local level (Onyango and Jentoft 2010).

Lake Victoria fisheries are further governed through the National Fisheries Sector Policy and Strategic Statements of 1997. The policy is backed up by Fisheries Act No 22 of 2003 and Fisheries Regulation of 2009. These legal documents stipulate on issues such as enforcement, offences, penalties and control of the fishing industry as well as general provisions. In sum, the multiple actors in governance, at all levels, create a complex governing system. Coordination of the multiple actors in all levels and types of organization involved in governance can be challenging in a fishery that depends largely on donor funding to implement management measures. The inadequate involvement of BMUs in decision-making undermines the roles of fishers and other social actors in governance, which, according to Song et al. (2013) and Chuenpagdee and Jentoft (2013), affects the overall governability.

Governing interactions

Chuenpagdee and Jentoft (2009) argue that the governability of both the system-to-be-governed and the governing system centres on: (i) information sharing and communication, (ii) integration and coordination with other governing measures, and (iii) learning and adaptation between these two systems. As previously described, the co-management system is designed to facilitate interaction between different fisheries actors. For instance, the ward fisheries officer should interact with the BMUs on a daily basis. Interactions are, however, limited to only some activities and has largely remained top-down and uni-directional, that is, from the fisheries officers to BMU. Further, due to budgetary constraints, and inadequate staff, the focus of interaction has been mainly

related to the first order of governance, i.e. day-to-day business such as boat licensing, revenue collection and patrolling.

It has been argued that the co-management system in Lake Victoria has given fishing communities greater participation in decision making (Ogwang et al. 2009). However, an observation by Onyango and Jentoft (2010) reveals that despite the new Fisheries Act 2003, which entrenched decentralization of decision making to the communities, the government still retains the power of decision making and directing how the implementation should be done. Because consultation and discussion forums where the government and resource users can voice their opinion are lacking, fishers are left only with a formal channel to voice their concerns. This means going through a time consuming process involving various governing actors in different levels before their concerns are addressed. This lengthy chain makes the governing interaction tedious and ineffective. The lack of an open access to decision-making (like a consultative forum) has basically deprived fishers from discussing fisheries matters with other governing actors. At the same time, the BMUs do not participate in collecting fisheries information and there are no proper channels of sharing research findings with the communities to provide required knowledge. This weak communication weakens the performance of BMUs. For example, BMUs seldom hold fisheries stakeholders' meetings at the landing sites as required by the BMU guidelines. In addition, fishers are not involved in the preparation of patrols; they only get involved when a patrol team is already at the landing site. However, there seems to be good interactions at the LVFO level and between the directorate of fisheries and research institutes (Onyango and Jentoft 2010). As observed by Barragan-

Paladines and Chuenpagdee (2015), weak involvement of resource users in governance greatly contributes to limiting governing interaction, hence making the overall governance system ineffective. This lack of communication between governments and BMUs negatively affects the ability of the latter to govern the lake, and limits the abilities of relevant actors to deal with emerging challenges such as IUU fishing and livelihoods concerns.

The reformation of BMUs in 2006 through enactment of legislation is a significant step towards shifting the emphasis on function rather than structures. However, the low degree of dialogue and interactions and "top down" communication that follows a hierarchical path from the governments to fishing communities prevents learning from previous challenges, and also for adapting to new situations. This inflexibility poses challenges as representativeness and inclusiveness are required in co-management. In summary, though the existing governing interactions in Lake Victoria are diverse and complex, lack of effective cooperation and interactions, along with intrinsic challenges, have made the governing system inflexible to address the needs and demands of the system-to-be-governed.

Table 2 Summary of the assessed system properties

	System-to-be-governed			
System properties	Natural	Social	Governing system	Governing interactions
Diversity	Moderate	Moderate	High	Medium-high at regional level, but low at local level
Complexity	High	Moderate	High	
Dynamics	High	High	Low	
Scale	High	High	Medium	

Discussion

The assessed system properties as summarized in table 2, indicate the existence of underlying governance issues in the system-to-be-governed, the governing system and the governing interactions that makes the system less governable, thus giving rise to low governability. It is also through these systems that governability assessment should be focused. Chuenpagdee and Jentoft (2009, p.112) further elaborate that 'governability depends on the ability of the system-to-be-governed and the governing system to respond individually and in concert to the challenges and demands that their diversity, complexity, dynamics and scale bring up'. In other words, this observation implies that however high the level of system properties in the system, it may still be governable if there are effective interactions and response between the systems.

In the case of Lake Victoria fishery system described above, the inherent weak interactions between the governing system and the social aspects of the system-to-be-governed are likely to contribute to low governability. This weak interaction between the governing system and the social aspects of the system-to-be-governed (resource users) denies them the opportunity to make a contribution towards fisheries goal formation. In other words, their concerns, including issues that are important to them are not taken into consideration in decision making processes. For instance, a study by Onyango and Jentoft (2010) in Lake Victoria shows that fishers consider access to food more important than sustaining the fish stocks. However, the technical management measures (rules and regulations) employed by the governing system have not only inadequately addressed the challenges related to dynamics and diversity in the natural system, but also the needs and

concerns of the social system. These rules seem to focus most on the most commercially viable fish species in Lake Victoria-Nile perch and not the other fish species such as haplochromines and tilapia, which are primary sources of food to many people (Balirwa et al. 2003). Under such circumstances, the laws are likely to be challenged and possibly opposed thus reducing the governability. This low governability on the part of the governing system illustrates the inflexibility and irresponsiveness of the governing system (Jentoft 2007; Nunan 2010; Satumanatpan and Chuenpagdee 2015), to imposing rules that do not respond to the demands and concerns of the system-to-be-governed.

In addition, governability of the lake is further affected by the moderate to high level of system properties in the system-to-be-governed. On one hand, the high complexity and dynamics in the natural system and on other hand, the high dynamics and complicated scales embedded in the social system require constant attention, monitoring and collaboration with many stakeholders. Although the lake is governed through a co-management approach, however, its implementation faces myriad challenges from operational to financial to inadequate human resources (Ogwang et al. 2009; Onyango and Jentoft 2010; Njiru et al. 2008). This has hampered the management measures-including efforts to tackling IUU fishing. It should be noted that in Lake Victoria, the dynamics in the fishing gears and methods experienced in recent years are influenced by international and regional fish markets. These exogenous factors bring more complexity and dynamics that may affect system governability. For example, the increase in number of fishers and subsequent increase in the use of destructive fishing gears and methods are attributed to these factors (Cowx et al. 2003; Njiru et al. 2009; Ikwaput-Nyeko et al

2009). Given this challenge, the governability of the fishery may be improved by considering or implementing an ecosystem approach to fisheries management. This approach merges both the goal of conserving the structure, diversity and functioning of ecosystem, and satisfying the societal and human needs for food and economic actions.

Following the assessment of Lake Victoria system, we argue that the persistent IUU fishing is a governability issue that can be traced from the system-to-be-governed, the governing system and the governing interactions. It is also within these systems that a governability assessment can be conducted. Such assessment may highlight how to make strategies to tackle IUU fishing more effective by addressing the weaknesses and failures in the system. This is an approach that the existing technical management measures used to address IUU fishing have not focused on. These measures treat the problem as an ecosystem based one. And this explains why the problem has persisted despite the instruments directed at it.

Conclusion

To better understand and address IUU fishing in Lake Victoria the governability assessment framework developed by Chuenpagdee and Jentoft (2013), provides a four step assessment with three key areas that guides such examinations, i.e., (i) where to look (ii) what to look for; and (iii) what to look at. The first step should focus on how the lake's stakeholders understand and define the IUU problem, how they regard the governing system approaches to tackling the problem, and what they consider to be the causes of the problem. In the second step, the focus is on examining the system-to-be-

governed, the governing system and the governing interactions based on the four system properties, i.e., diversity, complexity, dynamics and scale. This assessment, as already discussed in this chapter, identifies where or that part of the system that makes the system less governable. It also highlights potential opportunities or areas where to improve governability. In the third step, the examination is on the elements that make up the governing system. This involves looking at the suitability of the mode of the governance in responding to the challenges and facilitating fitting interactions. Finally, the last step focuses on the interactions between the system-to-be-governed and the governing system. Here, examination is on the factors that enable or hinder interactions and how these interactions are favourable to governability. This examination should be guided by questions such as; how is the problem perceived and defined? Who considers it to be a problem? Why is it a problem? What are the institutions and instruments used to address it? Why have they been chosen to address the problem? How do the governing actions against IUU fishing match the needs of the natural and social systems?

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Chapter 3: A bottom-up understanding of illegal, unreported and unregulated fishing in Lake Victoria

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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 gears 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, the 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 in Ijinga Island in the south-eastern 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 varied judgements exist between fisheries stakeholder groups on this topic. In particular, fisheries managers and scientists tend to consider some IUU fishing-related activities less damaging to the fisheries resources and ecosystem than some non-IUU fishing activities. Such disparity creates governability challenges, pointing to the need to revisit relevant regulatory measures and to make them consistent with the knowledge and judgements of

all stakeholders. Based on these findings, we conclude by discussing governing interventions that may contribute to lessening IUU fishing.

Keywords: Lake Victoria, IUU fishing, interactive governance, governability, RPOA and image

Introduction

Illegal, unreported and unregulated (IUU) fishing is not only an issue in high seas but is also a matter of great concern to inshore and coastal areas, where small-scale fisheries operate. Given the importance of this sector to nutrition, food security, livelihoods and poverty alleviation – especially in developing countries (Bene et al. 2007; Salas et al. 2007; Garcia and Rosenberg 2010), it is imperative that IUU fishing is addressed as it could lead to resource degradation and fisheries unsustainability (Swan and Greboval 2004). As a response to IUU problems, the Food 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) (FAO 2001). Despite the implementation of these measures, IUU fishing has persisted in several waters. In developing countries, the situation is made worse with the unabated continuation of overfishing and habitat destruction, despite numerous scientific warnings (Duda and Sherman 2002; Vince 2007). A critical view has emerged, however, about the applicability of the IPOA-IUU in small-scale fisheries, given their diversity, complexity and dynamics (Kolding and Zwieten 2011; Nielsen 2003). IUU fishing falls into the category of the 'wicked problems' in fisheries (Jentoft

and Chuenpagdee 2009), meaning that it is difficult to understand where and why the problem begins, and therefore it 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 (Kooiman et al. 2005; Bavinck et al. 2013; Jentoft and Chuenpagdee 2009; Chuenpagdee 2011; Song et al. 2013). In addition, governing institutions need to be structured in a way that corresponds with the problem that they are intended to address (Jentoft 2007; Chuenpadgee et al. 2008). This is to say that the 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 (Bavinck and Salagrama 2008; Jentoft and Chuenpagdee 2009; Song 2015).

In the context of IUU fishing, mismatches may occur because fishers do not realize how ecologically damaging their fishing activities are or they do not understand the rationale behind fishing regulations like conservation and sustainability. More fundamentally, they may not hold the same images regarding these objectives as with the managers or scientists who have problematized the issue of illegal fishing in the first place (see Song and Chuenpagdee 2013). Several examples attest to this, Onyango and Jentoft (2010, p.260) 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. (2010) and Voyer et al. (2015) in their studies on 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 establishment of MPAs as an attempt to limit their fishing grounds while in other areas fishers felt that they were not adequately informed prior to establishments. In such cases, compliance to certain management measures, including IUU-alleviating measures would be a hard-sell, rendering any state or regional effort a dubious undertaking. This paper commences by conceptualizing the concept of image, and discusses how it may influence management outcomes. This is followed by a description of the study area, methods used in data collection and data analysis. Next, the paper presents respondents' judgements on level of damages of different fisheries-related activities, causes of IUU fishing and suggested actions to tackle IUU fishing. This is then followed by a discussion on how the observed differences affect efforts towards tackling 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.

The concept of images in fisheries governance

According to interactive governance theory, images that stakeholders hold are said to have a significant influence on the outcome of governance measures (Jentoft et al. 2010; Chuenpagdee and Jentoft 2013; Song et al. 2013). Images are a representation of ideas about 'what is and what should be' (Jentoft et al. 2010, p.1316). As such, differences in images between the stakeholders are likely to make a problem persists and also contribute to lower governability (Song and Chuenpagdee 2014). Conversely, this should not be translated that stakeholders in the governing process should have only one image to rely

on. As Jentoft et al. (2012) argue, stakeholders should be made aware of the present images, their origins, variations or concurrences, and the prospects they hold. Similarly, Kooiman et al. (2005) 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. 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 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 (Ikwaput-Nyeko et al. 2009; Njiru et al. 2008) may not be shared by fishers and other resource users. In such a case, governance initiatives overlooking this disparity may face on-the-ground resistance, rendering the system less governable. Moreover, this can be marred with further challenges as fishers may respond to the emerging changes in the natural system in ways that are consistent with their images while these measures remain static. Hence, Chuenpagdee et al. (2008) 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.

Materials and methods

Description of the 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 68,800km^2) and second only to Lake Superior in the world. 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[1] in Magu district of Mwanza region, Tanzania. The island is approximately 10 kilometers 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 Fig 1. Maneto is a landing site in another village external to the island but 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

[1] An administrative unit comprising several villages in Tanzania, while a village is made up of several sub-villages. The sub-villages are the lowest administrative unit at the community level.

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 2,516 people, comprising 1,245 males and 1,271 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 kept 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 through small canoes (3 and 10 meters long), and rafts (averaging 3 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.

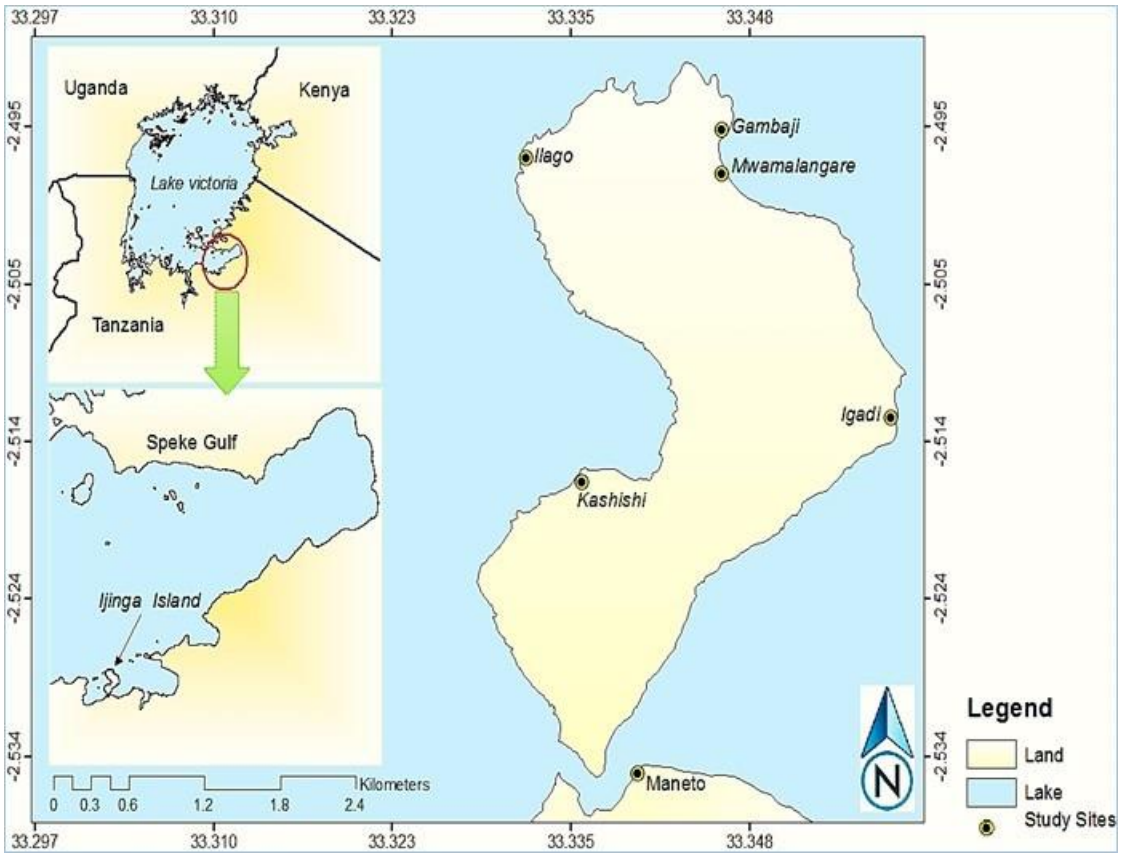

Fig 1 Map of Ijinga Island showing surveyed landing sites

Research methodology

The study employed mixed methods comprising literature review, direct observation and in-person questionnaire survey. The field research covered the period from July to October 2015. Preliminary site visits and informal discussions with key informants took place in the early stage of the research to help prepare the questionnaire and build rapport with the target communities. A pre-testing of the questionnaire was conducted in order to check for wording clarity and comprehension. The main data collection commenced in August 2015.

Survey respondents comprised three main groups; (1) resource users, including fishers and 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 judgement of the key groups involved in the fish chain. The respondents in the resource users' category were selected based on their visible occupation in the fishery, i.e., boat owners, fishing crew and fish traders/processors. A boat owner is a 'fisher' who owns fishing equipment, although he/she rarely goes out fishing. 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. Local residents were included in the survey because they represent consumers and as such may influence what happens in the fish chain. Solicitation of survey participants for the fisher group followed the common practice in Lake Victoria where potential respondents were approached after the boat arrived to a landing site. Conducted during daytime at the landing sites, the questionnaire was completed in-person with the first author asking the questions and recording the data in Kiswahili, which is his native tongue. On average, each survey took about 35 to 50 minutes to complete. In the case of managers/scientists and local residents' groups, the survey took place at their offices or homes. A total of 150 questionnaires were completed, 90 of which were from resource users (boat owners, fishing crew, processors and traders) and the other two groups completed 30 each (see Table 3).

The questionnaire contained three parts. The first part asked demographic and fishery background information such as gender, number of years in fishery-related occupation, contribution of fisheries to household income, type of fishing gears owned, and size of the

gears. The second part of the questionnaire involved a use of paired-comparison method to gauge the judgment of respondents on the impact of various fishing activities on the lake fisheries. Pair comparison is a simple and cognitively less-demanding method to elicit subjective judgments between multiple variables (Chuenpagdee et al. 2001). It is particularly useful when the subjects under the study are sensitive to literacy needs and when relative judgments or order of preferences are sufficient to provide insightful information (Chuenpagdee et al. 2001; Brown and Peterson 2009). The method has been successfully applied to study fisheries and coastal issues in several locations and contexts, including Malawi, Mexico and Thailand.

In this study, 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 4a, 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. 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, Canada). The key ethical consideration was the confidentiality and anonymity of the respondents. Names of the respondents were not recorded and participation to the survey was voluntary. All questionnaires were assigned unique ID numbers. These were then used when entering and analysing data.

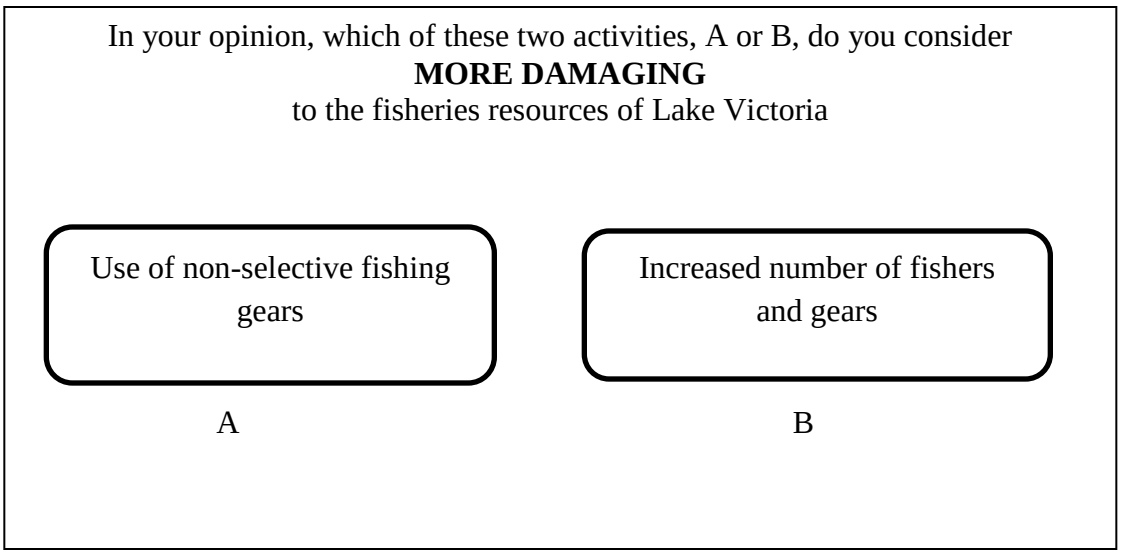

Fig 2. Sampled paired comparison question

Data analysis

Descriptive analyses were performed on demographic and fishery background questions. A series of pre-determined steps were taken to analyse the paired comparison responses (Chuenpagdee 1998). First, the number of times an activity was chosen over the other by the respondents was tallied to obtain aggregated scores for each activity. Next, the scores were normalized to a scale of 0 to 100, before assigning ordinal ranking to them, such that 1 refers to fishing activity considered most damaging while 8 designates the least. Once this was done, Kendall Tau rank correlation analysis was conducted to measure the degree of correspondence between respondent groups. All statistical tests were considered

at the significance levels higher than 0.05. Kendall Tau is an appropriate nonparametric method for ordinal rank data (Noether 1981). It is also suitable for smaller sample size and statistical hypothesis testing that establishes an association between respondent groups and measured variables (Helsel and Frans 2006; Gibbons and Chakraborti 2011).

Results

Demographic characteristics

As shown in Table 3, 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 (Lwenya et al. 2009). Table 3 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 120 of resource users' respondent group. Similar to the rest of Lake Victoria (Chitamwebwa et al. 2009; LVFO 2012), gillnets were the most commonly used gear on the island, targeting Nile perch. Additional field observation revealed that about half of the boat owners interviewed (16 of 30 respondents) use gears that are considered illegal by the fisheries regulation, i.e., gillnet with < 6 inches' mesh size, hooks size outside of the legal range of size 4-9, or dagaa seine <8 millimeter mesh size. This supports the enduring observation that small sized fishing gears are still used in the lake (Cowx et al 2003; Njiru et al. 2008).

Table 3 Demographic characteristic of respondents

Variables	Respondent category				
	Boat owner	Fishing crew	Processor/ Trader	Local resident	Managers/ 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**				

Stakeholders' 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 gears" was considered the most damaging fishing activities by all stakeholder groups, as shown in Table 4a, 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, judgements on other activities showed variations among groups. For example, boat owners, fishing crew 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 license" and "landing fish in non-gazetted site" to be least damaging with a ranking of 7 and 8, respectively. At the same time, the boat owners and local residents considered "fishing without 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 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 crew, and processors and traders were still significant, at 95% confidence level (see Table 4b). 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 Song and Chuenpagdee (2011) who found significant correlation between resource users and managers/scientists in their study of illegal fishing in Lake Nyasa (or Lake Malawi).

Table 4a: Aggregated preference normalized scores for damaging fishing activities by stakeholders group 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 4b. Kendall tau correlation coefficient analysis for stakeholders group

	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

Reasons for using destructive fishing gears

About one-third of the respondents in each category indicated poverty as a major reason for using destructive fishing gears. Other reasons showed greater variation between the respondents (see Table 5). For example, boat owners, fishing crew, processor/trader, and local residents considered 'high costs of buying legal gears' the second most significant cause, whereas managers/scientist considered 'insufficient penalties/fines' to be the secondary reason after poverty. Interestingly, fisheries managers and scientists considered 'corruption' the third biggest cause with approval from 17 respondents. This was different from the boat owners, fishing crew and local residents who considered 'good returns from using small fishing gears' to be the third cause with approval from between 5 to 8 respondents. These findings concur with other recent studies of illegal fishing (for example, Etiegni et al. 2011; Daliri et al. 2016), which show that economic conditions and management issues contribute to non-compliance of fisheries regulations. With exception of poverty, our findings reveal that managers/scientists and resource users do not share the same views on the causes of using destructive fishing gears in the area.

Table 5 Distribution of reasons for using destructive fishing gears by stakeholders (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 gears	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

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 direct fishery stakeholders, whereas local residents considered 'need for continuous awareness to fishers' a priority. The order was reverse with the secondly preferred action being 'need for continuous awareness to fishers' for the direct fishery groups 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. The agreement by respondents on the most preferred actions to improve conservation provides an important clue 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 currently undertaken.

Table 6 Distribution of suggested action to improve conservation by stakeholders (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 gears	5	3	5	11	13
Change fisheries regulations	5	1	2	4	8
Use local leadership to enforce regulations	3	1	1	5	16

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 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 effectuating 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 alternative insights into the persistence of IUU fishing and enable discussion into possible governance interventions to address the situation. In this regard, our finding reveals 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 (LVFO 2012; Chitamwebwa et al. 2009; Msuku et al. 2011). Furthermore, there was a strong association between the fishing group and the local residents and more impressively between the boat owners and the managers/scientists. While a wider agreement between the resource users and the managers/scientists was not observed, unlike the case in Lake Nyasa/Malawi (Song and Chuenpagdee 2011), the result nevertheless supports a view that a reasonable range and degree of agreement between the key stakeholder groups in this part of Lake Victoria exists to confirm potential to effectively govern IUU fishing.

At the same time, the revealed group differences should not be downplayed. For instance, the marked differences between other fisher groups (i.e., fishing crew, processors and

traders) and the managers/scientists present concerns for IUU governance. This is because unlike the boat owners, fishing crews and processors/traders are the majority in the fishery. They are also considered the least educated and poor compared to boat owners (Lwenya et al. 2009; Burnley et al. 2014). This group is also more directly involved in the fish harvest and fish marketing. In addition, they interact in greater dependency with other actors and are often highly mobile in search for better catches, prices and improved access to markets (Nunan et al. 2012). This interaction and their social status, which they seem to share with the majority of people within the lake region, might result into their images influencing others. 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 (Fulton et al. 2011; Voyer et al. 2015). Probing further in the fisheries governance literature, it is argued that images, instruments and actions are closely connected (Chuenpagdee et al. 2008; Jentoft 2007). 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 (Song and Chuenpagdee 2014). However, as observed, the images of the fishers and managers are not necessarily compatible. This creates 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 license" and "landing fish in non-gazetted site" as less or least damaging, which by virtue of their official positions they are supposed to enforce. In this stream, there is an emergence of two sets of laws; one which is implemented and enforced, and another which is not implemented. This patchy implementation and enforcement of some measures subsequently creates room for non-compliance from fishers. Combined, these perspectives shed 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 position. 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 (Eisma et al. 2005; Alabsi and Komatsu 2014).

Our findings also show that despite moderately high conservation understanding among fishers, the persistent use of destructive fishing gears (Njiru et al. 2008; Ikwaput-Nyeko et al. 2009) clearly implies that having a better conservation knowledge does not automatically translate into subsequent rule compliance. This finding corroborates with Song and Chuenpagdee (2011) who found 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 gears, also supported by other findings (Etiegni et al 2011; Abila and Omwega 2006). However, poverty is not restricted to the fishing community alone; it is a pervasive issue within the region (Abila 2003; Olago et al. 2007; Onyango and Jentoft 2010). 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 difficult reality that engenders the gap between one's judgement 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.

Conclusion

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 re-approach its resolution. In light of this, the findings from the study area provide insights that can guide policy

makers in tackling the issue in Lake Victoria. First, they highlight 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. This suggests that to successfully address IUU fishing solutions to these mismatches must be sought. Second, it suggests a need to revise some of the regulatory measures to conform to the knowledge of the stakeholders and needs of the natural system-to-be-governed. At the same time, multipronged approaches at multi levels are required to address the complex but unique issues and concerns associated with the problem. For example, for addressing non-compliance to fishing activities that are considered more damaging to the fisheries resources such as "the use of destructive fishing gears" and "fishing in breeding areas", a greater emphasis should be placed on engaging with what drives their violations such as poverty. However, in tackling other IUU fishing activities that are considered less damaging (thus less prioritized) such as "fishing without license" and landing fish in non-gazetted site", more meaningful discussion and better informed awareness and education to stakeholders could be an appropriate initial strategy. 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 which cannot only be tackled by the technical approaches. Addressing it requires a mutual interaction of both the social system-to-be-governed and the governing system.

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Chapter 4: Summary and conclusion

4.1 Thesis summary

The overriding purpose of this study is to explore why illegal, unreported and unregulated (IUU) fishing has persisted in Lake Victoria fisheries despite the international and national strategies that are directed at its alleviation. It also aims to provide alternative governance approaches, which may help address IUU fishing in the lake, and with broader implications elsewhere. The increase in IUU fishing practices in Lake Victoria (Ikwaput-Nyeko et al. 2009; Njiru et al. 2009) indicates the inadequacy of existing alleviation strategies in addressing the problem. To better examine this problem, the thesis applied an alternative perspective called interactive governance theory and governability assessment framework (Kooiman et al. 2005; Bavinck et al. 2013), which focuses on the entire fishery system and the interactions between the parts. First, the characteristics of the system-to-be governed, governing system, and the governing interactions were examined. Next, fisheries stakeholders' judgements about the level of damages that various fishing-related activities have on fisheries resources as well as actions taken to tackle IUU fishing were gauged. This methodological approach has recently received much attention in fisheries studies, following evidence that fisheries and coastal management are confronted with 'wicked' problems (Jentoft and Chuenpadgee 2009; Onyango and Jentoft 2010). This contrasts the long-held assumptions that IUU fishing is a technical or management problem that requires management technical fixes.

Chapter 1 introduces the study by presenting the issues related to IUU fishing, its impacts and causes, and inherent challenges in alleviating it. In particular, it illustrates that the

challenges experienced in tackling IUU fishing make it a 'wicked' governance issue that requires systematic and comprehensive examination to understand and address. In Chapter 2, the assessment of the system's properties reveals that the natural system-to-be-governed is moderately diverse, but is highly complex and dynamic, while the social system-to-be-governed is highly dynamic, operating at various scales. At the same time, the governing system is highly diverse and complex, but with low dynamics, i.e. little change has taken place during the last decade. The chapter highlights that the inadequacies of the governing system to respond to the needs and demands of the system-to-be-governed contribute to the overall low governability of the fishery. The chapter also reasserts that the technical management measures, in particular efforts to combat IUU fishing, are mainly focused on conserving the ecosystem health and not the concerns of the social system. Align with evidences from several other studies (see for instance Onyango and Jentoft 2010; Song and Chuenpagdee 2011; Chuenpagdee 2011), findings from this thesis point to the fact that persistent IUU fishing in this lake is indeed a 'wicked' governance issue that cannot be addressed by these management technical fixes.

In chapter 3, an empirical study was undertaken in Ijinga Island in Magu district, Tanzania to examine the fisheries stakeholders 'images' and considerations about the level of impacts of fishing-related activities, including those considered IUU fishing based on the current regulation. This was important because stakeholders may have different images about the problem and the actions required to address it, and such difference may either lessen or compound the problem. Findings reveal an agreement between respondents on the most damaging fishing-related activities. However, varied

judgements existed between respondents' groups with respect to the damaging impact of fishing-related activities. In particular, some IUU fishing-related activities according to the regulations are considered least damaging by fisheries managers. In this regard, the study found that this disparity creates governability challenges. Furthermore, the study reveals that efforts to tackle IUU fishing are also interlocked with the issue of poverty, which is prevalent in this area and the entire region. This concurs with previous findings from other areas, which recorded relationship between poverty, weak governance and IUU fishing (Daliri et al. 2016; Onyango 2009; Etiegni et al 2011).

4.2 What makes IUU fishing persists in this fishery?

Combating IUU fishing has received considerable focus in recent years given the negative impacts on the fish stocks, habitat destructions and livelihoods (FAO 2014; Pauly et al. 2002; Pitcher et al. 2002). There is general consensus among fisheries stakeholders that IUU fishing needs to be controlled. However, different disciplines often point to different solutions. In spite of the differences, the dominant efforts directed at alleviating IUU fishing have focused on strengthening the fisheries regulations or laws and creating regional fisheries bodies in order to have a strong surveillance and controls. However, IUU fishing has proven to be resistant to these attempts. Through the methodological approach employed in this thesis, the multi-faceted dimensions of IUU fishing are revealed. The thesis has demonstrated that persistent IUU fishing in Lake Victoria does not only point to the failure of the technical and regulatory management measures, but to some underlying governance problems such as inadequacies of the governing system to

respond to the needs of the system-to-be-governed. The assessment of governability has shown that the occurrence and persistence of IUU fishing depends greatly on the inherent and constructed system's characteristics, especially those within the social and the governing systems. The findings identify where the challenges lie in the system-to-be-governed and also point out the weaknesses in the governing system. The governability of the system-to-be-governed exhibits a range of system properties, indicating a set of needs and demands, which may not be difficult to handle. However, because the governing system faces many challenges, and that it contains some characteristics that make it less capable to perform its function, it has inadequately responded to the needs and demands of the system-to-be-governed. Moreover, the technical management measures employed in tacking IUU fishing do not take into account the diversity and dynamics in the natural system. These rules and regulations are implemented as if the lake is a single fish species (Nile perch). This has unintentionally produced an effect of rendering other fishers using other gears and targeting other fish species as "illegal fishers". Apart from the regulatory frameworks, the multiple actors and the complex governance structure represented by various levels and complex relationships are likely to pose some limitations that prevent satisfactory results. Additionally, the low interaction between the government agencies and the fisher's communities is another factor that has compromised efforts to tackle IUU fishing. The established co-management units, contrary to the anticipated results, have not provided fisheries stakeholders (managers and fishers) with a conducive environment for interactions. The interactions have mainly remained on day-to-day business with uni-directional communication from the authorities. This has continued to give the government more powers in designing fisheries regulations. From a governability

perspective, decision making and policy implementation should be grounded on, and informed by values that are socially constructed, and culturally legitimized (Jentoft et al. 2012; Bavinck et al 2013). Seen in this light, persistent IUU fishing can be attributed to the formulation and enforcement of measures without fishing community inputs, thus resulting into dissent from the social system that is being governed.

The examination of respondents' level of awareness on damaging fishing-related activities suggests high level of agreement between respondents on the most damaging fishing-related activities. The most damaging fishing-related activities judged by the respondents such as 'using non-selective fishing gears' and 'fishing in breeding areas' are consistent with the general conservation understanding in the region. However, this finding indicates that persistent IUU fishing in this lake may not be entirely attributed to inadequate conservation knowledge. Rather, the persistent IUU fishing can be explained by divergent conservation understandings or images held by respondents, and actions taken to tackle the problem. For example, fisheries managers who are mandated to implement these regulations do not prioritize some of the IUU fishing-related activities such as 'fishing without license' and 'landing fish in non-gazetted' site as exceedingly damaging. Assuming that the majority of fisheries managers in the region hold this view, it is reasonable to foresee that these measures will be enforced with relatively little potency. This may as well lead to fishers not complying this regulation thus making IUU fishing persist. These differences in the images between the governing system and the system-to-be-governed have been reported to be contributing to lowering governability (Jentoft et al. 2010; Kooiman et al. 2008; Song et al. 2013; Song and Chuenpagdee 2014;

Voyer et al. 2015). In a nutshell, this thesis has demonstrated that persistent IUU fishing is a governance issue, which has often been tackled through technical management measures and this explains why the problem has persisted despite the concerted international and national alleviation strategies. Therefore, to effectively address IUU fishing governability problems, there is a need to consider the characteristics of the natural, social and governance systems surrounding the issue.

4.3 Alternative approaches to addressing IUU fishing

To effectively tackle IUU fishing, it is imperative that the nature of solution is informed by the nature of the problem that it sets out to solve. The methodological approach used in this thesis has illustrated clearly that the nature of the problem lies with the system properties. Therefore, tackling the weaknesses and limitations that these systems pose in terms of governability should be the key to addressing IUU problem. As observed by Chuenpagdee and Jentoft (2009, p.112), governability depends on the way a system adapts and responds individually, and in concert, to the challenges and demands brought by its characteristics. Further, Jentoft (2007) submits that in order to improve governability the components need to be mutually compatible. In this light, effective tackling of IUU fishing should be guided by addressing the mismatches. For instance, actions taken to tackle an IUU fishing problem should be based on some verifiable facts and agreement about what constitutes IUU fishing in the first place, and about ways to address it, which are acceptable to stakeholders (Chuenpagdee and Jentoft 2009; Jentoft & Chuenpagdee 2009; Kooiman & Chuenpagdee 2005). This may lead to having a shared

and acceptable image across stakeholders, which may then improve legitimacy of the regulations. According to Nielsen (2003), legitimacy can be improved through directly involving fishers in the formation and enforcement of laws. In order to achieve this, the thesis suggests improvement of the existing dialogue or consultation system with the local resource users and other stakeholders, to be more consultative than directive. This interaction may lead to linking ideas emanating from the local context where fishing takes place all the way to the upper level of management. At the same time, having continuous interactions between the governing system and the social system-to-be-governed may improve how emerging governability challenges such as dynamics in the natural system (due for instance to climate change) can be dealt with.

In addition, the regulatory frameworks should also be designed to reflect the diversity, dynamics and complexity in the natural and social system-to-be-governed. In this regard, the thesis calls for multiple governance approaches to deal with the complex but unique concerns of the social and natural system-to-be-governed. For instance, tackling non-compliance to fishing activities which are both IUU fishing and considered most damaging by the entire respondents, i.e., “using non-selective fishing gears” and fishing in breeding areas”, a greater emphasis should be placed on addressing drivers of IUU fishing such as poverty, lack of alternative employment and high costs of buying the legal fishing gears. This can be achieved through strengthening coordination and partnership among various sectors and stakeholders in the fisheries. Poverty is a pervasive cross-cutting challenge in this region and one that relates to many interconnecting issues outside the riparian districts.

Tackling fishing activities that are officially defined as IUU fishing but considered less damaging by some of the fisheries stakeholders such as “fishing without license” and “landing fish in non-gazetted site”, an emphasis should be placed on the provision of education and awareness. The interactions between the managers and fishers should also be improved. This will provide explanations on the importance of paying a fishing license and boat registration, and fisheries statistics to fisheries management. Third, on the fishing activity that is not IUU fishing, but considered potentially damaging such as “increased number of fishers and gears”, more consultation between the stakeholders is required to see how to incorporate it as a management measure. This may enhance the legitimacy of these regulations since it is likely to garner support from a wider fisher community. Some studies have shown that the more fishers are directly involved in establishing and enforcing regulation the more the regulation becomes accepted as legitimate (Nielsen 2003; Hauck 2008). This kind of approach may take care of the deficiencies evident not only in the system-to-be-governed but also in the governing systems and the interactions between them (Kooiman and Chuenpagdee 2005).

4.4 Future research

The study of the persistent IUU fishing in Lake Victoria using the interactive governance approach has been helpful to identify key governance challenges that limit governability and the governance outcomes. The approach can be applied to examine other complex

fisheries problems. However, in the course of carrying out this study, there are several issues that surfaced, which can be further investigated. First, the study only focused on the image that fisheries stakeholders have on IUU fishing and the efforts to tackle it. An investigation on the image that resource users have on the governing system could also help provide more insights to improve governance. In addition, the images of the fish agents and fish processors who are important actors in the fishery need to be explored. This will help illuminate how well their images fit with the images of the other stakeholders. Finally, wider coverage of lake areas or landing sites can generate additional information to understand fisheries sustainability issues in the lake. The general observation made by this study is that the findings from this particular context (Ijinga Island) can form a basis for reshaping the strategies towards IUU fishing as well as governance of Lake Victoria.

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Appendix I: Questionnaire

INFORMATION FOR COMPLETING THE QUESTIONNAIRE

I am a graduate student from Memorial University of Newfoundland in St. John's, Newfoundland and Labrador, Canada. As part of my studies I am conducting a research that is part of a project named Too Big To Ignore (TBTI), which is a global partnership for small-scale fisheries research.

The objective of this questionnaire is to obtain your opinion about what you think about the fisheries of Lake Victoria and its conservation. There are no right or wrong answers to the questions. I anticipate that we may take around 25-30 minutes to complete this questionnaire. I would appreciate it if you could complete all questions.

Your participation in this study is completely voluntary, and you are free to withdraw from the study, as well as any information you have provided, at any point while the data is being collected. Once the data collection phase has ended, individual questionnaires cannot be withdrawn because the data is anonymous. If you wish to stop and/or end involvement in the data collection, you can communicate it to the enumerator to do so. Data collected up to the point of a participant's withdrawal will be destroyed and there will be no consequences associated with your withdrawal.

There are no potential risks of being involved in the study. Your privacy as a participant will be maintained and identity kept confidential by the means of the following procedures;

- No questionnaire information will be collected that may directly reveal the identities of participants (e.g. name of person or description of physical appearance);
- The returned questionnaires will be coded using identification numbers;
- Sorting and ordering data will be numerically transformed ad recorded in a spreadsheet for further analysis;
- Information about the participants will be aggregated;
- Overall, data released will not contain names, initials or other directly identifying information. The study will only present and analyze data base on responses and not individuals.

Furthermore, every reasonable effort will be made to ensure the participant's anonymity, and they will not be identified in any reports and publications. Anonymous data will be achieved in this study through the protection of confidentiality of personal information

and records. This study will only involve written records. There will be no audio, video, or photographic record of data in this study.

The data collected for this survey will be used for the completion of a Master's thesis. The data will also be presented at conferences, published in scholarly journals as well as a report to be accessed by the general public including Ijinga fishing community. Data will be presented in aggregated form, so it will not be possible to identify individuals. This questionnaire has three sections.

Section A
This section has few questions on your occupation and questions to get background information on the fishery of the lake.

Section B
This part has two text boxes containing two sets of fishing activities, **A** and **B**, to get your opinion on which activity you consider **MORE DAMAGING** to the fishery resources of Lake Victoria.

Section C
The last part of the questionnaire and contains questions that seek information about fishery management and your opinion on conservation to the fisheries resources.

The proposal for this research has been approved by the Interdisciplinary Committee on Ethics in Human Research at Memorial University. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at **icehr@mun.ca** or by telephone at +1 709 864 2861.

If you have comments or questions, or wish to receive a copy of the final report, please contact myself or my supervisor, Dr. Ratana Chuenpagdee at **ratanac@mun.ca** or by telephone at (709) 237-1427.

Thank you.

Sincerely,
Joseph Luomba
Contact information: ☎ +255 767 20 67 30
✉ jol373@mun.ca

Name of landing site	
Date of interview	
Time of the day	
Questionnaire number	
Respondent gender	

Section A: Background information

1. What is your occupation? (Please tick all that apply)

   [1] Boat owner
   [2] Crew member
   [3] Fish trader and processor
   [4] Local resident
   [5] Fisheries Manager
   [6] Research Scientist

2. If more than one, which occupation represents you best

3. How long have been in the occupation_____ years (if < a year) _____months

4. Please indicate the fishing gear you owned, mesh size, and species targeted. Please tick all that apply. ***(If not involved in actual fishing but post-harvest, please go to Question 6, but if not a primary resource user go to section B)***

Gear type	Gear owned	Mesh/hook size	Target species
Gillnet			
Hooks			
Beach seines			
Dagaa seine			
Cast net			
Monofilament			
Other			

5. Who decides on the fishing gear to be used?

6. How many days a week do you spend on fisheries related activities?

7. How many hours do you spend on fisheries related activities in a day?

8. How much does fishing contribute to your household income?

Section B: Impacts of fishing activities on the lake

9. In your opinion, which of the fishing activities do you consider **MORE DAMAGING** to the fisheries resources of Lake Victoria?

a. Using non selective fishing gears
b. Fishing in breeding areas
c. Fishing without license
d. Landing fish in non-gazetted site
e. Fishing for longer hours
f. Fishing around breeding areas
g. Many fishers targeting single fish species
h. Increased number of fishers and gears

Section C: Fishery management

10. In your opinion, what drives people to use destructive fishing gears? (tick *all that apply*)

[1] Inadequate regulation knowledge
[2] Weaker penalties/fine
[3] Insufficient enforcement
[3] Poverty
[4] Ready market for juvenile fish
[5] Open access
[6] Weak community involvement
[7] Legal gears are expensive
[8] Corruption
[9] It is profitable
[10] I don't know
[11] Other specify_____

11. What is the extent to which the destructive fishing gears are used at this landing site? (If *not a directly involved in fisheries, go to Question 16)*
[1] Not used [2] Rarely used [3] Moderately used [4] Highly used [5] Very highly used

12. In your opinion, what more could be done to improve conservation of the lake?
[1] Create awareness to fishers [2] Strengthen enforcement measures
[3] Use of local leadership to enforce measures
[4] Subsidies on the cost of legal gears
[5] Change regulations
[6] No opinion
[7] Other specify_____

13. Is there any particular issue of concern that you would like share about management of the lake?
[1] Yes [2] No