

1-1-2021

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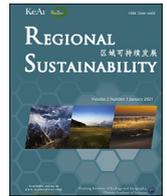
Recommended Citation

Sok, Serey and Yu, Xiaojiang (2021) "Co-management of small-scale fishery in the Tonle Sap Lake, Cambodia," *Regional Sustainability*: Vol. 2 : Iss. 1 , Article 1.

DOI: 10.1016/j.regsus.2020.12.002

Available at: <https://egijournals.researchcommons.org/regional-sustainability/vol2/iss1/1>

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Full Length Article

Co-management of small-scale fishery in the Tonle Sap Lake, Cambodia

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ARTICLE INFO

Keywords:

Small-scale fishery
Co-management
Local planning process
Community fishery
Tonle Sap Lake

ABSTRACT

In Cambodia, fishery co-management is an important process to transfer authority and ownership to the communities along the Tonle Sap Lake to manage fishery. This paper aims to determine why the co-management of small-scale fishery has not been implemented satisfactorily in the Tonle Sap Lake of Cambodia. The research was primarily based on a household survey among 404 households for quantitative data, equally divided between the Cham (202 households) and Khmer (202 households). Participatory process was also applied to collect qualitative data from key stakeholders. We found that limited interaction among the involved stakeholders, i.e., unequal distribution of authority and resources co-management, has impeded implementation. The engagement of fisherfolk was influenced by dependence on fishery, law enforcement, and events organized by the communities. While the Khmer had better opportunities to participate in planning at the provincial and district levels, the Cham were only engaged in local development activities initiated by their people. However, the latter evinced a higher rate of satisfaction due to their access to fishery resources and to a large quantity of fishing gear. In the future, efforts should be made to: (1) improve resource and authority sharing among all key stakeholders; (2) urgently resolve issues pertinent to capacity building, insufficient budgets for commune councils (CoCs) and community fishery (CFi); and (3) urge law enforcement regarding illegal fishing.

1. Introduction

For more than two decades, fishery co-management has been applied in the Tonle Sap Lake area, Cambodia. Now its fisheries are managed under a regime of community fishery (CFi). The fisherfolk are eligible to access, use and manage all fisheries in accordance with the CFi area. However, the involvement and partnership of all stakeholders in the co-management process are not yet clearly defined. In 1995, the Food and Agricultural Organization (FAO) introduced the co-management concept in the form of a Participatory Natural Resources Management Program in Siem Reap Province, Cambodia. Three years later, Oxfam Community Aid Abroad established community fisheries (CFs) in Pursat Province, Cambodia. In 2001, a widespread co-management approach was adopted (Resurreccion, 2008). However, fishery co-management has been hampered (i) by an increased trend towards decentralization (Ribot, 2002); and (ii) by dilemmas attributable to top-down governance (Driessen et al., 2012).

According to Pech and Sunada (2008), many conflicts have occurred involving lot owners and small-scale fisherfolk who have been pressured to relinquish their fishing grounds to local management. With regards of the Tonle Sap Lake, the implications of fishery

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Received 30 July 2020; Received in revised form 23 December 2020; Accepted 24 December 2020

Available online 13 January 2021

2666-660X/© 2020 Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences. Publishing services by Elsevier B.V. on behalf of KeAi

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co-management evolved in two stages of the national policy reforms. In 2001, the Royal Government of Cambodia (RGoC) initially transferred 5.00×10^5 hm² or 56% of the large-scale commercial lot owners' grounds to small-scale subsistence fisherfolk. During the second reform in March 2012, the Ministry of Agriculture, Forestry and Fisheries (MAFF) cancelled all fishing lots nationwide and handed them over to local communities for usage, management and conservation. Prior to the second reform, the Tonle Sap Lake accommodated three fishery scales, i.e., large, medium and small-scale fishing (Hap et al., 2006). Co-management has been fully applied through the establishment of CFI. By 2016, there were 516 CFs nationwide and 207 CFs (or 40% of the national total) had been established in the Tonle Sap Lake area (MAFF, 2016).

Although 90% of the local people depend upon small-scale and subsistence fishing for their food security (Hap et al., 2006), the fisherfolk have found little opportunity to participate in management. Subject to traditional overlapping and conflicting institutional arrangements, fishery management today is overshadowed by the government's fishery-associated dominant views (Pech and Sunada, 2008). Ratner (2006) argued that legal authorities and the rights and accountability of the fishery officials were required to strengthen the effectiveness of CFI, whereas Nuon and Gallardo (2011) expressed optimism regarding the CFI's operation to reduce illegal fishing. At the macro-level, fishery management helps to increase economic, environmental and legal conditions. However, economic productivity at the individual level remains inconclusive (Elliott et al., 2020).

To date, scholarly work on fishery management in the Tonle Sap Lake area has mainly focused upon the following aspects: governance and participation (Béné and Neiland, 2006; Sneddon and Fox, 2007; Sok et al., 2014), women's participation (Resurreccion, 2006), institutional arrangements (Keskinen and Varis, 2012), social capital building (Sultana and Thompson, 2004), and enhancement of resources through integrated resource management (Lambters, 2006). In the case of small-scale fishery, co-management is arguably more feasible given that it creates smaller group sizes and homogeneity of communities for collective actions (Olson, 1965). A study of the co-management in the Tonle Sap Lake revealed that fishery management is constrained by lack of linkage among state agencies, community fishery and Non-Governmental Organizations (NGOs) when it comes to implementing relevant regulations, policies and plans (Sok et al., 2012). In this paper, we try to determine why stakeholders from national to local levels have been unable to interact successfully in general, and to identify the major factors influencing the fisherfolk's degree of participation in fishery management. In addition, the Cham and Khmer fisherfolk's perceptions regarding participation in and satisfaction with both the planning process and implementation of regulations will be addressed. Finally, some future solutions will be suggested.

2. Revisiting co-management in the development world: towards an analytical framework

In the 1990s, the concept of co-management was introduced to recognize the significance of the roles and responsibilities transferred by the state to the communities for natural resource management (Lewins et al., 2014). The introduction of a centralized system has been proven a challenge for authorities with very limited legitimacy to enforce regulations (Sen and Nielsen, 1996). This top-down approach has failed to manage fishery stocks effectively (Jentoft, 1989). Co-management is designed to integrate coordination and participation of government and key stakeholders at various levels (Carlsson and Berkes, 2005). While the establishment of co-management has been time consuming (Kooiman, 2003), it has tasked local engagement with the managing of resource crises (de Oliveira, 2013).

According to Berkes (1994), co-management is a sharing of responsibilities and decision-making between the fisherfolk and the state-based management authorities. Moreover, co-management provides an opportunity to incorporate small-scale fisherfolk and other stakeholders in management (Noble, 2000). In the Cambodian context, co-management through the establishment of CFI has created a partnership arrangement in which the community, government and NGOs share both the responsibility and authority for fishery management (MAFF, 2018). Similarly, Viner et al. (2006) defined 'co-management is being implemented through the creation of community fisheries; these involve management partnerships between a community of local resource users and the provincial office of fisheries (POF), usually supported by a non-governmental organization (NGO)'. This definition is adopted in this study because it is developed specifically for fishery management in Cambodia.

Most of the developing countries influenced by international donors have introduced co-management reform in the interests of sustainable management (Knowx and Meinzen-Dick, 2001). The government holds the strong perception that fisherfolk are able to formulate locally acceptable regulations designed to fight overfishing trends (Ferguson and Derman, 2000). In Costa Rica of Central American, the centralized management has been proved ineffective due to high rate of overexploitation; and the application of co-management for exclusive access is an alternative (Lozano and Heinen, 2016). Additionally, participatory approaches to conservation have failed because the work is mainly focused upon overall project goals rather than the means for achieving real issues (Campbell and Vainio-Mattila, 2003).

In contrary, community-based conservation programs in Nepal were managed under the direction of NGOs and tended to perform well because they fostered capacity building, local income generation, benefit-sharing and more favorable attitudes (Baral and Stern, 2011). Decentralized conservation programs tend to be successful if governments legislate to promote empowerment, participation and incentives structures (Baral and Heinen, 2007). Stern and Baird (2015) identified four types of trust (dispositional, rational, affinitive and systems-based) that contributes to play a role among networks of people and organizations to govern, debate and interact in decision-making processes for natural resource management.

A well-known common-property researcher argues that self-organization is possible if collective action is shared (Ostrom, 1990). To avoid dependence on government, Pomeroy and Berkes (1997) proposed establishing community co-management. Evans et al. (2011) advocated financial investment in fishery co-management after conducting the requisite assessments. The first comprehensive global assessment revealed that leadership is a key factor in successful co-management (Gutiérrez et al., 2011). Moreover, scholars have emphasized the importance of co-management in social relationships (Pinkerton, 1989), citing the involvement of fisherfolk in key decisions regarding fishing rights (Jentoft et al., 1998). Successful fishery co-management variously requires: (1) an appropriate

institutional framework for governance (Baland and Platteau, 1996); (2) a high degree of local control (Pinkerton, 1994); and (3) solid relationships among human actors and informal arrangements (Pinkerton, 1989). Key elements of co-management consist of a degree of power-sharing (Béné and Nieland, 2006), participation and involvement (Nunan et al., 2012; Smith, 2012), coordinating institutions (Noble, 2002), empowerment and community benefits (Napier et al., 2005).

Co-management involves empowering and the sharing of rights, roles and responsibilities of state agents, communities and interested stakeholders (Berkes et al., 1991; Sen and Nielsen, 1996; Castro and Nielsen, 2001; Pomeroy, 2004; Béné, 2009). Co-sharing tasks between community and government makes co-management more effective than relying solely on state regulation (Carlsson and Berkes, 2005). Geoghegan and Renard (2002) maintained that while it is not essential for stakeholders to participate in management, their views and interests are essential features of co-management. d'Armengola et al. (2018) argued that although co-management has put considerable emphasis upon technical solutions to fisheries' management problems, it plays little attention to the socio-political factors of local representatives.

In addition, fishery co-management has been impeded by the following factors: (i) insufficient attention to practice (Wilson, 2003; Lewins et al., 2014; Quimby and Levine, 2018); (ii) inflexibility (Jentoft, 2003); and (iii) vagueness of the relevant information (Bown et al., 2013). In the context of the Tonle Sap Lake, co-management has always been the sole responsibility of the government and is mainly carried out by NGOs. However, sustainability remains an issue due to shortages of internal financial and human resources. As a result, analyses of key stakeholders' participation in planning and regulation making, and engagement with fisherfolk have become key development agendas for supporting co-management in the Tonle Sap Lake.

3. Study area and methods

The Tonle Sap Lake in Cambodia is the largest freshwater lake in Southeast Asia. It varies in size from approximately 2.50×10^5 – 3.00×10^5 hm² during the dry season to approximately 1.00×10^6 – 1.30×10^6 hm² in the wet season (Kummu and Sarkkula, 2008). As Friend (2007) observed, the fishing industry has sustained Cambodians over the centuries, accounting for 75% of animal protein intake in a typical Cambodian diet (Ahmed, 2003). Cambodia claims to have the world's most productive inland fishery, largely based on production from the Tonle Sap Lake and Mekong River (Thoun and Chambers, 2006). Its annual catch is conservatively estimated at 4.00×10^5 t, approximately two-thirds of which comes from the Tonle Sap Lake (Hortle, 2007). Given its great freshwater ecosystems, the lake is extraordinarily highly productive: it sustains enormous fish production and transport (van Zalinge, 2002). According to Baran et al. (2007), the lake's fishery ranks the first in terms of productivity and the fourth in terms of catch size in the world. The Tonle Sap Lake is frequently considered 'the heart' of the Mekong River; and, almost half of all Cambodian people benefit from its rich resources (Bonheur, 2001).

The field work for this study was conducted in one of the five provinces of the Tonle Sap Lake, i.e., Kampong Chhnang Province, between November 2015 and April 2016. Additional interviews were conducted in March 2020 to facilitate collection of reliable

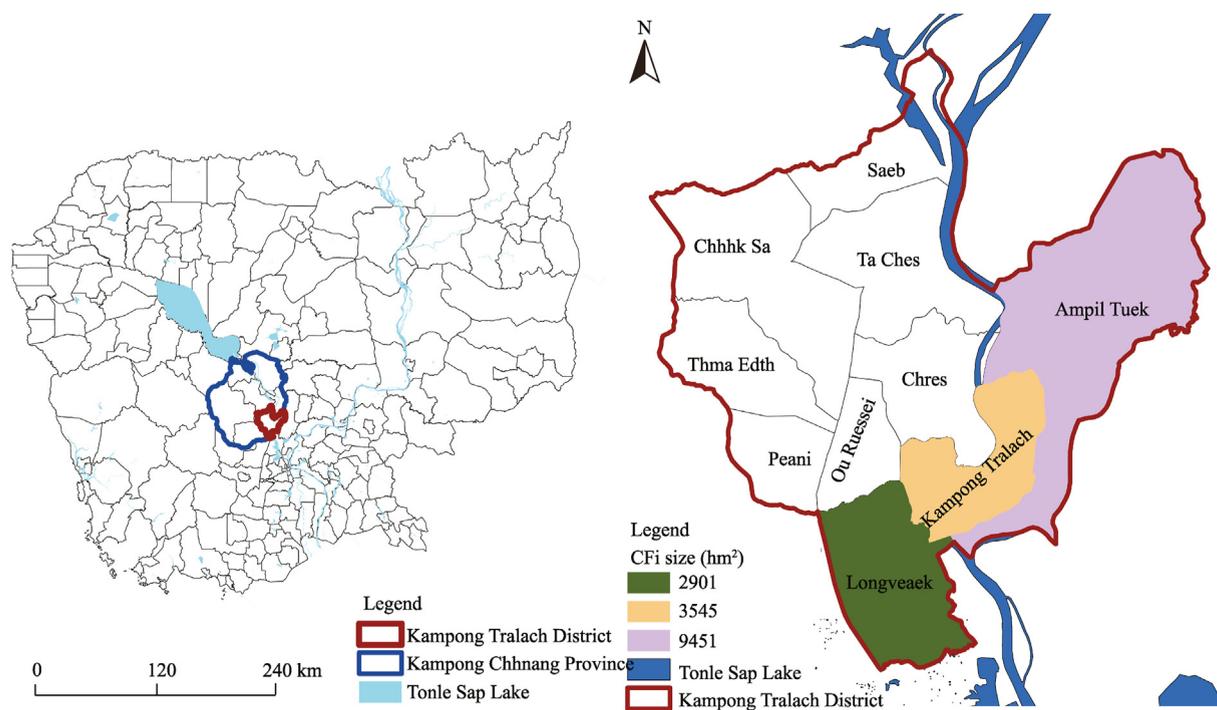


Fig. 1. Location of Kampong Tralach District in Kampong Chhnang Province, Cambodia (a), and distribution of the community fishery (CFI) in the Kompong Tralach District.

qualitative data and to update information regarding fishery management in the Tonle Sap Lake. Kampong Tralach District, which was purposely selected for this research, is located approximately 37 km south of the capital of Kampong Chhnang Province (see Fig. 1). Despite its very small land area, this district is home to the largest population in Kampong Chhnang Province. It is well-irrigated and has a sound transport infrastructure. The majority of the people in the district are fisherfolk working, either full-time or part-time. As Table 1 shows that, within the study area, 21 CFs were established in three communes: Longveaek, Kampong Tralach and Ampil Tuek, accounting for approximately 1.59×10^4 hm².

The research methodology included: (1) a household survey for collecting quantitative data; and (2) employment of a participatory approach (e.g., key informants, group discussions) for collecting qualitative data and random information. For the purposes of collecting quantitative data, we interviewed a total of 404 households in the surveys, equally divided between the Cham (202 households) and Khmer (202 households) groups (corresponding to the research of Yamane (1967)). In addition, group discussions with key informant associations were organized, with the aim being to elicit qualitative information. To explore the roles of key stakeholders and local engagement, we identified nine stakeholders in fishery co-management as key informants (Appendix 1). The list of associations included the Fishery Administration (FiA), District Administration of Kampong Tralach, Commune Councils (CoCs), CFs, Fisheries Action Coalition Team (FACT) and WorldFish. In addition, a group discussion between five Cham and five Khmer people was conducted to collect qualitative data. The technique was used to gain insights and to rank constraints regarding local participation in fishery co-management.

The Cham and Khmer interviewees were selected for the purposes of conducting a comparative study to investigate their degree of engagement in fishery co-management (see Table 2). In 2013, Cambodia was home to 14.70×10^6 people. The Khmer, who constituted the majority group, accounted for 90.0% of the total national population (MoP, 2013). The Cham, one of Cambodia's largest minority groups (totaling 2.17×10^5 people), were spread throughout the country (Joshua Project, 2014). Kampong Tralach District has a total population of 9.30×10^4 people or 2.14×10^4 households. It is home to two ethnic groups: the majority Khmer (77.6%) and the minority Cham (22.4%) (District Planning Unit, 2016).

While the Cham villagers have established closed micro-societies (separate villages), they continue to maintain economic ties with the Khmer. The majority of the Cham, who are recognized fisherfolk, reside along the Mekong River in the vicinity of the Tonle Sap Lake. They are highly skilled in the art of fishing gear usage. The study district constitutes one of Cambodia's highest Cham populations.

In quantitative analysis of the surveys, weighted average index (WAI) was applied to rate their degree of satisfaction with and fisherfolk participation in policies, laws and planning. Moreover, *T*-test analysis was also used to investigate different degrees of satisfaction between the Cham and Khmer interviewees. Simultaneously, multiple regression was applied to discern if variables significantly contributed to fisherfolk engagement in fishery co-management and conservation. Qualitative data collected from key informants and group discussion were used to analyze the key stakeholders in fishery co-management.

4. Results

4.1. Key stakeholders in fishery co-management

In managing fisheries in Kampong Tralach District, government agencies, development partners, NGOs, CoCs and CFi are key stakeholders. At the central level, the FiA of the Ministry of Agriculture, Forestry and Fisheries (MAFF) is responsible for the

Table 1
Number of community fisheries (CFs) in Kompong Tralach District in 2016.

No.	Commune	Village	Name of CFs	Area (hm ²)	Plan	CFi member		Registration date (dd/mm/yy)
						Total	Female	
1	Longveaek	Voat	Phum Voat	1008	Yes	181	85	30/12/08
2		Srah Chak	Srah Chak	535	Yes	70	36	30/12/08
3		Boeng Kak	Boeng Kak	1358	Yes	160	76	30/12/08
4	Kampong Tralach	Neak Ta Hang	Neak Ta Hang	566	Yes	241	133	30/12/08
5		Kampong Tralach Leu	Kampong Tralach Leu	727	Yes	235	77	30/12/08
6		Samretthi Chey	Samretthi Chey	265	Yes	126	44	30/12/08
7		Kampong Tralach Kraom	Kampong Tralach Kraom	446	Yes	300	140	30/12/08
8		Preaek Kanlang	Preaek Kanlang	552	Yes	219	90	30/12/08
9		Kampong Kdar	Kampong Kdar	601	Yes	222	71	30/12/08
10		Kien Roka	Kien Roka	388	Yes	83	49	30/12/08
11	Ampil Tuek	Kbal Kaoh	Kbal Kaoh	647	Yes	249	135	30/12/08
12		Kaek Pong	Kaek Pong	314	Yes	325	201	30/12/08
13		Baek Chan	Baek Chan	649	Yes	318	145	30/12/08
14		Khla Krohuem	Khla Krohuem	502	Yes	104	55	30/12/08
15		Bak Phnum	Bak Phnum	178	Yes	181	98	30/12/08
16		Veal Sbov	Veal Sbov	331	Yes	130	60	30/12/08
17		Kien Khleang	Kien Khleang	296	Yes	160	70	30/12/08
18		Ou Mal	Ou Mal	243	Yes	222	131	30/12/08
19		Stueng Snguot	Stueng Snguot	3397	Yes	388	202	30/12/08
20		Ampil Tuek	Ampil Tuek	2384	Yes	243	129	30/12/08
21		Sdei Banlich	Sdei Banlich	510	Yes	363	184	30/12/08
Total				15,897		4520	2211	

Note: CFi, community fishery. Source: MAFF (2016).

Table 2
Characteristics of the Cham and the Khmer.

Ethnic group	Characteristic
The Cham	About 50.5% of the Cham were full-time fisherfolk. The Cham owned less land but were more skilled at fishing.
The Khmer	About 16.9% of the Khmer were full-time fisherfolk. The majority Khmer were full-time rice farmers.

Note: Source: Field survey (2016).

management and conservation of fishery based on national fishery laws and policies of Cambodia. The FiA commissioned three levels of the provincial fishery cantonment, the sectional fishery authority and the Sangkat fishery authority to oversee fishing activities and to control instances of perceived fishery exploitation. In 2001, the FiA created the Department of Community Fisheries Development (DCFD) to build technical capacity and manage CFs countrywide.

The main functions of the DCFD were to coordinate the relevant institutions, promote the establishment and operation of CFs, and conduct monitoring, evaluation and research (KI-1 (KI, key informants) in [Appendix 1](#)). The FiA also worked with the development partners to mobilize resources and collaborated with NGOs to build capacity and support the implementation of CFI. Between 2006 and 2009, the Asian Development Bank (ADB) supported the DCFD's efforts to implement the Tonle Sap Environmental Management Project. The aim of the project was to improve sustainable management and conservation of natural resources, and protect biodiversity of the Tonle Sap Lake Biosphere Reserve ([ADB, 2011](#)). Within the communities, NGOs extensively supported the establishment and operation of CFI. For example, NGOs directed and followed up the CFI's daily tasks to ensure its effectiveness.

In December 2008, subsequent to the technical and financial support of the DCFD and the ADB, a total of 21 CFs were established in Kampong Tralach District. They operated as community-based organizations with the aims of (i) managing fish conservation areas or reserves, and (ii) restoring habitats and ecosystems in accordance with the guidelines of the FiA and the rules formulated by the fisherfolk (KI-2 in [Appendix 1](#)). A Kampong Tralach Leu CFI committee member revealed that the MAFF's approval of a CFs was based upon: (i) the perceived level of fishery dependence of the community; (ii) the availability of fishing grounds; and (iii) the financial support and capacity building provided by the DCFD, the ADB and/or other NGOs (KI-3 in [Appendix 1](#)). The committee membership of each CFI varied from 6 to 12 people. They were in charge of operation activities contrary to the CFs' management plans. The tasks and the responsibility for managing fishery were shared by the fishing CFs. The main tasks included organizing meetings, sharing information among members and monitoring illegal fishing (KI-1 in [Appendix 1](#)).

Human resources and budgets were the main challenges to the operation of these community-based organizations. However, they lacked the requisite expertise to carry out the proposed activities (KI-4 in [Appendix 1](#)). For example, after the completion of the ADB projects, Ampil Tuek CFI was unable to carry out regular patrols and to organize awareness-raising programs appertaining to fishery law and the associated legal framework. In effect, the implementation of these tasks would not have been possible without the financial and technical support of NGOs. During the survey, we discovered that CFs could only undertake few activities which were mainly participating in workshops or meetings organized by NGOs. Funding for CFs' operations heavily relied on NGOs' support because not all CFs have generated their own revenues. The education levels of CFI committee members elected by the local fisherfolk tended either to be lower secondary or high school levels (KI-5 in [Appendix 1](#)). Moreover, the CFs were unable to raise the awareness and enhance the capacity of the fisherfolk without technical support or capacity building by NGOs.

In effect, the CFs and NGOs did little to enhance law enforcement and reduce illegal overfishing. Law enforcement became the responsibility of fishery officers from the provincial fishery cantonment. The sectional fishery authority and Sangkat fishery authority played greater roles in managing fishery and enforcing associated laws and regulations. However, their collaboration with the CFs and NGOs was far from smooth when it came to eliminating illegal fishing. For example, the CFs and NGOs found it was difficult to get fishery officers to: (i) discuss illegal fishing at community meetings; (ii) share their concerns; and (iii) offer effective solutions (KI-3 in [Appendix 1](#)). The chairperson of the Kampong Tralach Kraom CFI stated that the CFs worked closely with the NGOs and CoCs on ways of resolving conflict over equal access to fishery and the monitoring of illegal fishing (KI-6 in [Appendix 1](#)). Both the CFI committee members and the fisherfolk preferred to report illegal fishing to CoCs or NGOs for intervention rather than to fishery officers or the police. That is because, based upon past experience, the fisherfolk and CFI committee members realized that reporting illegal fishing was always ignored or ineffectively handled by both fishery officers and the police (KI-7 in [Appendix 1](#)).

4.2. Fisherfolk's perceptions on planning, regulations and community

The fisherfolk's participation in planning and daily management activities had largely influenced their livelihoods. Given that the Cham and Khmer can claim equal representation in the planning process at all levels, they are adequately equipped to find solutions to their concerns. The WAI was used to rate the degree of fisherfolk participation in and satisfaction with planning and regulations. In addition, *T*-test analysis was employed to test if the Cham and Khmer expressed different views regarding planning and regulations for fishery co-management of the communities located along the Tonle Sap Lake (see [Table 3](#)).

Overall, the Cham and Khmer evinced different levels of participation and satisfaction regarding provincial planning, district planning, usage of fishery resources, size of fishing gear, establishment of the CFs, and community outreach. The Khmer had better opportunities to take part in higher levels of meetings, e.g., provincial and district planning. They used high-level meetings as platforms to express their concerns about and suggestions for improving fishery management in their respective communities. At the community

level, both the Cham and Khmer equally and widely participated in the planning process initiated by the CoCs and NGOs. They evaluated a range of agreements and satisfied with most of all attributes apart from commune planning. In late 2015, the CoCs invited all of the villagers, irrespective of whether they were the Cham or Khmer, to prioritize development activities including the commune investment plan scheduled for 2016. Also, one representative from each household was invited to participate in fishery management which was considered a prioritized activity within their communities.

The Cham are especially family-oriented and not willing to travel out of their communities. Out of the 10 communes and 21 CFs in Kampong Tralach District, the Cham managed 7 CFs in the Kampong Tralach commune. However, their connection to the NGOs, Kampong Tralach District and provincial administrations could best be termed negligible. The Cham seemed highly satisfied with their usage of fishery resources, the size of the fishing gear, CFI membership and community outreach. However, the Khmer complained about the restrictions on fishing grounds usage and frequently appealed for revision of the size and types of fishing gear. The Cham's culture of helping each other, together with their higher dependence on fishery resources for their livelihoods, motivated most of the communities to become the CFI members.

The NGOs focused on the most vulnerable groups, and their plans were mostly directed towards the poor in the communities. The CoCs and NGOs engaged with the Cham and Khmer equally and had undertaken their work mainly among the local people in the communities. Some targeted groups among the NGOs, e.g., Fisheries Action Coalition Team (FACT), were invited to develop their action plans for 2016. The FACT and the Coalition of Cambodia Fishers worked to assist the operations of the CoCs and CFs. Their action plans included some activities proposed by the CoCs and CFI appertaining to fishery management. Although several activities of the CFs were integrated with commune investment plans, CoCs rarely allocated funds to these activities. Every year, each commune receives between 2.0×10^4 USD and 5.0×10^4 USD from the central government for development projects. The main portion of the budget is allocated to infrastructure construction.

4.3. Factors influencing the participation of fisherfolk in fishery co-management

Four groups of attributes were considered useful to analyze if they have influenced the participation of fisherfolk in fishery management, which included: demography, fishery-related economic activities, participation in meetings at various levels and law enforcement. In line with all predictions, the results, i.e., a combination of five out of the 12 attributes, significantly estimated the engagement of fisherfolk in fishery management. Table 4 suggests that some attributes, e.g., fishery contribution to household and participation in community meetings, can make a significant positive effect to the engagement. However, demographic factors, e.g., age, education and ethnicity, are not significantly associated with their engagement. This indicates that age, education and ethnicity are not the main factors influencing the fisherfolk participating in fishery management.

The model predicts the positive fishery contribution to household and participation in community meetings. The contribution of fishery to the livelihoods of householders invariably influences the fisherfolk's degree of engagement. The prediction tends to suggest that the higher the degree of fishery dependency for household, the greater the opportunity for fisherfolk to participate in local fishery management events. The fisherfolk believe that fishery can be sustainable and provide a long-term livelihood support only when the communities are playing very important roles in fishery management. The effective fishery management helps to secure their food security in the future. The engagement of fisherfolk is likely to be enhanced by the availability of community meetings. Regular community meetings are monthly or quarterly organized by CoCs, NGOs and CFs. At these meetings, concerned parties discuss key issues, listen to concern expressed about topics such as illegal fishing, and raise awareness of fishery management. This model suggests that when meetings are regularly organized in the communities, there will be a strong likelihood of enhanced fisherfolk engagement in fishery management.

The same model also suggests that attributes, e.g., primary job as fisherfolk, restrictions on fishing gear, and arrest by fishery officers, had some negative contributions to engage the fisherfolk in fishery management. Nevertheless, full-time fisherfolk were unlikely to be actively engaged in fishery management. For those who rely on fishery as their primary source of income, they are reluctant to discuss topics like restrictions on gear and illegal fishing. Some full-time fisherfolk confessed to feeling very guilty when participating in events organized by CFs, NGOs or the provincial officer of fishery. Some hesitantly admitted that during their respective lifetimes, they had personally used illegal fishing gear. Some had earlier been arrested by maritime officers for breaching fishery laws. Many full-time

Table 3
Degree of fisherfolk participation in and satisfaction with planning and regulations.

Attribute	Khmer (n = 202)		Cham (n = 202)		Overall (n = 404)		P-value
	WAI	OA	WAI	OA	WAI	OA	
Provincial planning	0.45	M	0.37	L	0.41	M	0.000***
District planning	0.48	M	0.45	M	0.46	M	0.005**
Commune planning	0.66	H	0.67	H	0.66	H	0.416
NGOs planning	0.51	M	0.52	M	0.51	M	0.670
Usage of fishery resources	0.49	M	0.58	M	0.49	M	0.000***
Size of fishing gears	0.54	M	0.61	H	0.54	M	0.000***
CFi's membership	0.53	M	0.62	H	0.54	M	0.000***
Community outreach	0.52	M	0.58	M	0.52	M	0.000***

Note: WAI, weight average index (L, less (0.21–0.40); M, moderate (0.41–0.60); H, high (0.61–0.80)); OA, overall assessment; **, significance at the 0.01 level; ***, significance at the 0.001 level.

Table 4
Influencing attributes on fisherfolk's respond to fishery management.

Attribute	B	Standard error	β	t-value	P-value
Age	0.029	0.045	0.025	0.645	0.519
Education attainment	-0.169	0.152	-0.044	-1.107	0.269
Ethnicity (Khmer or Cham)	1.366	1.107	0.052	1.234	0.218
Number of male fisherfolk	0.505	0.617	0.033	0.818	0.414
Number of female fisherfolk	0.316	0.925	0.013	0.341	0.733
Primary job as fisherfolk	-7.444	1.227	-0.269	-6.069	0.000***
Fishery contribution to household	12.851	1.419	0.432	9.057	0.000***
Participation in national meetings	-4.753	8.195	-0.043	-0.580	0.562
Participation in regional meetings	-3.369	6.693	-0.039	-0.503	0.615
Participation in community meetings	11.975	3.495	0.167	3.426	0.001**
Restrictions on fishing gear	-15.611	3.986	-0.182	-3.916	0.000***
Arrest by fishery officers	-4.535	1.957	-0.088	-2.317	0.021*

Note: B is the unstandardized coefficient and it was generated from the natural units of each variable; β is the standardized coefficient which was estimated by standardizing the variables before running the regression. The t-value and P-value were used to test the null hypothesis that the coefficient is 0; either of these two statistics indicated the significance of the selected independent variables. *, significance at the 0.05 level; **, significance at the 0.01 level; ***, significance at the 0.001 level. All 12 attributes were derived from a total sample size of 404 households.

fisherfolk had invested considerable amounts of money in fishing gear and paid bribes to both the police and fishery officers in exchange for using oversized fishing gear. Whereas for those who rely on fishery as their secondary job, they preferred to catch fish in the vicinity of their homes; full-time fisherfolk frequently traveled miles to fishing grounds in other districts or in neighboring provinces.

5. Discussion

5.1. Constraints impeding interaction between key stakeholders and fishery co-management

The research has discovered that co-management has been weakened by unequal sharing of authority and responsibility. Based on the definitions by Viner et al. (2006) and MAFF (2018), the emergence of broader interaction among stakeholders in the fishery management of the Tonle Sap Lake, occurred when co-management was officially adopted as a national policy in the 2000s. But, interactions among CFs, fishery officers and the police are limited due to the fact that only responsibilities are transferred from the governments. However, the fisherfolk, CoCs and CFs don't have any authorities of financial/human resources, and decision-making. When developing laws, policies and planning strategies, the FiA invites stakeholders to participate in consultation.

However, decision-making largely remains in the hands of the central government. Many of the concerns raised and suggestions proposed by the fisherfolk are not addressed in the final decision-making process. During the formulation of regulations, for example, fisherfolk, CoCs and CFs, are granted temporary rights to detain illegal fishing offenders pending the arrival of the authorities. In reality, however, the fisherfolk are only allowed to inform the relevant officers about illegal fishing. They have no rights to detain offenders. As a result, the offenders flee the scene before the officers or police arrive. In addition, CFs and CoCs mainly work to support activities implemented by the DCFD and NGOs.

Lack of sufficient funding limits many local communities' abilities to fulfill their roles and responsibilities. From the experiences in Nepal (Baral and Stern, 2011; Stern and Baird, 2015), it is noted that NGOs play important roles in supporting the Community-based Organization (CBOs) for natural resource management. In the study area, NGOs have both good human and financial resources, and they fulfill their tasks well. However, most of their tasks are short-term. Also, NGOs' relationships with the DCFD are not always congenial. For this reason, the missions they pursue often are dependent upon external helpers and/or humanitarian agencies. The CFs' development activities cease when the DCFD and NGOs no longer allocate funding to the communities. Co-management cannot be achieved if CoCs and CFs are not equipped with sufficient resources, or if NGOs are not authorized to work in support of local communities. The central government is considering allocating an annual budget to the CFs through a commune investment plan designed to support basic activities, i.e., patrols, community meetings and transportation.

During a group discussion convened in Kampong Tralach District, the fisherfolk proposed that the fishing grounds managed by the CFs should be zoned into a protected area with open fishing and cooperative fishing grounds. Because cooperative fishing grounds are open to public auction, the resultant income could be used for CFi operations. According to a FACT official, CFs were unable to collect membership fees and integrate their activities into a commune investment plan (CIP) for mobilizing an annual budget to finance the management plans. In case where activities which were already integrated with the CIP, CoCs did not allocate the annual budget that would support CFs implementation of the management plan. As a result, NGOs were the main funding sources supporting the implementation of the CFi's management plans (KI-8 in Appendix 1). At the same time, NGOs and the DCFD could continue to promote awareness, capacity building and advocacy campaigns. We would like to emphasize that roles and responsibilities can work effectively only if resources and authority are equally distributed among all stakeholders in fishery co-management.

5.2. Development of fisherfolk's livelihoods and law enforcement

The policy reforms introduced in 2000 and 2012 have proven to be very important milestones in fishery co-management in

Cambodia. Their introduction allowed fisherfolk to establish CFs as community-based organizations. Sub-Decree on Community Fishery Management and Fishery Law, which was formulated in 2006, includes the monitoring of illegal fishing in the Tonle Sap Lake. The law is jointly enforced by the provincial fishery cantonment, the sectional fishery authority and the Sangkat fishery authority. The fishery law recognizes local authorities, in particular CoCs, as collaborating partners in law enforcement. The law also provides a means of ensuring that members of the local police force have sufficient authority to deal with illegal fishing. The CFs have formulated internal regulations in the fishery law with which members and others must comply upon entering fishing grounds (KI-7 in [Appendix 1](#)). However, the question remains: why is illegal fishing still rampant in the Tonle Sap Lake when so many institutions from national to local levels are working to implement fishery management?

During the group discussion, fisherfolk identified two of the main reasons behind the failure: (1) the fisherfolk's low capability to survive; and (2) the bribing of involved officers. Several fisherfolk admitted that they could not earn enough to survive due to the current limitations on fishing gear, fishing grounds, and the high cost of equipment and gasoline. To comply with the current limitations on fishing gear, the fisherfolk could only use seine nets that does not exceed 400 m. The harsh reality is that the fisherfolk find it is difficult to survive irrespective of net size. Small-scale fisherfolk are left with two options only: (1) bribing the relevant officers; and (2) engaging in illegal fishing. When implementing the management plan, the CFs were responsible for conducting patrols to oversee illegal activities, but they obtained little support from the provincial fishery cantonment, i.e., the sectional fishery authority when dealing with illegal offenders. They claimed that they had insufficient staff and equipment to conduct patrols with CFs (KI-4 in [Appendix 1](#)).

Up-to-date, the fisherfolk are facing to the rapid declines of fishery when the operation of CFs is constrained by insufficient power-sharing ([Béné and Nieland, 2006](#)), limited local control ([Pinkerton, 1994](#)), and lower degree of empowerment ([Napier et al., 2005](#)) to manage resource effectively. At Kampong Tralach commune, the fisherfolk complained about a perceived ineffective crackdown on illegal fishing and corruption. In earlier times, there were fishing lots. Fishing lot owners had to adhere to certain regulations and instructions issued by the FiA. After the fishing grounds opened in March 2012, illegal fishing became more widespread, almost out of control. As a result, the annual catch by small-scale fisherfolk has dramatically reduced in size.

The introduction of various larger-scale illegal fishing events involving local elites has also impacted deleteriously on the fisherfolk. Although some of these events occurred in the daytime, legal action was not taken unless direct orders came from fishery officers. These powerful elitists always know the patrol plan in advance; frequently, someone leaked the patrol information to the fisherfolk. When forewarned, the offenders could temporarily postpone their illegal fishing activities for a few days (GD (group discussion) in [Appendix 1](#)). When the fisherfolk informed the relevant officers about the high incidence of illegal fishing, patrols were either delayed or ignored. Conversely, the officials always acted immediately against poor fisherfolk who used traps and/or other forms of banned gear for subsistence fishing. When action was taken against those using banned gear, the charges were more likely to be directed towards small-scale fisherfolk. The latter were unable to pay bribes to officials patrolling illegal fishing practices (KI-2 in [Appendix 1](#)).

5.3. Participation of the Cham and Khmer

Based on the findings of our study, there are three parts to the co-management: (1) components of management; (2) key stakeholders; and (3) a participatory process. Key stakeholders, e.g., the government, NGOs, CoCs and CFs, are working to promote sustainable livelihoods and fishery management. A satisfactory outcome will depend upon components of management and a successful participatory process. The latter will depend upon a management mechanism. The striking of a balance between fishery conservation and livelihood development requires a carefully considered level of sustainable management. The study confirms that the respective degrees of engagement of the Cham and Khmer will be determined by: (1) their respective degrees of dependence upon fishery for their livelihoods; (2) the availability of development activities in the communities; and (3) law enforcement. The findings in [Table 3](#) distinguish the degree of participation of the two ethnic groups in fishery co-management. While the Cham had fewer opportunities to participate in district and provincial planning, they expressed higher satisfaction regarding usage of fishery resources and size of fishing gear.

The existing studies reveal that decentralized conservation programs and local benefits ([Baral and Heinen, 2007](#)) improve the engagement of communities in development activities. In the case of the Tonle Sap Lake, a higher proportion of the Cham were full-time fisherfolk. The Khmer were considered part-time fishers. At Kampong Tralach commune, where the villagers were very actively involved in community development, projects were invariably initiated by community members (e.g., the CFs committees). They helped their neighbors and friends by sharing their experiences of fishing and disseminating awareness of fishery management.

However, they have chosen not to established close relationships with the NGOs and authorities in general, particularly at the district, provincial and central levels. In contrast, where fishery management was concerned, the Khmer established a better connection with the district and provincial governments. The Cham were less likely to become involved in the formulation of laws, policies and regulations. Within the study communities, the Cham preferred to gather together to discuss religious issues. Economic development seemed not a priority. The Khmer were more willing to participate in economic events organized by NGOs and government agencies at both regional and national levels. Their participation influenced the development of a legal framework.

5.4. Suggestions about future actions

In order to increase the effectiveness of fishery co-management in the Tonle Sap Lake area, the authorities should share national programs and resources with the CFs to enable the latter to work independently and on a long-term basis. The authors strongly recommend as the following: first, the DCFD should provide the CFs with political and legal support by transferring more authority and sufficient financial resources. The CFs should be eligible to confiscate illegal activities and the CFi committee may include some

members from the police and CoCs. Moreover, the CFs should also be allocated an annual budget through commune investment budget that will allow them to carry out key activities independently. As an example, the human and financial resources for patrol should be available for 15 d per month at least, which is aligned to World Wide Fund for Nature (WWF) guideline for effective fishery management. As a result, the CFs could be expected to perform much better in their daily management duties, such as the organization of regular community meetings, investigation of illegal fishing and the solving of any committee problems. Second, local revenue of CFI should be collected through membership fees with the restriction of fishing activities by non-members of CFs. The CFs should collect fees for the entry of fishing ground in a CFI area. Also, the CFs should be able to earn local revenues through CBOs, such as saving group and eco-tourism initiative. Third, the authority of CFs in decision-making should be automatically shared or transferred as the CFs have enough human and financial resources. Fourth, the engagement of the Cham in planning and policy implementation should be further encouraged, especially their participation in meetings and consultation at both regional and national levels. To achieve this, we recommend that a great effort should be made towards raising the public participation awareness of the Cham.

6. Conclusions

Based on our primary findings and discussion, we conclude that fishery co-management has been constrained by insufficient interaction among the involved stakeholders, seemingly due to uneven sharing of authority and resources. In the case of the communities domiciled along the Tonle Sap Lake, CoCs and CFs emerged as the core agents working closely with the fisherfolk. However, they lacked sufficient human and financial resources for implement the CFI mismanagement plans. Without sufficient resources, both CoCs and CFs were unable to fulfill their tasks. They could only support some development activities organized by government agencies and NGOs. Factors such as dependence on fishery for livelihood development, law enforcement, and events organized in the communities greatly contributed to the engagement of fisherfolk in co-management. Fisherfolk were more actively involved in the activities launched by local governments, NGOs and CoCs in the communities. The relevant events organized at provincial and regional levels had little influence on the local fisherfolk, particularly on the Cham. To achieve better fishery co-management in the future, we recommend that resources and authority should be equally shared among all key stakeholders. As well, issues of capacity building, insufficient budgets for CoCs and CFs, and law enforcement on illegal fishing must be urgently addressed.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This study is under the financial support from MK32 Mekong Fellowship and it is a part of Consultative Group for International Agricultural Research (CGIAR) research program on Water, Land and Ecosystems. We are thankful for the Royal University of Phnom Penh to provide institutional support in the research. The authors greatly appreciate the editorial board of the journal and the anonymous reviewers for their constructive comments on this paper; and Dr. Estelle Dryland and Ms. Diana McCosker at Macquarie University, Sydney for their language editing. Also, the authors gratefully acknowledge Mr. Kanharith Samath, Mr. Boromey Samath and Mr. Sok Sela for assisting in the fieldwork and data collection.

Appendix

Appendix 1. Lists of key informants (KI), in-depth organization and group discussion (GD)

Code	Organization	Interview date
KI-1	Fishery Administration, Phnom Penh Office	April 2016
KI-2	Kampong Tralach Commune, Kampong Tralach District, Kampong Chhnang Province	January 2016
KI-3	Kampong Tralach Leu CFI (community fishery), Kampong Tralach District, Kampong Chhnang Province	March 2016
KI-4	Ampil Tuek CFI, Kampong Tralach District, Kampong Chhnang Province	March 2020
KI-5	Fisheries Action Coalition Team, Phnom Penh Office	March 2020
KI-6	Kampong Tralach Kraom CFI, Kampong Tralach District, Kampong Chhnang Province	March 2016
KI-7	WorldFish, Phnom Penh Office	April 2012
KI-8	District Office, Kampong Tralach District, Kampong Chhnang Province	January 2016
GD	Fisherfolk, Kampong Tralach Commune, Kampong Tralach District, Kampong Chhnang Province	February 2016

References

- ADB (Asian Development Bank), 2011. Cambodia: Tonle Sap Environmental Management Project. Asian Development Bank, Phnom Penh.
- Ahmed, M., 2003. Fish Consumption in Selected Asian Countries: A Disaggregated Analysis by Types of Fish and Classes of Consumers. The World Fish Center, Penang.
- Baland, J.M., Platteau, J.P., 1996. Halting Degradation of Natural Resources: Is There a Role for Rural Communities? Clarendon Press, Oxford.
- Baral, N., Heinen, J.T., 2007. Decentralization and people's participation in conservation: a comparative study from the Western Terai of Nepal. *Int. J. Sustain. Dev. World Ecol.* 14 (5), 520–531.
- Baral, N., Stern, M.J., 2011. A comparative study of two community-based conservation models in Nepal. *Biodivers. Conserv.* 20 (11), 2407–2426.
- Baran, E., Starr, P., Kura, Y., 2007. Influence of Built Structures on Tonle Sap Fisheries—Synthesis Report Cambodia National Mekong Committee. Working Papers, number 36990, July. The WorldFish Center, Penang.
- Béné, C., Neiland, E.A., 2006. From Participation to Governance: a Critical Review of the Concepts of Governance, Co-management and Participation, and Their Implementation in Small-Scale Inland Fisheries in Developing Countries. Working Papers, number 36883, July. The WorldFish Center, Penang.
- Béné, C., 2009. Power struggle, dispute and alliance over local resources: analyzing 'democratic' decentralization of natural resources through the lenses of Africa inland fisheries. *World Dev.* 37 (2), 1935–1950.
- Berkes, F., George, P.J., Preston, R.J., 1991. The evolution of theory and practice of the joint administration of living resources. *Altern.* 18 (2), 12–18.
- Berkes, F., 1994. Co-management: bridging the two solitudes. *N. Perspect.* 22 (2), 18–20.
- Bonheur, N., 2001. Tonle Sap Ecosystem and Value. Technical Coordination Unit for Tonle Sap. Ministry of Environment, Phnom Penh.
- Bown, N.K., Gray, T.S., Stead, S.M., 2013. Co-management and adaptive co-management: two modes of governance in a Honduran marine protected area. *Mar. Pol.* 39, 128–134.
- Campbell, L.M., Vainio-Mattila, A., 2003. Participatory development and community-based conservation: opportunities missed for lessons learned? *Hum. Ecol.* 31 (3), 417–437.
- Carlsson, L., Berkes, F., 2005. Co-management: concepts and methodological implications. *J. Environ. Manag.* 75 (1), 65–76.
- Castro, P.A.E., Nielsen, E., 2001. Indigenous people and co-management: implications for conflict management. *Environ. Sci. Pol.* 4 (4–5), 229–239.
- d'Armengol, L., Castillo, M.P., Ruiz-Mallén, I., et al., 2018. A systematic review of co-managed small-scale fisheries: social diversity and adaptive management improve outcomes. *Global Environ. Change* 52, 212–225.
- de Oliveira, L.P., 2013. Fishers as advocates of marine protected areas: a case study from Galicia (NW Spain). *Mar. Pol.* 41, 95–102.
- District Planning Unit, 2016. Socio-economic Data of Kampong Tralach (In Khmer). District Office of Planning, Kampong Chhnang.
- Driessen, P.P.J., Dieperink, C., van Laerhoven, F., et al., 2012. Towards a conceptual framework for the study of shifts in modes of environmental governance – experiences from The Netherlands. *Environ. Policy Gov.* 22 (3), 143–160.
- Elliott, M.L., Knodt, A.R., Ireland, D., 2020. What is the test-retest reliability of common task-functional MRI measures? New empirical evidence and a meta-analysis. *Psychol. Sci.* <https://doi.org/10.1177/0956797620916786>.
- Evans, L., Cherrett, N., Pemsil, D., 2011. Assessing the impact of fisheries co-management interventions in developing countries: a meta-analysis. *J. Environ. Manag.* 92 (8), 1938–1949.
- Ferguson, A., Derman, B., 2000. Writing against Hegemony: Development Encounters in Zimbabwe and Malawi (Development Encounters: Sites of Participation and Knowledge). Harvard University Press, Cambridge.
- Friend, R., 2007. Securing Sustainable Livelihoods through Wise Use of Wetland Resources: Reflections on the Experience of the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBSP). MWBP, Vientiane.
- Geoghegan, T., Renard, Y., 2002. Beyond community involvement: lessons from the insular Caribbean. *Parks* 12 (2), 16–27.
- Gutiérrez, N.L., Hilborn, R., Defeo, O., 2011. Leadership, social capital and incentives promote successful fisheries. *Nature* 470 (7334), 386–389.
- Hap, N., Seng, L., Chuenpagdee, R., 2006. Socioeconomics and Livelihood Values of Tonle Sap Lake Fisheries. International Food Policy Research Institute (IFPRI), Phnom Penh.
- Hortle, K.G., 2007. Consumption and the Yield of Fish and Other Aquatic Animals from the Lower Mekong Basin. Mekong River Commission, Phnom Penh.
- Jentoft, S., 1989. Fisheries co-management: delegating government responsibility to fishermen's organizations. *Mar. Pol.* 13 (2), 137–154.
- Jentoft, S., McCay, B.J., Wilson, D.C., 1998. Social theory and fisheries co-management. *Mar. Pol.* 22 (4–5), 423–436.
- Jentoft, S., 2003. Co-management – the way forward. In: Wilson, D.C., Nielsen, J.R., Degnbol, P. (Eds.), *The Fisheries Co-management Experience: Accomplishments, Challenges and Prospects*. Kluwer Academic Publishers, Dordrecht.
- Joshua Project, 2014. Cham, western in Cambodia. [2020-09-09]. https://joshuaproject.net/people_groups/print/15361/CB.
- Keskinen, M., Varis, O., 2012. Institutional cooperation at a basin level: for what, by whom? Lessons learned from Cambodia's Tonle Sap Lake. *Nat. Resour. Forum* 36 (1), 50–60.
- Knox, A., Meinzen-Dick, R.S., 2001. Collective Action, Property Rights, and Devolution of Natural Resource Management: Exchange of Knowledge and Implications for Policy. CAPRI working papers 11. International Food Policy Research Institute (IFPRI).
- Kooiman, J., 2003. *Governing as Governance*. Sage, London.
- Kummu, M., Sarkkula, J., 2008. Impact of the Mekong River flow alteration on the Tonle Sap flood pulse. *J. Hum. Env.* 37 (3), 185–192.
- Lamberts, D., 2006. The Tonle Sap Lake as a productive ecosystem. *Int. J. Water Resour. Dev.* 22 (3), 481–495.
- Lewins, R., Béné, C., Baba, M.O., 2014. African inland fisheries: experiences with co-management and policies of decentralization. *Soc. Nat. Resour.* 27 (4), 405–420.
- Lozano, A.J.G., Heinen, J.T., 2016. Property relations and the co-management of small-scale fisheries in Costa Rica: lessons from marine areas for responsible fishing in the Gulf of Nicoya. *Mar. Pol.* 73, 196–203.
- Ministry of Agriculture, Forestry and Fisheries (Maff), 2016. Community Fisheries Update 25/6/2016. Ministry of Agriculture, Forestry and Fisheries, Phnom Penh.
- Ministry of Agriculture, Forestry and Fisheries (Maff), 2018. Fisheries Co-management Training Manual – N° 1: Establishing a Community Fishery. Fisheries Administration and Inland Fisheries Research and Development Institute, Phnom Penh.
- MoP, 2013. Intercensal population survey, preliminary findings. Phnom Penh: Ministry of Planning.
- Napier, V.R., Branch, G.M., Harris, J.M., 2005. Evaluating conditions for successful co-management of subsistence fisheries in KwaZulu-Natal, South Africa. *Environ. Conserv.* 32 (2), 165–177.
- Noble, B.F., 2000. Institutional criteria for co-management. *Mar. Pol.* 24 (1), 69–77.
- Nunan, F., Luomba, J., Lwenya, C.A., 2012. Finding space for participation: fisherfolk mobility and co-management of Lake Victoria fisheries. *Environ. Manag.* 50 (5), 204–216.
- Nuon, V., Gallardo, W., 2011. Perceptions of the local community on the outcome of community fishery management in Krala Peah village, Cambodia. *Int. J. Sustain. Dev. World Ecol.* 18 (5), 453–460.
- Olson, M., 1965. *The Logic of Collective Action*. Harvard University Press, Cambridge.
- Ostrom, E., 1990. *Governing the Commons. The Evolution of Institutions for Collective Action*. Cambridge University Press, Cambridge.
- Pech, S., Sunada, K., 2008. Population growth and natural-resources pressures in the Mekong River basin. *Ambio* 37 (3), 219–224.
- Pinkerton, E., 1989. Attaining better fisheries management through co-management prospects, problems and propositions. In: Pinkerton, E. (Ed.), *Cooperative Management of Local Fisheries: New Direction in Improved Management and Community Development*. University of British Columbia Press, Vancouver.
- Pinkerton, E., 1994. Local fisheries co-management: a review of international exercises and their implications for salmon management in British Columbia. *Can. J. Fish. Aquat. Sci.* 51 (10), 2363–2378.
- Pomeroy, R.S., Berkes, F., 1997. Two to tango: the role of government in fisheries co-management. *Mar. policy* 21 (5), 465–480.
- Pomeroy, R.S., 2004. Devolution and Fisheries Co-management. ICLARM, Manila.
- Quimby, B., Levine, A., 2018. Participation, power, and equity: examining three key social dimensions of fisheries co-management. *Sustainability* 10 (9), 3324.
- Ratner, B.D., 2006. Community management by decree? Lessons from Cambodia's fisheries reform. *Soc. Nat. Resour.* 19 (1), 79–86.

- Resurreccion, B., 2006. Rules, roles and rights: gender, participation and community fisheries management in Cambodia's Tonle Sap Region. *Int. J. Water Resour. Dev.* 22 (3), 433–447.
- Resurreccion, B., 2008. Gender mainstreaming in the Tonle Sap region: three myths. *Modern Myths of the Mekong* 65–77.
- Ribot, J.C., 2002. Democratic Decentralisation of Natural Resources. World Resources Institute, Washington, DC.
- Sen, S., Nielsen, R.J., 1996. Fisheries co-management: a comparative analysis. *Mar. Pol.* 20 (5), 405–418.
- Smith, S.L., 2012. Toward inclusive co-management: factors influencing stakeholder participation. *Coast. Manag.* 40 (3), 327–337.
- Sneddon, C., Fox, C., 2007. Power, development, and institutional change: participatory governance in the lower Mekong basin. *World Dev.* 36 (12), 2161–2181.
- Sok, S., Yu, X., Wong, K.K., 2012. Impediments to community fisheries management: some findings in Kompong pou commune, krakor district in Cambodia's Tonle Sap. *Singapore J. Trop. Geogr.* 33 (3), 398–413.
- Sok, S., Yu, X., Yila, O., 2014. Decentralized local institutions and livelihood development of riverine communities in the Lower Mekong Basin, Cambodia. *J. of Asian Pub. Pol.* 7 (3), 275–290.
- Stern, M.J., Baird, D.T., 2015. Trust ecology and the resilience of natural resource management institutions. *Ecol. Soc.* 20 (2), 14. <https://doi.org/10.5751/ES-07248-200214>.
- Sultana, P., Thompson, P., 2004. Methods of consensus building for community-based fisheries management in Bangladesh and the Mekong Delta. *Agric. Syst.* 82 (3), 327–353.
- Thoun, T., Chambers, M., 2006. Situation Analysis: Stung Treng Province, Cambodia. Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme, Vientiane, LA.
- van Zalinge, N., 2002. Update on the status of the Cambodian inland capture fisheries sector with special reference to the Tonle Sap Great Lake. *Catch and Culture* 8 (2), 1–5.
- Viner, K., Ahmed, M., Bjørndal, T., 2006. Development of Fisheries Co-management in Cambodia: a Case Study and its Implications. Working Papers, number 36885, July. The WorldFish Center, Penang.
- Wilson, D.C., 2003. The community development tradition and fisheries co-management. In: Wilson, D.C., Nielsen, J.R., Degnbol, P. (Eds.), *The Fisheries Co-management Experience*. Fish and Fisheries Series, vol. 26. Springer, Dordrecht.
- Yamane, T., 1967. *Statistics: An Introductory Analysis*, (2nd ed.). Harper and Row, New York.