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Conditions for sustainability of small-scale fisheries in developing countries

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Proud fishermen at Njale Fishing Village

Abstract

Institutions that manage small-scale fisheries across the globe can be locally based, state controlled or of a mixed, cross-scale nature. The latter arrangement, widely known as co-management, is generally believed to be the preferred approach for sustainability. This paper employs a crisp-set qualitative comparative analysis (csQCA) to examine 17 cases of small-scale fisheries in developing countries, in order to assess the degree of state involvement which may be most effective in realizing sustainable small-scale fisheries.

These degrees vary between: (a) strong top-down regulation irrespective of fishing community wishes, (b) a co-management mode of negotiation with fishing communities, (c) a merely supportive role of the state, or absence from the fishing scene. It was revealed that contrary to expectations, the sustainability of small-scale fisheries depended solely on the strength of collective social capital of the local communities at the resource scale. With weak local social capital, degrees of government involvement did not make any difference; the fisheries were unsustainable in all cases. The prime role for governments in small-scale fisheries in developing countries therefore seems to be as intelligently absent as possible, by way of respecting, protecting, and supporting local institutions.

Keywords: small-scale fisheries, developing countries, sustainability, co-management, community-based management, governance, success and failure factors

3.1. Introduction

The management of small-scale fisheries (SSF) has received considerable attention in recent years (Evans & Andrew, 2011; Hauzer et al., 2013), despite the assertion of Isaacs (2013) and Alfaro-Shigueto et al. (2010) that the management of SSF has generally been overlooked. Out of this rich literature, the present paper uses case studies from developing countries notably Chile, Comoros, Ivory Coast, Malawi, India, Laos, Mexico, South Africa, Zambia, Zimbabwe, Senegal, and Nigeria to investigate which degree of state involvement may be most effective in realizing sustainable SSF. While some of the cases studies examined are success stories, others are not.

The key factors that lead to either success or failure of these fisheries may be unique to a particular system and therefore not necessarily applicable elsewhere (World Bank, 2004). However, recent experiences and scholarship reveal some of the major conditions that are crucial in making SSF sustainable. Evans & Andrew (2011), for example, highlight that development of social networks that empower local resource users and foster resilience is crucial for the sustainability of SSF in developing countries. The effectiveness of such management responses can only succeed if there are modifications in power relations between the state and the local institutions (Berkes & Seixas, 2005). In their general assessment of global fisheries management (with no particular focus on SSF), Gutiérrez et al. (2011) identified strong community leadership and a robust collective social capital as the most important attributes for success. Collective social capital is defined in this regard as the social capacity of groups, in terms of trust and institutions, to take collective action (Lankhorst & De Groot, 2012). Nevertheless, co-management still remains the main adage in SSF management, implying that in addition to community strength there is a need to have strong governments to safeguard the sustainability of fisheries. Through a detailed review of literature and an analysis of 17 cases studies from twelve developing countries the present chapter aims to determine the key actors and the level of institutions (local, state controlled or mixed) which is most decisive in the sustainability of most SSF in developing countries. This analysis is crucial for comparing the key actors and institutions in the management of the Elephant Marsh fishery with situations in other developing countries. Mention has to be made here that the cases are examined as they are reported in literature and therefore some deviation from the latest developments regarding a particular fishery may be expected.

The next section reviews literature on SSF management in developing countries, thus providing the basis for the variables used in the analysis. The third section provides the methods used, an overview of the cases and how the scores for each variable were

generated. The fourth section gives results and discussion. The paper ends with some implications for future policy direction and fisheries management practice in developing countries.

Being a form of resource extraction, capture fisheries usually do not continuously require high inputs after making the initial investment in the acquisition of the extraction equipment. Thus, the benefits of high-level extraction may easily outweigh the operational cost and lead to over-exploitation of the resource. Moreover, capture fisheries usually start out as an open access situation and even if access is later closed to a restricted group, full privatization is usually impossible and the fisheries remain a common pool resource, hence subject to the risk of Hardin's (1968) 'tragedy of the commons' that leads to resource exhaustion. Hardin (1968) concluded that communal natural resources can only be sustained if a coercive central authority oversees the exploitation or if the resource is fully privatized (e.g. by enclosing private farm land and restricting fishing areas). In the same vein, Béné et al. (2010) stated that "over-exploitation of a resource which is owned by many and not effectively managed by anyone, leads to reduction in catch and eventual poverty of users and others who would otherwise benefit from the harvests".

Capture fisheries are sometimes protected against over-exploitation by natural circumstances such as sheer size, inaccessibility or cold, as shown for instance in Brox (1990) and Planque et al. (2010). In most cases however, small-scale capture fisheries, consisting for instance of inland water or tropical seas are seldom protected by such circumstances, thereby requiring strong institutions that can regulate extraction by humans and achieve sustainability of the resource. Such regulatory institutions can be locally based, state controlled or a crossbreed of the two in what is widely known as co-management.

The concept of 'tragedy of the commons' has become deeply entrenched in fisheries management, as shown for instance by Ward and Weeks (1994) who found that in spite of all evidence to the contrary, U.S. government officials hung on to the idea that fishing communities without government control can only deplete the resource. As discussed by Carswell (2003), governments often need such narratives to justify their regulatory existence. Ostrom (1990) was the first to dispute this management paradigm, not by denying the logic itself as faulty or untrue, but by studying how communities can counteract the 'tragedy' mechanism in crafting successful institutions. She postulated eight conditions for the success of managing common pool resources which have been included in the present study as highlighted in Table 3.1.

Table 3.1 Choice of conditions of interest for SSF in developing countries

Ostrom's condition/attribute	Ostroms' definition of the condition/attribute	The community variable under which Ostrom's condition/attribute was captured in the study
Clearly defined boundaries	Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.	This condition was met for each fishery (case) as a precondition for inclusion in the study.
Congruence between appropriation and provision rules and local conditions	Appropriation rules restricting time, place, technology, and/or quantity of resource units (in this case fish) are related to local conditions and to provision rules requiring labour, material, and/or money.	This condition is part of collective social capital; presence of locally crafted fishing rules.
Collective choice arrangements	Most individuals affected by the operational rules can participate in modifying the operational rules	This condition is part of collective social capital; fishermen involvement in making rules.
Monitoring	Monitors who actively audit CPR conditions and appropriator behaviour are accountable to the appropriators or are the appropriators.	This condition is part of collective social capital; fisheries committees at each fishery are responsible for monitoring the resource.
Graduated sanctions	Appropriators who violate operational rules are likely to be assessed using graduated sanctions (depending on seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators or by both.	Part of collective social capital: the application of sanctions within the fishing community.
Conflict resolution mechanism	Appropriators and their officials have rapid low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.	Part of collective social capital: the availability of locally accepted adjudication.

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Minimal recognition of rights to organize	The rights of the appropriators to devise their own institutions are not challenged by external government authorities.	This condition is part of the variable on the role of the state.
Nested enterprises	Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises.	This condition is part of collective social capital at the level of the resource.

These conditions were emphasized by Cox et al. (2010) using both empirical and abstract cases, and are a good basis for designing management systems for SSF. For example, “minimal recognition of rights to organize” necessitates legitimacy and non-interference by central states of the locally constructed institutions, while “nested enterprises” underscores the need to nest the local rules into rules that exist at a larger scale. The nesting is important for support (e.g. information sharing) as well as completeness and endurance of a system so that issues of cross-scale cooperation and resource users at a larger scale can best be addressed.

Wilson et al. (2006) state that local SSF management cannot be effective if it is not considered legitimate by local resource users especially when central states are too weak to enforce formal rules as is often the case in developing countries. When central states are weak, the activities of intruders are not controlled and compliance becomes a voluntary action (Sowman et al., 2013; Chabwela & Haller, 2010). When central states fail to devolve power to local communities in co-management or community-respecting arrangements and consistently take a position of commanding, imposing and enforcing alien rules and regulations, the negotiated fulcrum is lost, illegal activities may emerge and the management system is likely to fail (Béné et al., 2009; Isaacs, 2012). From a broader view of Ostrom's (1990) theory as highlighted in Table 1, it can be deduced that central states and resource users are the two crucial parties in making the eight conditions of SSF management to either work well or not. The presence of a central state in SSF management might be supportive (recognizing, helping, educating, informing), seeking a co-management arrangement (power and responsibility sharing), or conflictive (imposing external regulations). Despite most efforts in SSF management in developing countries have put considerable emphasis on setting up co-management arrangements. The approach in Africa, however, has generally been devolution of some aspects of management from central states to local communities resulting in an imbalance of power and interests. Co-management's failure to clearly define and allocate power relationships as well as operational responsibilities to resource users has also been reported by Ruddle and Davis (2012).

From the critical perspective of Ward & Weeks (1994) and Carswell (2003), it may be noted that the co-management discourse still justifies the '*raison d'être*' (reason for existence) of state regulators. Thus, a proper theoretical perspective leads to a research platform that can reveal instances where purely community-based fisheries management can be conceptualized along with the other management types. Hints that such research might be fertile are given for instance by Hara & Nielsen (2003) who point out that co-management in Africa appears to be more of an illusion than an empowerment of local fishing communities

and there is need to find some bold answers to its ability in achieving the objectives of all players. Even years after Ostrom' (1990) work, Jentoft et al. (2003) also found it difficult to conceptualize the necessity of the state in the management of fisheries. They mention that "an alternative agent like the state is not always needed and community level institutions play a greater role in fisheries management if they are allowed and equipped to do so". In some cases, however, informal institutional building can get support from centralized formal law like in the V-notch lobster programme as reported by Acheson (1989) as well as Acheson & Gardner (2011).

In her book "Understanding Institutional Diversity", Ostrom (2005) defines institutions as rules, norms and shared strategies that mediate human behavior. From this perspective, it is clear that the sustainability of SSF depends on a continuum of attributes that positively shape human actions towards a negotiated consensus on powers and responsibilities in relation to the fisheries resource at either the supra-local level (e.g. existence of guiding legislation and policies from central government) or the local level (e.g. leadership, power relations, benefit sharing). Several scholars (Sowman et al., 2013; Béné et al., 2009; Wilson et al., 2006; Castello et al., 2011; Pomeroy, 1991) have decried the lack of recognition and involvement of small-scale local fishers in fisheries management, especially in developing countries. To achieve a balanced representation in decision making, there needs to be a stronger shift to arrangements in which local communities and governments share responsibilities over a resource. Although the basic idea of such arrangements is to achieve equal power sharing (strong government interacting with strong communities), the application of the notion has varied widely especially in SSF management where the socio-ecological context is quite complex and diverse (Allison & Ellis, 2001; Evans et al., 2011). Whatever the case, these partnerships require high levels of compliance from local communities and significant support, information sharing, consultation, advice and cooperation from government (Sen & Nielsen, 1996) in order to sustainably manage common pool resources.

From the literature reviewed this study analyses 17 SSFs in developing countries which were chosen on the basis of availability, sufficiency and clarity of data on fish catch trends, the role of the state and the ability of a fishery to fulfill at least the first condition on Ostrom's list (clear boundaries). The chapter seeks to determine the key actors and the level of institutions (local, state controlled or mixed) which is most decisive in the sustainability of most SSF in developing countries. The analysis uses four factors namely: collective social capital (CSC), supportive central states (SUP), co-management (CO-M) and imposing

central states (IMP) on the sustainability (SUS) of small-scale fisheries in developing countries.

3.2. Methodology

3.2.1 Research variables

The present study has used crisp set qualitative comparative analysis (csQCA) to analyze success and failure factors for sustainable SSF in developing countries. The first step was to define community and government-action variables whose influence would be tested on the sustainability of SSF. Obviously, the work of Ostrom (1990) and Cox et al. (2010) offer a good basis for assessing community capacity (collective social capital) and as Latour (2005) puts it, the social connections that an actor has with different networks determine what the actor is, wants and can do. The social networks have actually been found to influence actors' behaviour in natural resources management (Bodin & Crona, 2009). Table 3.1 gives Ostrom's eight attributes and the way these variables were included in the present study. Out of the eight variables, two are fixed in the methodology of this paper. The first is "clearly defined boundaries" which was used to select case studies where no confusion existed over the physical and social (insiders/outside) boundaries. The second fixed variable is Ostrom's attribute number 8 of "nested enterprises" which has been incorporated in the definition of social capital that primarily looks at the scale level of the whole fishery (e.g. whole lake). The remaining six attributes were collapsed into one and defined as community strength or capacity variables which are formally called collective social capital (CSC). Reasons for this collapse were, first, that the interest of the paper is more in the roles of the state, and second, that most of the case study data did not simply allow assessment of all separate attributes (e.g. conflict resolution mechanisms or graduated sanctions). So typically, if a case study tells a story of successful, self-organizing communities, CSC is taken as high and when authors indicate "weak social cohesion" and such-like phenomena, that is translated as low CSC, with Ostrom's more detailed variables as a background check of the decision.

The variables on the role of the state have been inspired by a non-fishery case study analysis by De Groot et al. (1995) who classified the supportive or destructive roles of the state in efforts by local communities to manage natural resources. The classification of the state roles is done using a simple seven-rung ladder based on direct, indirect or passive influence. The case study analysis by De Groot et al. (1995) explains the interplay of factors influencing the defence of common pool resources by local communities in various parts of the world. The analysis is presented in simple but quantified terms (e.g. 'time to get to the

resource', or 'labour productivity of the foregone activity'), added to which are the respective dimensions (e.g. 'hours' and '\$/day'). The assumption is that initially the local community decides on how to spot 'intruders' to the resource and make the first coercive contact; this establishes the 'Cost of Contact' (CC). This CC then becomes a component of the total 'Cost of Defence' (CD), which is weighted against its total benefit. The model is applied to examples of local resource defence: rangelands in southern Sudan; management of trees and pasture in southern Somalia; management of beaver stocks by the Cree in Quebec; and resource use rights in the Logone Basin of Cameroon and Chad. Table 3.2 specifies the three basic state roles derived from that ladder and the formal definition of each of the variables.

Table 3.2 Research variables. Adapted from De Groot et al. (1995).

Variable	Abbreviation	Definition	Score
Collective social capital	CSC	Strong locally crafted institutions	0 or 1
Supportive state	SUP	State recognizes and supports local institutions	0 or 1
Co-management	CO-M	State is involved in co-management arrangements with the community	0 or 1
Imposing state	IMP	State is imposing issues on the community	0 or 1
Sustainability outcome	SUS	Fishery is sustainable	0 or 1

The preceding literature review has indicated that success and failure factors for sustainable SSF in developing countries should at minimum include:

1. The strength/weakness of the fishing community (CSC). This variable is scale-dependent in the sense that the local institutions should be present at resource scale. For instance, if a fishery has a biological scale of one big lake, coordination should be present at the level of the lake, and not only at the level of separate user groups or village communities.
2. The degree of support given to the local institutions by the central state (SUP). Such support could be the protection of the resource against outsiders, or fish stock monitoring.

3. Willingness of the state to enter into open negotiation with user groups (CO-M). In other words this variable represents willingness of a state to enter into co-management arrangements with a community. Note that in this variable, it makes no difference if a fisheries policy formulated by the state is formally devolved, decentralized or de-concentrated (Lewins et al., 2014). What really matters in the actual interaction at the state-community interface.
4. The degree of central state regulation set irrespective of community desires (IMP). In practice, this is a scenario where the state is involved but imposing its own regulations on the community.
5. The last variable represents the overall status of the fishery (outcome) in terms of its sustainability during the case study period (SUS). Sustainability in this respect is looked at with the assumption that it is not attributable to variations related to climate, river discharge, pollution or decline from original to sustainable yield levels. In this particular case, the indicator for sustainability was based on trends in fish catch data (including species composition and the size of the classes in the catches) as reported by the authors in literature. Persistent decline of fish catches indicated that the fishery was unsustainable.

The advantage of having three variables on the role of the state (variables 2, 3 and 4) is that they can vary independently from each other enabling the comprehension of mixed situations. A central state may, for instance, protect the resource from outsiders through patrols (variable 2) but at the same time impose state-based regulations on the same local communities whose interests it wants to safeguard (variable 4).

3.2.2 Qualitative Comparative Analysis and the sample of the cases

Qualitative Comparative Analysis (QCA) focuses on linking an outcome to causal configurations, which are considered as explanatory conditions. There are three QCA techniques (all based on set theory and Boolean algebra) namely: multivariate QCA, crisp set QCA, and fuzzy set QCA. This paper uses crisp set QCA because of its ability to portray multiple causal combinations including minority effects which enabled the data from the case studies to be assessed. A crisp set is a condition in which a case may be interpreted based only on two possible outcomes (0 or 1) expressed as either in or out; true or false; yes or no. For example, a specific fishery might be successful (1) or not (0) if there is a rule-imposing state. The major limitation with csQCA is that the method does not allow for intermediate scenarios because it is case-based and therefore reproducibility of results can sometimes be difficult.

Crisp set QCA is done in six steps (Rihoux & DeMeur, 2009; Marx, 2010; Rihoux, 2013) using TOSMANA (*Tool for Small-N Analysis*) version 1.3.2.0 (Cronquist, 2007). It allows a direct conversion of hypotheses into variables (Table 3.1) which are relevant for all the cases, followed by building of a raw dataset for the cases (Table 3.3) and construction of a truth table. The third step involves resolving contradictory configurations (outcomes that lead to 0 for some observed cases and 1 for other cases). Contradictory configurations were solved by re-examining the way in which the various conditions were operationalized. For instance, if the threshold of dichotomization for a given condition was the source of the contradiction between cases, the threshold was adjusted to resolve the contradiction (Rihoux, 2013). The next step was to perform Boolean minimization (step 4), which helps to clarify and simplify complex expressions of causal configurations. Step 5 identifies the logical remainders (combinations that are possible but have not been observed among the cases). The truth table and overall result of the analysis (Box 3.1) are automatically generated by TOSMANA (step 6).

3.2.3 The case studies and the dataset

The following is a summary of the 17 cases indicating how the scores for each variable were generated. The overview is given in Table 3.3.

I. Lake Mweru-Luapula Fishery in Zambia (Aarnik, 1999)

The management of Mweru-Luapula Fishery is officially under the jurisdiction of the state. This happened as a result of a move to change colonial rules which were perceived to favour the “whites”. The government of Zambia, through the Department of Fisheries, imposed a management structure which allowed for open access to the resource for all Zambians under the national motto of “One Zambia, One Nation” (SUP = 0, IMP = 1, CO-M = 0). The imposition of the new management structure faced a lot of resistance from the local communities (mainly the Lunda, Shila and Bwile ethnic groups), led by their traditional chiefs. The ethnic groups however, remained highly divided at the resource scale (CSC = 0). There was observed change in the catches which decreased from 12kg per 100metres of net in 1955 to 3kg per 100 metres of net in 1992 (SUS = 0).

II. Lake Kariba Fishery in Zimbabwe (Jackson et al., 1998; Musando, 1996)

The first settlers of the area belong to the Tonga ethnic group and they had managed the fisheries resource based on chieftaincy. Other ethnic groups such as the Gova and Korekore later settled in the area and they adopted the management style sanctioned by the Tonga

(CSC = 1). However, between 1974 and 1980, the management system was disrupted by guerrilla war to liberate Zimbabwe to independence. Post-independence policies resulted in the formation of Lake Kariba Fisheries Research Institute (LKRFRI) which promoted the formation of cooperatives with fisher communities under state control and imposed rules and regulations over the resource (SUP = 0, IMP = 1, CO-M = 0). The local communities resisted. In order to diffuse the growing tension, Lake Kariba Fisheries Research Institute facilitated the creation of a fishers association but this was viewed with suspicion by fishers the local communities were not willing to enforce the imposed regulations. It is evident from the literature that despite the diversity in group composition (three ethnic groups) the fishers relate well with each other, especially against outsiders like government agents who are seen as enforcers of alien law. Fish catches declined from over 3000 tonnes per year in 1987 to about 1500 tonnes per year in 1997 (SUS= 0).

III. Lake Chilika Fishery in India (Sekhar, 2007; Pattanaik, 2007; Nayak and Berkes, 2010)

Lake Chilika Fishery had about 150 fishing villages in 2009, with about 30% of the village population involved in fishing. The local communities had very good social networks which were strong enough to implement a system that gave fishing rights only to locals and not outsiders, even when the latter belonged to the elite. The fishing communities had also organized themselves so well that they have clear boundaries and societal allocations of the types of fish species to be captured by particular groups (CSC = 1). This arrangement required leaders with good reputation to enforce the rules they set thereby ensuring sustainable utilization of the resource. Government interventions were seen to erode cooperation and trust between the different fishing groups but also allowed outsiders to gain easy access to the resource. Although the state had recognized and allowed the presence of the local institutions (SUP = 1), it continued to lease out parts of the lake to outsiders (with mechanized boats and gear) in addition to imposing restrictions on the use of traditional nets (IMP = 1). There was no cooperation arrangement between the government and the local fishing groups (CO-M = 0). Fish catches remained stable at about 7000 tonnes per year between 1985 and 2004 (SUS = 1).

IV. Aby Lagoon Fishery in Ivory Coast – Period 1 (Kponhassia & Konan, 1998)

The fishery had well-established-community-based management arrangements (CSC = 1) until 1980 when the state decided to control access by introducing professional identity cards for fishers (IMP = 1). The exercise of distributing identity cards however, included outsiders (SUP = 0). The local fishers then reduced their trust in government-led initiatives (CO-M = 0)

and fish production dropped from about 6000 tonnes in 1980 to 3600 tonnes in 1981 and even 2100 tonnes in 1982 and continued to drop in the early 1990s (SUS = 0).

V. Aby Lagoon Fishery in Ivory Coast – Period 2 (Khan et al., 2004; Njifonjou et al., 2006)

Due to the continued drop in fish catches and conflicts which arose between local fishermen and outsiders at Aby Lagoon, the government of Ivory Coast re-instituted local fisheries administration in 1994 under the Integrated Development of Artisanal Fisheries (IDAF) programme (IMP = 0). The programme allowed the local communities to form their own fisheries associations to work with government agents and the roles of various actors were also agreed upon (SUP = 1, CO-M = 1). This arrangement led to renewed community confidence and trust as well as re-organization of the fishery. There now was active involvement of the communities. The fishery had about 3000 fishers in mainly from Aboures and Mossi ethnic groups. There is local democracy in choosing leadership and the good social cohesion (CSC = 1) has also helped to improve participation towards management of the common pool resource. Fish catches are reported to have improved since 1997 to an average annual production of about 10 000 tons in 2006 from the reported 2100 tonnes of 1982 (SUS = 1).

VI. Ngazidja Coastal Fishery in Comoros (Hauzer et al., 2013)

The fishery has 44 fishing villages and the existing arrangements are mainly community based and informal. Each fishing village has established a fishing association based on local democracy and leadership attributes. The number of resource users per village is small with some villages having only 10 fishers, but what is clear is that there is strong social cohesion (CSC = 1). Fisheries governance at Ngazidja is shared between government through the fisheries department and village fishing associations (CO-M = 1). The state maintains no formal regulations on fishing (IMP = 0) but is involved in overarching logistical and administrative support such as external funding for projects and guidance on new management tools (SUP = 1). Most fishers at Ngazidja use extremely simple gears, yet catch figures remain considerably high (e.g., they average at 22 kg/day per traditional canoe with one fisher on-board and 110 kg/day per powerboat with two fishers on-board) over a 20 year period (1989-2009). (SUS = 1).

VII. *Caleta El Quisco* Inshore Fishery in Chile (Castilla & Fernandez, 1998)

The *Caleta El Quisco* Fishery had about 139 fishers (with 42 officially registered divers). The fishers had a committee called '*Caleta*' whose leadership was democratically elected and the

aim was to regulate the fishery and keep outsiders out in order to sustainably manage the fisheries resource. The system worked well based on solidarity (social cohesion), strong commitment from the fishers and trust in the leadership (CSC = 1). The government had a supportive role through the establishment of "Management and Exploration Areas" in a co-management agreement (SUP = 1, CO-M = 1, CON = 0). Fish catches were sustainable with an average of about 1000 metric tonnes for a 6 year (1989-1995) period (SUS = 1).

VIII. *Sero Callos de Hacha* Coastal Fishery in Mexico (Basurto, 2005)

The main ethnic group at the *Sero Callos de Hacha* Fishery is the Seri and initially there was no regulation by the federal government. However, pressure from outsiders (non-Seri communities) to have access rights to fish in the Seri waters increased and the government started to issue fishing licenses at a fee including outsiders (SUP = 0, IMP = 1). The government agents kept all the financial benefits to themselves (CON = 1), a scenario that did not go well with the Seri people who successfully created parallel entry mechanisms for outsiders to divert the benefits to themselves (CSC = 1). The parallel entry system was possible because the government had no presence or authority inside the Seri waters (CO-M = 0). SSF catch data have not been systematically collected at *Sero Callos de Hacha* Fishery but historical counts indicate that a fish buyer in 1978 used to receive about 400 kg daily from about 20-25 fishers and in 2001 a buyer was receiving about 100 kg catch from a similar number of fishermen, indicating that the catches tended to be unsustainable (SUS = 0).

IX. Lake Chiuta Fishery in Malawi (Donda, 1998; Njaya et al., 2012)

The motivation to create a management arrangement for Lake Chiuta fisheries originated from the local communities as a result of harmful effects of the use of *Nkacha nets* (having very small mesh size) by some fishers. The rules were based on popular consensus (CSC = 1) and to some extent spirit worship. The lake has three islands and fishing close to any of the islands is perceived as a provocation of the spirits who would kill the fisher. Fishers have 9 fisheries committees. These committees report to Lake Chiuta Fisheries Association which is an umbrella body of all the committees and works hand-in-hand with government agents (SUP = 1). For instance, local fishers and their committees made a decision to ban the use of *Nkacha* seines because it was perceived that the gear destructive to the fishery. According to Njaya et al. (2012) the committees "instructed the Department of Fisheries to legally endorse the decision, which is still in force today" (CO-M = 1). Trust in the leadership and a strong social cohesion are the main pillars of the community-based management

arrangement at Lake Chiuta Fishery. Annual fish catches increased from 1600 tonnes in the late 1980s to over 4000 tonnes in 1996 and appear to be sustainable (SUS = 1).

X. *Lake Kariba in Zambia (Hachongela et al., 1998)*

The fishery has four ethnic groups (Valley Tonga, Bemba, Lozi and Plateau Tonga). In the 1980s, the Valley Tonga were the dominant first settlers and did not want the other groups to fish in the area but were not powerful enough to drive them out and that resulted in very weak social cohesion at the resource level (CSC = 0). To bring equity in access rights, in 1993 the government of Zambia revised the management arrangement of the fishery by placing the state in pivotal decision making position (IMP = 1). Community participation was low (CO-M = 0), conflicts became rampant, the government did not help out in any local problem (SUP = 0) and all elements of trust, equity and efficiency were lost. Fish catches decreased further from 2, 237tonnes in 1990 to 1,355tonnes in 1995 (SUS = 0).

XI. Lake Chilwa Fishery in Malawi (Njaya, 2009; Evans & Andrew, 2011)

Lake Chilwa Fishery has 43 legitimate fishing committees and access is controlled through issuing of licenses from the Department of Fisheries to local fishers and the enforcement of local rules is done by the committees in a co-management agreement. The government supports the local committees materially (gear) and financially (CO-M = 1, SUP = 1, IMP = 0). Because fishing at the lake is mostly seasonal (the lake recedes in the dry season months of August to November), fishers usually migrate to and from the lake. This migration makes it difficult to have stable local committee leadership that can really oversee the utilization of the resource. There are also reported power struggles between the local chiefs and the committee leadership resulting in weak social relations (CSC = 0). Fish catches have generally been decreasing from about 15,000tonnes in 1990 (van Zwieten et al., 2003; Allison et al., 2002) to about 12,000 tonnes in 1999 (Nyasulu et al., 2001) and only about 5000 tonnes in 2008 (Chiwaula et al., 2012) (SUS = 0).

XII. Khong District Inshore Fishery in Laos (Baird & Flaherty, 2005)

Khong fishery has 63 fishing villages and is supported by two non-governmental organizations (Lao Community Fishers and Dolphin Protection Project) which were implemented between 1993 and 1997 respectively. Locals initiated the community-based management and the government gives them support without interference with the running of the fishery (SUP = 1, CO-M = 0). The success levels for the different villages are varied but overall, the system is robust and most fishers have reported an increase in fish catches.

According to Baird and Flaherty (2005) the social homogeneity in the Khong contributes to the success of the community based fisheries management arrangement (CSC = 1). In 1997, it was estimated that 4,000 tonnes of fish were caught in Khong District which was reportedly higher than in 1993 (SUS= 1).

XIII. Nguru-Gashua Wetland Fishery in North East Nigeria (Neiland et al., 2005)

The Nguru-Gashua Wetland Fishery is managed by a local committee headed by a chief fisherman who is referred to as 'Sarkin Ruwa'. The chief fisherman is responsible for controlling access to the resource and ensuring adherence to the local regulations. The fishing grounds where access is restricted are well organized based on community membership especially to the Bulama and Jarma ethnic groups (CSC = 1). The government has introduced a licensing scheme but the system has failed to gain acceptance from locals (SUP = 0, CO-M = 0, IMP = 1). In 1997, the total catch was about 18,000 tonnes (Neiland et al., 2000) but by 2008, the fishery had declined to an annual catch of about 16,000 tonnes and it was anticipated that the fishery would become overexploited (biologically and economically) in the near future (Neiland & Béné, 2008)(SUS = 0).

XIV. Olifants River Coastal Fishery in South Africa (Hauck & Sowman, 2001; Sowman, 2003)

The fishery is dominated by two Afrikaans speaking rural coloured communities of Ebenaeser and Papendorp. During the 45 years of apartheid in South Africa (1948 - 1994), natural resources management was based on state command and control. Soon after the post-apartheid government came into office, a local committee was put in place to oversee the fishery. Although the committee was elected in 1994 at a public hearing, there was weak social cohesion between the two groups (CSC = 0) and there was no trust in the local leadership as well as the government officials. The committee ended up having no legitimacy in the community resulting in confusion and unwillingness of the resource users to take up responsibilities. The mistrust stemmed mainly from the apartheid rule where such local committees were used as spy agents. By 1999, all efforts to formulate co-management arrangements had collapsed (CO-M = 0, SUP = 1) mainly due to lack of interest and support from government officials to give up some powers (IMP = 1) to the local community (Sowman, 2003). There are no figures on catch statistics but fishers are reportedly indicating declining catches (SUS = 0).

XV. Lake Malombe Fishery in Malawi (Njaya, 2007)

In this fishery, there is a fisheries committee which is headed by a chairperson. Members of the committee comprise 30 percent of fishers. Most of the fishers feel their concerns are not well represented by the committee. There is a lot of power struggle between the committee leadership and the traditional chiefs underlining poor social cohesion and lack of trust in the leadership (CSC = 0). There is no local democracy as the traditional chiefs prefer to appoint their own people into leadership positions. Therefore there are no reliable community based fisheries management structures at Lake Malombe. Consequently the government has set the existing fisheries rules and is currently supporting the people in implementing them through the Department of Fisheries (SUP = 1). Although the government initiated the formation of co-management arrangements, there is no concrete agreement yet (CO-M = 0, IMP = 0). Lake Malombe had annual catches of about 7500 tonnes in the 1980s but only about 750 tonnes in the 1990s. For example for *Oreochromis* species, there was a drop from 25kg per 100m net in 1984 to 1kg per 100m net in 1995 (van Zwieten et al., 2003) (SUS= 0). Of course, the decline in catch per 100m could also be attributable to other factors such as an increase in the population of fishers.

XVI. Kafue Flats Floodplain Wetland Fishery in Zambia (Haller & Merten, 2008)

The Batwa, Balundwe and Ila ethnic groups were the first to settle in the floodplain and had a well-coordinated social structure with local rules on management of the fishery. As time passed by, however, Lozi and Bemba immigrants created pressure on the fisheries resource and conflicts arose. The central government created by-laws that legitimized access to everyone as long as they were Zambians and had identification to that effect (IMP = 1). This declaration broke the original social structures at the level of the resource (CSC = 0). Citizenship and not communal locality took over the control of the fishing arrangements thereby creating an open access situation with no government support (SUP = 0, CO-M = 0). According to official national data on the Kafue Flats Fisheries the annual catches had reduced from 6 metric tonnes in 1990s to only 2 metric tonnes in 2004 (SUS = 0).

XVII. Kayar and St. Louis Coastal Fishery in Senegal (Gaspart et al., 2007)

Two groups (belonging to the Wolof ethnic group) operate at this fishery; the native Kayar and the migrating St. Louis fishers. The Kayar are in favor of controlled access while the fishers from St. Louis are in favor of open access, at least for them. In 1994 both groups reached a consensus of establishing a fisheries committee (*comité des peches*) and a Kayar/St Louis Solidarity Committee (CSKSL), to help in the declining fisheries. They

effectively agreed upon ways of restricting outsiders' access to the resource (CSC = 1). The government officially recognizes the presence of CSKSL and gives it the necessary support but there is no official co-management agreement (SUP = 1, IMP = 0, CO-M = 0). The system works well and the fish catches increased (Morand & Breuil, 2005) from 4500 tonnes in 1948 to 40,000 tonnes in 1999 (SUS= 1)

Table 3.3 The dataset built on the 17 cases

Case ID	Name of case	Location	CSC	SUP	CO-M	IMP	SUS
I	Mwelu - Luapala	Zambia	0	0	0	1	0
II	Lake Kariba	Zimbabwe	1	0	0	1	0
III	Lake Chilika	India	1	1	0	1	1
IV	Aby Lagoon – case 1	Côte d'Ivoire	1	0	0	1	0
V	Aby Lagoon – case 2	Côte d'Ivoire	1	1	1	0	1
VI	Ngazidja	Comoros	1	1	1	0	1
VII	Caleta El Quisco	Chile	1	1	1	0	1
VIII	Sero Callos de Hacha	Mexico	1	0	0	1	0
IX	Lake Chiuta	Malawi	1	1	1	0	1
X	Lake Kariba	Zambia	0	0	0	1	0
XI	Lake Chilwa	Malawi	0	1	1	0	0
XII	Khong District	Laos	1	1	0	0	1
XIII	Nguru-Gashua	Nigeria	1	0	0	1	0
XIV	Olifants	South Africa	0	1	0	1	0
XV	Lake Malombe	Malawi	0	1	0	0	0
XVI	Kafue Flats Case	Zambia	0	0	0	1	0
XVII	Kayar & St. Louis	Senegal	1	1	0	0	1

3.3. Results and Discussion

Table 3 shows that the dataset is simple enough to basically analyze the trends without the use of csQCA. For example, in all cases where CSC = 0, there is no sustainability (SUS = 0) irrespective of any score for a supportive government, co-management or a conflictive state, but when CSC = 1, there is always sustainability except in cases where the government imposes its own rules (IMP = 1). The csQCA is still used however to have more formal certainty.

Using csQCA, the truth table of the 17 cases generated in the TOSMANA Analytical Report (Box 3.1) shows that different configurations (sustainability and non-sustainability) could be found among the empirical cases.

Box 3.1 The Truth Table and TOSMANA Analytical Report

Algorithm: Graph-based Agent

Truth Table:

v1: Collective Social Capital v2: Supportive Government

v3: Co-management v4: Conflictive Government

O: Outcome id: Case Study

v1	v2	v3	v4	O	id
0	0	0	1	0	I, X, XVI
1	0	0	1	0	II, IV, VIII, XIII
1	1	0	1	1	III
1	1	1	0	1	V, VII, IX
1	1	0	0	1	VI, XII, XVII
0	1	1	0	0	XI
0	1	0	1	0	XIV
0	1	0	0	0	XV

Result (all): Collective Social Capital {1} * Supportive Government {1}

(III, V, VI, VII, IX, XII, XVII)

The output is read as: successful SSF management is observed in conditions (III, V, VI, VII, IX, XII, and XVII) that combine strong collective social capital [Collective Social Capital {1}] and a supportive government [Supportive Government {1}].

It is clear from the overall result of the 17 cases examined that good collective social capital and a supportive government are the key factors in achieving sustainability of fisheries management in developing countries. Although recent scholarship has emphasized the need to promote co-management arrangements in common pool resources, it only sounds logical (and within definition boundaries) to suggest that there can never be co-management if the state authority does not recognize community organization and interests. Imposition of interventions by the state often breaks the existing collective social capital and the consequences can be even worse if there is no pre-existence of collective social capital. Experiences from Kafue Flats Floodplain Fishery in Zambia has also revealed that although central states promise many theoretical benefits when imposing management arrangements, there is usually limited involvement of local group interests resulting in social resentment and consequent counter-productivity (Haller & Merten, 2008; Chabwela & Haller, 2010). However, it is interesting to note that in Malawi, for example, the formation of functional local institutions which get support from the central state usually starts out from strong collective social capital at local level. Otherwise, if government support is given to communities in which the collective social capital is weak, there is no effect from the support which basically lands in a vacuum. Although the central state took a non-conflictive position at lakes Chiuta, Malombe and Chilwa, the fishery at Lake Chiuta is the only one which is thriving, due to the good social structures at local scale. This is consistent with findings by Gutiérrez et al. (2011) where fisheries management was not successful in communities with low social capital even when there was continued government effort. It is therefore imperative that future interventions in fisheries management policy and practice should strive to first build enough social capital (as evidenced, for example, by communities maintaining school blocks together, planting trees in a village plot, fixing dysfunctional bridges, resolving internal conflicts or anything in that line) and support the local institutions. In this line, fisheries managers may also need to properly define what constitutes social capital in particular communities because variations in this constitution have previously been observed (De Groot & Tadepally, 2008).

Cases which have co-management arrangements are only five in the dataset for this study and only appear to work when collective social capital is already strong. In other words, co-management does not appear to make any difference. Some cases such as Lake Chilika in India reveal an interesting scenario. While the state is conflictive and there are no co-

management arrangements, the fishery is still a success because the collective social capital is strong enough to persist under government pressure. This reflects that the formula for success hides in the local people who if properly involved can be used to craft successful SSF management systems which would divert away from popular theory-based designs. In such circumstances, it is always good practice for policy makers and fisheries practitioners to undertake a deeper analysis of the communities in question before conceptualizing and implementing strategies that would yield intended outcomes (Walters & Vayda, 2009; Castillo et al., 2005; Vayda & Walters, 1999).

In most developing countries, an understanding of the factors of success in SSF is still at infancy stage. Most of the reported success stories come from developed countries where SSF are not very prominent (Ratner et al., 2012; Isaacs, 2013). One thing though which is clear from this study is that where state agencies are weak (as is the case in most developing countries), strong local institutions appear to be '*conditio sine qua non*' (an indispensable condition) for resource sustainability. When the collective social capital is low, government support does not result in sustainability. However, when collective social capital is high, it can sometimes even survive an imposed state intervention although quite often, conflict with the state only results in the breakdown of local organization and the fishery becomes a failure. It is therefore important that when central states notice dwindling fisheries due to poor collective social capital they should bring in interventions that are not aimed at "ruling" the fishery but rather at (re)building the local community cohesion. The devised strategies need to be continuously improved to suit the complexity and dynamism of socio-ecological systems such as small scale fisheries. One analytical option for such interventions is the "Action in Context" (AiC) framework as devised by de Groot (1992) which essentially recognizes that social actors respond to definite underlying motivations in collective community action.

3.4. Implications for future policy direction and fisheries management practice

This study has emphasized that the sustainability of SSF management in developing countries relies heavily on a strong collective social capital and a supportive government. Future practice and policy directions on fisheries management should understand the relevance of concrete community trust, networks, norms plus values and strive to streamline them in decision making and policy formulation. Governments, especially in developing countries, and their agents should realize the need to rise above the theoretical principles of "impose and control" and begin to take a more passive, non-conflictive position in designing

working solutions for the sustainability of common pool resources such as small scale fisheries. In cases where fisheries fail due to weak local institutions, the imposition of fishing rules or the establishment of co-management arrangements is futile. The only feasible government reaction seems to lie in helping to (re)build collective social capital and then protect the institutional result. This can be done for example by encouraging civil engagement in transformative learning to reduce disadvantageous power differentials that exist in many fishing communities in developing countries.

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