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Working Paper Series No. 109

December 2016

A CDRI Publication

CDRI Working Paper Series No. 109

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ISBN-13:978-9924-500-09-4

Citation:

Sam Sreymom, Ky Channimol, Keum Kyungwoo, Sarom Molideth and Sok Raksa. 2016. *Common Pool Resources and Climate Change Adaptation: Community-based Natural Resource Management in Cambodia.* CDRI Working Paper Series No. 109. Phnom Penh: CDRI.

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Printed and Bound in Cambodia by Donbosco printing

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Acronyms

CBET	community-based ecotourism
CBNRM	community-based natural resource management
CBO	community-based organisation
CDRI	Cambodia Development Resource Institute
CF	community forestry
CFi	community fisheries
CPR	common-pool resources
CPA	community protected area
FGD	focus group discussion
FWUC	farmer water user community
ISF	irrigation service fee
KII	key informant interview
NGO	non-governmental organisation
MOE	Ministry of Environment
O&M	operation and maintenance
PDWRAM	Provincial Department of Water Resources and Meteorology
REDD^{+}	reducing emissions from deforestation and forest degradation

Acknowledgements

The authors are deeply grateful for the funding support generously provided by the Swedish International Development Agency (Sida) which made the research possible.

This paper has benefitted from the expertise and kind assistance of several colleagues at CDRI. Special thanks go to Dr Eng Netra for her review and extensive comments on this paper. Thanks are also extended to Dr Chem Phalla for his significant technical input and support throughout the study but particularly at the start, and to the key informants, too numerous to mention individually, for their substantial contributions at various stages of the study.

Sincere thanks are due to You Sethrith and Susan Watkins for editing, reviewing and facilitating the development and publication of this working paper. The authors wish to express their deep gratitude to Dr Chhem Rethy, executive director, and Dr Ouch Chandarany, acting senior administrative manager, for their guidance and insights which inspired and motivated the development of this report.

Finally, heartfelt thanks go to all key informants including local community leaders, village and commune chiefs and commune councillors who contributed very useful information for this working paper, and to CDRI colleagues who provided logistics and administrative support during the research.

Abstract

Using primary and secondary data sources, this study synthesises existing knowledge on community-based natural resource management (CBNRM) approaches in Cambodia. It identifies critical challenges and suggests ways to optimise the benefits of CBNRM in the context of climate change. Selected CBNRM initiatives include farmer water user communities, community fisheries, community-based ecotourism and community forestry. Factors contributing to the success and potential sustainability of resource communities are visible local economic benefits; ongoing institutional support including from government, NGOs and the private sector; and embedded local participation once benefits are secured. The challenges are grouped into three: technical, financial and governance. Limited knowledge, inadequate funding and technical support, intermittent participation and unequal access to resources are the biggest obstacles. Thus CBNRM practice is struggling to live up to the expectations of economic incentives, social benefits and environmental conservation. However, this approach is still advocated as the main mechanism for managing resources, with the condition that all stakeholders are performing their roles well and ongoing technical and financial supports are in place to sustain community activities.

1. Introduction

Natural resources such as forest, fisheries, water and land play a vital role in local livelihoods, especially for the poor (Bromley and Cernea 1989), who mostly rely on common-pool resources (CPR) for subsistence. CPR are defined as "natural or human-made resources where one person's use subtracts from another's use and where it is often necessary, but difficult and costly, to exclude other users outside the group from using the resource". The most used approach to CPR governance is direct centralisation whereby the state is responsible for the management of CPR. But this proved largely unsuccessful (Ostrom 1990), resulting in a shift to a people-oriented approach and transfer of CPR management to local resource-user groups. Although a global phenomenon, this paradigm shift is of particular importance in resource-rich regions.

Community-based natural resource management (CBNRM) has been widely recognised as a key approach for the collective use and management of natural resources. CBNRM is variously defined as "a diversity of co-management approaches that strive to empower local communities to participate actively in the conservation and sustainable management of natural resources" Carson et al. (2005, 37), an approach to encourage and empower rural communities to manage natural resources such as water, fish, forests and, wildlife, with knowledge, rights and authority (Anderson and Metha 2013), and "a process by which landholders gain access and use rights to, or ownership of, natural resources; collaboratively and transparently plan and participate in the management of resource use; and achieve financial and other benefits from stewardship" (Child and Lyman 2005 cited in Fernández-Giménez, Baival and Wang 2012, 23). Definition aside, the compelling goal of CBNRM is sustainability where local ecological knowledge and social and economic incentives play a dominant role in promoting resource management and conservation (Berkes et al. 1994; Kleymeyer 1994 cited in Killert et al. 2000). Of course, CBNRM initiatives around the world differ in scope and focus (Armitage 2005).

CBNRM initiatives and programs in Cambodia typically come under multiple umbrellas including water, fisheries, forestry, ecosystem goods and services. Specific types of community-based organisations (CBOs) have been established for specific types of CPR. These include farmer water user communities (FWUCs) for the operation and management of irrigation schemes, community fisheries (CFi) to safeguard fish stocks and breeding grounds, community-based ecotourism (CBET) for the protection of ecosystem services such as flooded forest and endangered species, and community forestry (CF) for forest conservation and restoration of denuded forestland. Since its inception, many challenges to the successful implementation of CBNRM have arisen, obstructing the operation of CBOs. As a result, CBOs have failed to live up to the expectations of resource user empowerment and CPR conservation. The prevailing and emerging problems identified in many CBNRM projects include a lack of cooperation among diverse stakeholders with different interests (Pomeroy, Katon and Harkes 2001; Shackleton 2002; Diepart 2015); lagging registration of community lands owing to the awarding of economic land concessions; ineffective application and enforcement of environmental policies and laws; and the capacity building needs of grassroots stakeholders (Learning Institute 2009).

Exacerbating CPR-related problems is the fact that Cambodia is one of the most vulnerable countries to climate change and has little capacity to adapt to climate change and create resilience. Despite strong commitment to building climate resilience, as set out in the Cambodia Climate Change Strategic Plan 2014-23, the country remains susceptible to adverse effects of climate change due to its high dependency on climate-sensitive sectors, specifically agriculture,

forestry, fisheries and tourism (MOE 2006; Shicavone 2010; NCCC 2013). Future changes are expected to include declines in agricultural production, deterioration in forest health and productivity, erosion of beaches and more frequent coastal inundation, and loss of species and habitat in natural areas (CWP 2010). Climate change poses a big threat to the rural population at large, and an even bigger threat and additional risk to the rural poor in particular, most of whom rely directly on natural resources for subsistence or income (Tompkins and Adger 2003). Effective natural resource management is therefore crucial to improve rural livelihood security. Climate-induced food insecurity constitutes another key threat to natural resource dependent communities whose resilience is inherently low.

1.1 Objectives

To date, no studies have critically assessed the various CBNRM approaches implemented in Cambodia to improve CPR (forest, fisheries, water and ecosystem services) management. Towards addressing this knowledge gap, this study aims to synthesise empirical evidence on the outcomes of local CBNRM programs.

For the challenges and opportunities of CBNRM to be properly addressed and climate resilience realised across diverse sectors, the prevailing approaches to CBNRM need to be rethought. To that end, the three-fold objectives of this study are to:

- Provide a synthesis of existing knowledge on CBNRM approaches in Cambodia;
- Identify expectations and critical challenges; and
- Suggest alternative institutional relationships to balance multiple stakeholder expectations of CBNRM in the context of climate change.

1.2 Methodology and data

Research method includes focus group discussions (FGDs), key informant interviews (KIIs) and a desk review. Data was collected in 2015 from three FGDs, nine KIIs and a desk review of research reports and literature (Table 1), including the following CDRI studies:

- Adaption Capacity of Rural People in the Main Agroecological Zones of Cambodia (Nang et al. 2014)
- Governance for Water Security and Climate Resilience in the Tonle Sap Basin (Sam et al. 2015)
- Fishery Reforms on the Tonle Sap Lake: Risks and Opportunities for Innovation (Kim et al. 2013)

Other research studies provided useful empirical data and insights into community forestry, specifically REDD+ (reducing emissions from deforestation and forest degradation) communities and community-based ecotourism, notably:

- Conflict resolution in REDD+: An Assessment in the Oddor Meanchey Community Forestry REDD+ Site, Cambodia (Brewster 2014)
- Does Community Forestry Provide a Suitable Platform for REDD+? A case study from Oddor Meanchey, Cambodia (Bradley 2012)

- Tmatboey Community Protected Area Committee, Cambodia (UNDP 2012)

Table 1: Data collection methods and sources by CBNRM type

CBNRM type	Name	Method and source
Community fishery (CFi)	Tonle Sap	Desk review of Kim et al. 2013
	Boeng Tourk and Boeng Kouy in Kompong Thom	FGDs, KIIs
Community forestry (CF) and community protected area (CPA)	REDD+ communities in Oddor Meanchey	Desk review of Bradley 2012 and Brewster 2014
	Chiork Boeung Prey Preah Vihear	FGDs, KIIs
Community-based ecotourism (CBET)	Kampong Phluk in Siem Reap	FGDs, KIIs
	Thmatboey in Preah Vihear	Desk review of existing information from UNDP 2012
Farmer water user community (FWUC)	Chinit, O Svay and Roluos in Kompong Thom Trapang Trabek, Taing Krasang and Pok Pen in Kompong Chhnang Damnak Ampil, Kompang and Wat Leap in Pursat Plov Touk in Takeo Chomlong Chrey in Kampot	Desk review of Sam et al. 2015

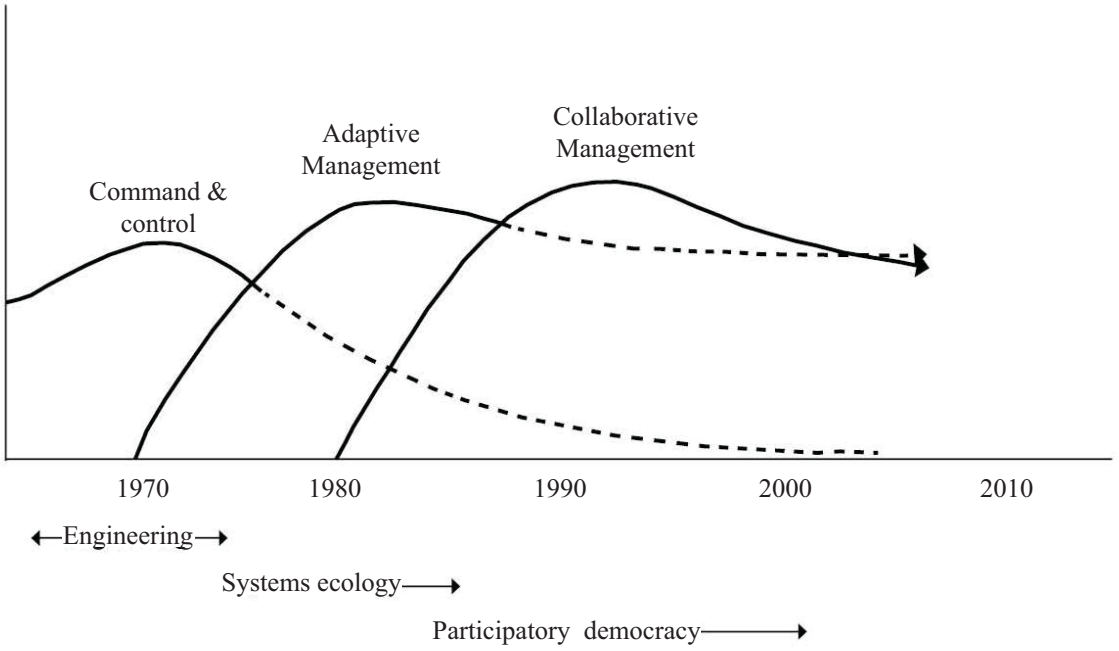
2. Literature review and analytical framework

2.1 Changing resource management paradigms

Natural resource management regimes have changed over time, mirroring shifts in underlying discourses; a timeline of paradigm change (Figure 1) illustrates their evolution. The command-and-control approach of the late 1970s (Holling and Meffe 1996) favoured a reductionist approach to science that imposed a linear order on the natural world with assumptions of "predictable and incremental change of natural systems" (Folke et al. 2005 cited in Cundill and Rodela 2012). It was then eclipsed by adaptive management in the 1970s and 1980s due to unexpected ecological changes resulting from human activities, bringing linked social-ecological systems, adaptation, learning and resilience into prominence (Holling 1986; Lee 1993; Gunderson et al. 1995 cited in Cundill and Rodela 2012). At the time, adaptive management was considered an innovative approach for promoting learning and stewardship (Lee 1999) and a practical means for dealing with uncertainty and change (Holling 1978; Walters et al. 1990).

After adaptive management came the development in the 1980s of a more collaborative environmental management regime, in part related to civic participation and rights-based approaches to empowering the poor as well as to equitable access to resources (Chambers 1994; Sen 1981, 1999 cited in Cundill and Rodela 2012). This approach attracted a multitude of international discourses, stemming from a combination of the influence of participatory democracy and recognition of the effectiveness of local community management "under certain conditions" (Ostrom 1990), with "appropriate levels of decentralization" (Murphree 2000), in sharing the benefits and management of conservation and development with local communities (Cundill and Rodela 2012).

Figure 1: Major paradigm shifts in natural resource management and underlying discourses



Source: Adapted from Cundill and Rodela 2012

Influenced strongly by systems ecology, the idea of adaptive co-management emerged in the 2000s (Cundill and Rodela 2012), defined as "a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, on-going, self-organised process of learning-by-doing" (Folke et al. 2002, 20). Adaptive co-management is considered a promising approach that has "the potential to deal with the complexity of interdependent social-ecological systems and enhance the fit between ecosystem dynamics and governance systems" (Olsoon et al. 2010, 263).

In addition, Glasbergen (1998) describes five forms of idealised environmental governance: regulatory, self-organising, civil society, cooperative and market-based. In practice, however, hybrid governance structures are the norm, meaning that CPR management regimes – co-management (CBNRM), public-private partnerships (logging) and private-social partnerships (ecotourism, payments for ecosystem services) – are idealised property rights regimes (Lemos and Agrawal 2006).

2.2 CBNRM evolution, expectations and challenges

The concept of CBNRM emerged during the 1980s as an approach to participatory natural resource management and rural development (Chishakwe et al. 2012). Its dual aims are to empower local communities to manage natural resources through collective action, full participation and the incorporation of local knowledge into management; and to provide communities with enough economic benefits to incentivise and enable them to conserve and sustainably use natural resources (Armitage 2005; Roe and Nelson 2009). An implicit assumption of CBNRM is that if local communities gain more power and responsibility over managing and conserving natural resources, and derive economic benefits from their stewardship, they will manage, use and conserve those resources effectively (Roe and Nelson 2009; Leach et al. 1999).

Essential to the success and effectiveness of CBNRM programs are community empowerment, economic benefit and conservation incentives (Murphree 2008; Anderson and Metha 2013; Jones and Murphree 2004; Wells and Bradon 1992; Killert et al. 2000). Social incentives are to be aroused by the genuine devolution of power to use and manage natural resources from central government to local actors or institutions, the participation of resource users in natural resource management, and the incorporation of traditional local knowledge into resource management (USAID 2002; Berkes et al. 1994, Kleymeyer 1994 cited in Killert et al. 2000). The empowerment of local actors or communities, specifically through promoting collective action, is arguably "one of the greatest impacts of CBNRM – far exceeding any economic or environmental benefits" (Binot et al. 2009, 55). Participation is "the active engagement of relevant stakeholders in the management and governance process" (Stringer et al. 2009 cited in Leitch et al. 2015,203. Conservation and environmental protection, which have often failed because of economic marginalisation that can lock people into a negative cycle of resource depletion, are to be achieved through devolution and paticipatory resource management (Agrawal 1999). Environmental protection and conservation are promoted by bringing to individuals and communities economic benefits that in turn can contribute to poverty reduction and inclusive local development (WRI 2005).

Joint proprietorship, where natural resources are shared and collectively managed by a group of people according to their own norms, strategies and rules, is another key element of CBNRM (Jones and Murphree 2004). However, this element is integrated with the first

principle of empowerment, in which local communities have to be provided legitimate rights and responsibilities in decision-making processes for resource management.

CBNRM is not without pitfalls, however. A global review (Anderson and Mehta 2013) of CBNRM programs in Cambodia, Guatemala and Kenya identifies three main constraints: technical, economic and governance. Technical constraints mainly concern limited capacity of local institutions in dealing with the complex problems of management planning resulting in lack of ownership, preparing technical and administrative documentation, conducting monitoring and evaluation, and handling knowledge and information, all of which are crucial aspects of sustainable natural resource management (Anderson and Metha 2013). Knowledge is especially important in responding to environmental stresses and shocks. However, knowledge that is not drawn from local people, scientists and other stakeholders is inherently limited (Armitage et al. 2012; Berkes 2010). A related issue is a lack of long-term investment in community capacity building to sustain accountability and stakeholder participation (Roe et al. 2009).

The economic constraints on CBNRM primarily relate to the low value of transferred resources and economic benefits, lack of markets, unequal distribution of benefits and elite capture (Anderson and Metha 2013). In the words of Roe et al. (2009, ix), such challenges are intensified by "strong political economic incentives for political elites and central bureaucracies to consolidate their control over natural resources".

Governance constraints can also strongly affect the processes and outcomes of CBNRM. The challenges to environmental governance shed light on those besetting CBNRM, namely fit and scale, adaptiveness and learning, knowledge, actors and roles, accountability and legitimacy (Armitage et al. 2012). Fit, here, refers to "the match or congruence between biophysical systems and governance systems" (Young 2008, 28). Scale is defined as "the extent to which institutional arrangements are similar and exhibit comparable processes across levels of social organizations ranging from the local to the global" (Young 2008, 26). The issue of fit and scale refers to mismatch between the scope of the environmental problem and institutional jurisdiction (Armitage et al. 2012), as well as the vertical and horizontal interractions or interplay between institutions and actors (Young 2008).

Adaptiveness and anticipatory learning are essential for managing uncertainty, particularly in the face of climate change. Adaptiveness is achieved through social learning processes and, involves collaboration among diverse actors across many levels. The need for collaboration creates a challenge because interplay between different groups of actors is not always clear. Further, achieving balanced social and ecological outcomes requires a complex knowledge system which integrates local and scientific knowledge (Armitage et al. 2012). Again, this necessitates collaboration between all actors. New nonstate actors in environmental governance are emerging, partly as a result of hybrid forms of governance. Even so, how these nonstate actors assume authority is recognised as a challenge ((Rhodes 1997; Kersbergen and Waarden 2004 cited in Armitage et al. 2012). Expectations of accountability and legitimacy are feasible with a top-down mode of governance but not with a cooperation mode (Armitage et al. 2012). Another governance challenge is that not all rights and responsibilities transferred to local communities fit each other, thus limiting community sanctioning power (Anderson and Metha 2013).

This review of the empirical and theoretical literature offers general insight into the expectations and challenges of CBNRM. Despite some shortcomings, CBNRM is still advocated as a main mechanism for boosting the accountability of local and state governments and strengthening local institutional capacity and processes to achieve desired conservation and rural development outcomes (Roe and Nelson 2009; Agrawal 2001).

2.3 Analytical framework

Ideally, CBNRM, through empowering local people to manage their own local natural resources, is expected to ensure the sustainable use and conservation of resources. But various barriers to this local management approach curb these expectations. The analytical framework builds on findings from the literature review by looking at how CBNRM is being implemented in various sectors, the extent to which the goals of social incentive, economic benefit and environmental conservation have been realised, and some of the specific challenges faced. Finally, this section provides some suggestions as to how the CBNRM approach can be further developed to improve resilience to climate change.

3. The case studies

Selection of resource-user communities was based on available information, type of common property resource (water, forestry, fisheries and ecotourism) and agroecological zone (Tonle Sap plain, plateau/mountains, Mekong plain and coastal).

3.1 Establishment and structure

The various resource-user groups have developed in different ways. Community forestry (CF) has a legal basis including the 2003 Sub-decree on Community Forestry, the 2002 Forestry Law, and the 2006 Community Forestry Guidelines (Prakas) set out by the Ministry of Agriculture, Forestry and Fisheries (MAFF) (Blomley et al. 2010). Community fisheries (CFi) also come under the jurisdiction of MAFF; their establishment is guided by three different yet related legal frameworks, namely the 2005 Sub-decree on Community Fisheries Management, the 2006 Fisheries Law, and the 2007 Guidelines for Community Fisheries (Blomley et al. 2010). CPAs are authorised by the Ministry of Environment (MOE) and established within national protected areas which were defined by Royal Decree issued on 1 November 1993 (Open Development 2016). The establishment of CPAs is supported by the 2008 Protected Areas Law, as clearly stated in Chapter 6 of the law aiming at increasing local communities' participation in the planning and implementation of sustainable resource management and conservation. There is still no specific regulatory and legal framework for CBET, which might develop as CFi or CPA subcommunities. CBET schemes are established with support from development partners and/or NGOs in collaboration with the sectoral ministry. FWUCs are the responsibility of the Ministry of Water Resources and Meteorology, and were implemented with the adoption of participatory irrigation management and development in 1999 under Circular No. 1 on the implementation policy for sustainable irrigation systems, and Prakas/Proclamation No. 306 for establishing community-based water management in 2001 (CDRI 2010).

The different resource communities have similar organisational structures, consisting of a chief, at least two deputy chiefs, a cashier, a bookkeeper and members responsible for different components. The sector ministries in cooperation with development partners and NGOs help

local groups initiate resource-user communities and obtain formal recognition from both local and national authorities. The process for selecting the committee leader and members is similar across community types: community members select their preferred leaders and representatives through periodic elections. Community operations are initially supported by government, donors and NGOs and then must transition to self-management when that support comes to an end. Member's participation is strongly required at all stages of community operations, from designing and planning to sharing information and spreading awareness and reflecting on how to do things better. Again, in practice, these expectations are often thwarted by many challenges obstructing members and operating committees' full participation throughout the resource management cycle.

Supporting organisations and agencies take on important roles in building local capacity, helping to formulate legal statutes and internal regulations, and implementing project activities. The extent of support varies depending on each actor's agenda.

Table 2: Description of each community

Community	Background
Community fisheries (CFi)	
Boeung Touk Boeung Kouy	Formed in early 2007 with the agreement of the provincial Fisheries Administration Cantonment, the CFi embrace the four villages of Taleav, Trery Myab, Prasat and Tanhaum of Prasat commune in Santuk district, Kompong Thom province. Their goal is to conserve natural lakes by preserving fishery habitats, replanting flooded forest and preventing illegal fishing. They have 480 members and 11 committees. Members' main occupations and sources of income are farming, vegetable growing, fishing, forestry and eco-tourism. Involved government agencies and local authorities include the Department of Community Fishery Development, Department of Environment, and commune and village chiefs, while NGOs include Khmer Fish, Good Program, Oxfam and Harvest (help with fish processing, training provision).
Tonle Sap	CFi were established variously but have a similar organisational structure and receive support from government agencies and NGOs.
Community forestry (CF) groups	
REDD+ (reducing emissions from deforestation and forest degradation)	REDD+ projects aim to protect forest and help mitigate greenhouse gas emissions by creating carbon sinks. With support from Danish International Development Agency, Department for International Development, New Zealand Agency for International Development and the Clinton Climate Initiative, the Forestry Administration has partnered with local authorities, Pact Cambodia, Terra Global Capital and local NGOs (e.g. Children's Development Association, Monks Community Forestry Association). Thirteen CF groups in Oddar Meanchey are engaged in a REDD+ project covering 58 villages and 67,783 ha of forestland. Through this project, 7.1 million tonnes of carbon dioxide are expected to sequester over 30 years (Poffenberger, De Gryze and Durscinger 2009). The October 2015 project update found that all 13 CF groups were carrying out activities to reduce deforestation within their community boundaries. Limited support means that each group has had to prioritise planned activities such as putting up signs and boundary posts to demarcate their areas and patrolling to deter illegal logging and hunting (Forestry Administration and Terra Global Capital 2015).

Community protected area (CPA)	
Chiork Boeungprey	Chiork Beoungprey CPA in Preah Vihear province was established in 2002 with support from a local NGO known as CSRP, which later provided training on leadership and community management in 2003-04. Other supporters include the United Nations Development Programme (UNDP), World Wildlife Fund (WWF), Ministry of Mines and Energy, Ministry of Environment (MOE) and Provincial Department of Agriculture, Forestry and Fisheries (PDAFF). UNDP provided training on climate change adaptation to villagers in 2013-14, and WWF helped with rattan handicraft production. As stakeholders, MOE and PDAFF participate in community activities. In addition, MOE organises annual training on climate change adaptation for the community leader, commune chief and villagers through a project called "Enhancing Climate Change Resilience of Rural Communities living in Protected Areas in Cambodia", funded by the Adaptation Fund and implemented by MOE and United Nations Environment Program.
Community-based ecotourism (CBET)	
Kompong Phluk	Kampong Phluk commune lies about 20 km southeast of Siem Reap and comprises three villages: Dey Krohorm, Kork Kdol and Thnot Kambot. In 1999, with support from an FAO-funded project and Siem Reap Provincial Fisheries Administration Office, Kompong Pluk formed a community to manage the 979 ha of flooded forest adjacent to the commune. In 2001, after the abolishment of fishing lots 4 and 5 by the government, nearly 15,000 ha of fishing grounds were given to the commune and Kompong Pluk community fishery was established (Evans, Marschke and Paudyal 2004). Recognising the ecotourism potential of flooded forest and biodiversity, in 2007 UNDP helped set up CBET within the existing community fishery. The main goals were to protect natural resources, create green environment, educate local people to conserve flooded forest, plant more trees and make the area the best tourism attraction. Today, CBET protects 5480 ha of flooded forest, 18 ha of fish refuge and 12 ha of bird habitat (HURREDO 2016).
Tmatboey	Tmatboey is a village within Kulen Promtep Sanctuary (famous for birdwatching) in Preah Vihear province. A pilot project conducted in 2002 supported by the Wildlife Conservation Society (WCS) led to the establishment of Tmatboey CBET in 2004. The community was initiated by WCS through the Ibis Rice Project with recognition from the commune council and MOE (Clements et al. 2008; UNDP 2012). The wildlife-friendly project links conservation with livelihood improvement, and is implemented by the WCS, MOE and Forestry Administration and operated by Samsom Mlup Prey (SMP 2015).
Farmer water user communities (FWUCs)	
Chinit Plov Tuok Rolous Trapang Trabek	FWUCs fall into two broad groups: those that can and those that cannot collect irrigation service fees (ISF). Only Chinit, Plov Touk, Roluos and Trapang Trabek schemes fall into the first category. All FWUCs have received support from various development partners and NGOs for establishment, operation and maintenance, infrastructure construction and capacity building. They all have a similar structure as they must follow the June 2000 prakas on the formation of FWUCs. Like other resource communities, FWUCs comprise a committee and members; the number of members depends on the size of the irrigation scheme. The FWUCs selected for study are classed as small and medium-sized schemes. FWUC committees govern their respective irrigation schemes, but in cooperation with the Provincial Department of Water Resources and Meteorology (PDWRAM). Committees are expected to collect ISF and file monthly, bi-monthly or annual reports with PDWRAM and/or report to all members at seasonal/annual meetings. Stakeholders include subnational government (PDWRAM, Provincial Departments of Agriculture, district, commune and village authorities), development partners, NGOs, intervention project holders and research institutes. At the time of study, external support for these FWUCs had come to an end and they were mainly interacting with subnational government.

3.2 Challenges

The following is a summary of the main challenges facing each type of community.

Table 3: Challenges facing each type of community

Specific community	Detail
Community fisheries (CFi)	
Boeung Touk Boeung Kouy	Declining fish catches, low water levels, limited financial support, passivity of committee members, and lack of participation in patrolling.
Tonle Sap Lake	The 2012 fisheries reform to abolish private fishing lots which was expected to resolve conflicts between local and commercial fishers has led to confusion among local fishers about rights of access to fishing grounds and consequent boundary conflicts. For managers, overlapping roles and responsibilities between administrative and implementation authorities are another source of confusion. Another issue is heightened ecological risk resultant of expanded access to fishing grounds, including in seasonally flooded terrestrial environments, encouraging fishers to use larger scale equipment. However, poor fishers still suffer inequitable access to fishing grounds, while CFi around the Tonle Sap Lake are beset by ineffective management due to limited commitment to the management of larger community fishing areas, limited budget and weak technical capacity in management (Kim et al. 2013).
Community forestry (CF)	
REDD+ community forestry	Conflicts with military personnel, economic land concession (ELC) holders, other CF groups and local government, and illegal logging and land clearance, are the biggest problems affecting forestry communities. Some of the military bases along the Cambodian-Thai border are in CF areas. Military personnel are granted land and encouraged to settle in the area with their families. To supplement their low salary, some soldiers become involved in illegal logging, land clearing and wildlife hunting. They also obstruct the activities of community forest patrols. Some ELC areas overlap CF areas because their licences were issued before the CF areas were granted legal status. CF groups reported that ELC holders have also been involved in illegal logging in CF zones (Brewster 2014). Although vital, the participation of the 13 community groups in CF management is constrained by lack of support, limited local resources and in-migration. The low level of participation has led to several internal problems concerning cohesion and solidarity, trust, leadership and perception of benefits (Bradley 2012). Conflict between CF groups and local government is largely a result of limited law enforcement in that local authorities do not investigate reports of illegal activities. Financial and human resource constraints limit the ability of local authorities to mediate conflict and help CF groups claim their legal rights. Illegal logging is mainly perpetrated by powerful figures with military backing. A climate of fear around bringing these people to justice means that CF groups dare not face illegal loggers alone. They need the Forestry Administration's firm support. Land clearance and encroachment are due to uncertain tenure rights and population pressure, particularly from newcomers converting forestland to agricultural land before claiming ownership and selling it on when land prices rise (Brewster 2014).

Community protected area (CPA)	
Chiork Boeungprey	Illegal logging within CPA boundaries, higher demand for declining non-timber forest resource stocks, water shortages and/or drought, limited livelihood options and lack of patrolling budget are the key challenges. Patrolling is voluntary but members do not always take part because earning their livelihoods takes most of their time.
Community-based ecotourism	
Kompong Phluk	Illegal logging of flooded forest, fishing by outsiders, weak coordination between provincial departments, local authorities and the community, free-foraging cattle in the dry season destroying the community's plants, poor roads and lack of transport are the main problems. Even so, the community can generate enough income to cover its operations and is optimistic about its future sustainability when external support stops.
Tmatboey	Not available
Farmer water user communities (FWUCs)	
Chinit Plov Tuok Rolous Trapang Trabek	Lack of technical backstopping, inadequate financial support, inequitable water allocation, poor sense of ownership, low participation, and unsophisticated or incomplete irrigation scheme design are the main problems. FWUCs reported limited management and operating capacity even though they received training before the irrigation schemes were transferred to them. When the FWUCs started to face critical issues and needed consultation, it became clear that technical backstopping was not in place. PDWRAM, which has sole responsibility for overseeing FWUCs, has limited ability to help due to understaffing, limited capacity and lack of public budget. Financial stress not only hampers FWUCs but other CBNRM initiatives as well. Budget for operation and maintenance, and support for the committees are found to be limited or non-existent, resulting in deteriorating scheme structures, inequitable water distribution, conflict between head- and tail-end users, and demotivation of committees and members. Inequitable water allocation due to incomplete and deteriorated irrigation structures is a major issue in almost all of the schemes. Adding to this problem is low participation from farmers, for example, in raising earth bunds and digging tertiary canals in Stung Chinit. Sense of ownership and participation are interrelated issues. A common perception is that all irrigation schemes belong to the government or support organisation, so local people do not necessarily feel obliged to repair and maintain them. Lack of financial support has demotivated committee members and they do not seem to participate in community activities. The best example of problematic irrigation design is Chinit, where an incomplete scheme combined with a low turnout of farmers to dig quaternary canals and build small levees has led to structural deterioration.

3.3 Success and sustainability

Among the communities studied, some show potential for sustainability and others are lagging. The most outstanding is Tmatboey CBET, which can generate enough revenue to cover operational costs once outside support stops. The main factors contributing to its success are the real economic benefits gained by community members and ongoing support from government, NGOs and the private sector. Local participation is embedded in the sense that participation improves as sustainable livelihood effects are realised (Box 1).

Box 1: Tmatboey Community-based Eco-tourism (CBET)

The main roles of the community are to manage the tourism site, tourism income and funds from donors, report illegal activities to the authorities, enforce the no-hunting agreement and oversee local land use planning specifically forest clearance for agriculture. Tmatboey CBET incorporates many institutions either directly or indirectly. For instance, it has a direct link with Sam Veasna Center for Wildlife Conservation, which promotes tours through advertisements, brochures and the internet, and helps build community ecotourism skills. Commune councils and village authorities muster villagers' support and help the community enforce the rules. The private sector also plays a crucial role in tourism advertising and booking. Indirectly involved organisations include the Wildlife Conservation Society, which works to support both the Forestry Administration and Ministry of the Environment in managing the sanctuary, and the protected area authorities who are responsible for enforcing land rights and the tourism agreement (UNDP 2012).

Local people participate in three main conservation activities: protecting the resin trees that ibis nest in, reporting and monitoring endangered species, and growing rice in accordance with conservation rules. In return for safeguarding ibis nests, the tree owners receive an annual payment of USD10-13. Likewise, forest resource collectors, in return for not selling endangered species' eggs and instead reporting and monitoring nests until the eggs hatch, get an annual payment of around USD7. The money to pay them comes from ecotourism revenue. Rice farmers wanting to sell their rice under the brand name "Ibis Rice" have to comply with the conservation rules, specifically the local land use plan and no-hunting rules. They can then get a premium price for their rice through a marketing association consisting of a village marketing network with assistance from Sansom Mlup Prey (UNDP 2012; SMP 2015). Furthermore, women considered particularly vulnerable can make money through selling goods, home-stay and cooking (UNDP 2012). Sharing local knowledge is another important aspect. The project has established a community-to-community model for knowledge exchange through which trust and support are built and ecotourism trainers developed.

Economic incentives also play an important role in the success and sustainability of FWUCs. There are two aspects. From the position of FWUC management committees, the payment of irrigation service helps cover the costs of scheme operation and maintenance; FWUC members, on the other hand, will pay the irrigation service fee (ISF) if their farming is profitable enough (Box 2).

Box 2: Phlov Touk and Rolus farmer water user communities (FWUCs)

Phlov Touk and Rolus schemes were established with support from NGOs and subnational government. They share similarities in irrigation service fee collection, self-sufficiency and private sector engagement. Both FWUC committees are able to collect irrigation service fees (ISF), though fee collection in Roluos seemed to be slightly lower than in Phlov Touk.

Private sector involvement in water services has benefitted both schemes and has so far been quite successful. Roluos FWUC has engaged two private firms because it lacks adequate pump capacity to meet irrigation needs. After getting permission from the provincial authority, the firms built a canal and installed a water pump. People then had to start paying for the service, though they also pay for water provided by their FWUC albeit a lesser amount. Plov Touk FWUC contracts pumping companies to reduce the committee's workload, with good results.

Subnational government agencies play a vital role in mediating upstream-downstream conflicts within FWUCs and some provide technical and financial support for operation and maintenance (O&M). However, schemes like Plov Touk that are able to collect sufficient collect ISF can afford to pay for their own O&M, relieving the burden on Provincial Departments of Water Resources and Meteorology.

The success of Plov Touk FWUC is perhaps the most interesting. Market access and clear leadership are the two factors that stand out. With easily accessible markets across the border in Vietnam, farmers are motivated and remain enthusiastic about growing rice and producing surpluses. They take the initiative to seek agricultural techniques from Vietnam and elsewhere without any support from the Provincial Department of Agriculture. They also recognise the importance of ISF and O&M to ensure water availability. Leadership, as the FWUC committee acknowledged, is the most critical factor since a charismatic leader can better find support and manage the community. But one condition must be available to motivate the leader, and that is benefit. As long as benefit is perceived, the leader remains motivated to perform well. Roluos scheme illustrates the difference motivation can make to effective water management and O&M. Because farmers have to pay ISF, they manage the water carefully without losing a drop. Due to limited scheme capacity, some people buy water from private water companies. They are active in this matter because they can grow two rice crops a year and thus boost their average income. All members are required to engage in their FWUCs through contributing to O&M, paying ISF, giving feedback to the committee and reporting any violation of the rules. ISF collection is transparent, with budget reports shared among all members, though some members think this reporting is not yet clear.

Sources: Sam et al. 2015; Nang et al. 2014

4. Discussion of the findings and implications

The study reveals both constraints and enabling conditions for the sustainability of CBNRM in meeting the high expectations of empowerment, economic benefit and environmental conservation, which are discussed in turn below. Having highlighted the challenges and opportunities that need to be addressed, the final section looks at how CBNRM approaches could be modified and outcomes optimised in the context of climate change.

4.1 Have the expectations of CBNRM been met?

4.1.1 Social incentives

The devolution of power in the CBNRM approach refers to the transferring of authority and responsibility from the state to local user groups (Meinzen-Dick and Knox 1999). Devolution involves many institutional arrangements between multiple actors including local authorities, private sector and local communities (Meinzen-Dick and Knox 1999). But can empowerment as an expectation of CBNRM implemented by local communities or community-based organisations (CBOs) be met in Cambodia?

The study finds that empowerment of local CBOs for the co-management of natural resources is lagging due to slower-than-expected unfolding of Cambodia's deconcentration and decentralisation reform. Although CBOs involved in CBNRM have been delegated responsibility for managing resources and responding to local needs, their power is limited because they have to consult and negotiate with subnational political hierarchies including provincial departments, district authorities, commune councillors and other stakeholders when making important decisions. Consultation and negotiation benefit decision making to an extent, but they also undermine CBOs' power, resulting in ongoing dependency. Further, this constraint on CBOs' legitimate power means that conflict resolution requires strong intra-agency coordination. These problems are even worse in resource-rich fishing grounds and forested areas which not only attract new settlers but also elite groups, whereby connection with national authorities determines authority to exploit resources. Although legislative support exists, CBOs and commune authorities find it hard to impossible to get meaningful and lasting solutions to the challenges confronting them. Powerlessness to deter illegal logging and land grabbing and to invoke their ownership and user rights characterises CF groups, though to some extent subnational authorities are quite helpful. Limited empowerment clearly obstructs authentic participation in CBOs' development activities. Moreover, the devolution of power without sufficient financial and technical support is counterproductive, compounding a "learned helplessness" instead of creating autonomy to manage and conserve local resources. In the Cambodian hybrid political context, devolution of central powers and responsibilities will continue to face a number of challenges for years to come

Participation of all members and committees is central to the principles of CBNRM; however, participation has been limited. This might be due to a misunderstanding among community members about their roles and expected contributions to the whole community. It could also be linked to their preference or need for immediate rather than long-term benefits. Another demotivating factor stems from the need to earn their individual livelihoods rather than spend time doing community work. Even so, the study finds that people are willing to join in community activities if they perceive the benefits of doing so. Some might be willing to attend

meetings just because there is an incentive from organiser, though this mainly happens when project support is available from NGOs and/or development partners.

It must also be borne in mind that Cambodia is a patron-client society, in which people are focused on their own families and without any empowerment to exercise their power in a democratic system (Chea 2010). Thus it is perhaps not surprising that both state agencies and NGOs/ development partners seem to have neglected the importance of creating strong interaction between their representatives and local people. In fact, they seem to take this process for granted; in the worst case scenario, meetings with local people resemble information sessions in which attendees are merely passive listeners rather than active and engaged participants. In some cases, local people were keen to attend meetings and take part in other community activities early on in the project cycle. But this initial enthusiasm waned due to weak institutional support and limited power to impose sanctions on wrongdoers.

Inequitable access to resources is also a catalyst in demotivating participation of members and committees in community work. Ensuring equal access for all women and men to natural resources would require investing in water resource infrastructure or enough tools for artisanal resource extraction. In some FWUCs, where hard infrastructure is incomplete, run-down or lacking, members find it difficult to get sufficient irrigation water. For CFis, the ability to extract resources depends on the availability and affordability of tools and technology that are still not accessible to the poor. In and around CF areas, competition from outsiders, both ordinary people and elite groups, seems to have further marginalised the poor by unfairly restricting their access to and use of resources.

Stakeholders' participation in CBOs varies depending on financial backing. Provincial departments and organisations also play a major role in sustaining resource communities; however, our case studies suggest that insufficient financial incentives meant that participation by those entities in community operations was intermittent at best. In addition, development partners' agendas and short project cycles hinder the efforts of NGOs to build resilience into communities through climate change adaptation (Sam et al 2015).

Limited human and technical resources at provincial level obstruct the implementation and sustainability of resource communities as they to some extent depend on provincial authorities for technical backstopping and cooperation in tracking down and curbing illegal activities. At commune level, commune councillors who have responsibility for environmental issues take part in community operations but the level of their motivation to do so depends on financial incentives. Again, as the CBET and REDD+ case studies suggest, all stakeholders are willing to participate so long as they perceive genuine value in doing so.

Trust and cohesion, which are also important for enhancing participation in local communities, are partly gained through the accountability of CBO committees. A transparent approach to budget and work planning has resulted in the successful engagement of local people in community resource management. Plov Touk FWUC and Thmatboey CBET owe their success to this approach, while other CBOs struggle to ensure transparency and mobilise resources for their activities due to limited support, knowledge and leadership.

Leadership plays a very prominent role in gaining support and participation from local people and attracting funding. As Bond et al. (2006, 20) state:

> The structure of the CBO and its institutions must provide incentives for the effective management of resources. The CBO that represents the members must be competent and able to make effective decisions and, where necessary, to monitor and enforce collective decisions. However, there must also incentives for the members of the CBO to conform to the rules that govern land and resource management.

A charismatic and knowledgeable leader proved to be a success factor in sustainable community development. In our case studies, local leaders maintained and strengthened their capabilities through their own commitment to sustaining benefits for their communities. As residents, they have strong attachment to their local areas and community outcomes. And even though leaders perceived benefits individually, they were working towards the betterment of their communities. However, in some cases, although leaders were capable and competent, their commitment and confidence had been eroded and their voice and accountability undermined by weak institutional coordination and collaboration and inadequate technical and financial support.

4.1.2 Economic incentives

CBNRM's promise of better and sustainable local livelihoods is the most critical incentive for successful implementation of community plans. Economic incentives stem directly from appropriating the benefits (e.g. employment, services and revenue) CBNRM offers (Chishakwe et al. 2012).

Inadequate financial support poses a challenge to all CBNRM communities at both the individual and community level. The findings clearly confirm that most of the benefits derived from CBNRM are not the primary correlates or determinants of sustainable livelihoods, except for FWUCs and REDD+ projects. Ecotourism, fisheries and forestry serve as secondary sources of income for local people. This then also obstructs participation in CBNRM. Take the case of FWUCs in which activities are mainly focused on rice farming: people are eager to engage in community management when they can earn a lot from their farming, but lose interest once agriculture plays a much smaller role in their livelihoods. Another exception is REDD+, where communities benefit from carbon trading. Once economic incentives are secured, the sustainability or success of natural resource management through CBOs is as good as ensured.

At the community level, lack of financial support obstructs many operational activities and progress towards achieving sustainability. Communities that create self-sustaining or even profitable incomes can continue to support progress even after support from NGOs and/or development partners has ended. Our findings show quite conclusively that ongoing cooperation between subnational government and NGOs/development partners to support CBET has achieved impressive results in delivering sustainable earnings improvement to support community operations. FWUCs have also shown potential for further improvement of irrigation service fee (ISF) collection to support scheme operation and maintenance (O&M); however, they also face a huge upgrading challenge for which they need investments supported by government and NGOs/development partners. CF groups and CFi are in a somewhat different position from other CBO types since they cannot earn. Regular patrolling should help clamp down on illegal fishing and logging but a lack of financial resources limits patrol teams' effectiveness. A special case is made for CFs attached to REDD+ projects through which local communities can benefit from conserving the forest for carbon trading.

With the uncertainty climate change is to bring, changes in natural resources and ecosystem services are expected. This is of concern because imbalance between the supply of and demand for natural resources and ecosystem services can lead to conflict and demotivation. In FWUCs, water distribution is not equal due to limited water availability and/or incomplete infrastructure. Expected shifts in water availability as a result of climate change would make the current situation even worse, especially without a clearly defined vision for adapting to change. For CBET, direct economic benefits are more associated with extraction, and many ecosystem services have not yet been fully and effectively exploited. But, at the same time, resource extraction can have a negative effect on other ecosystem services such as wildlife habitats and biodiversity. CF groups face similar conditions to CBET and FWUCs in terms of availability and accessibility of livelihood resources. And for CFi, due to competition, population growth and infrastructure development, fisheries resources are in a disastrous state. Further, climate change predictions indicate that fish production in capture fisheries will become increasingly uncertain (Baran, Schwartz and Kura 2009). It follows, then, that the more directly dependent people are on natural resources for their livelihoods, the greater their engagement. People naturally focus on their own individual priorities first, and very often alternative livelihoods are more viable than what CBNRM can provide, leading to limited participation. The effects might also jeopardise CBNRM activities. This is a major push-pull factor influencing involvement in CBNRM initiatives, particularly their success and sustainability.

4.1.3 Conservation and environmental protection

CBNRM is considered the main approach to resource conservation once local CBOs have been empowered and economic incentives secured. But what happen to this last expectation if the other two are not met?

Whether challenges are related to technology, knowledge, governance or funding, they are barriers to the implementation of CBNRM, specifically for it to live up to the expectation of conserving and protecting natural resources. Together with limited participation and institutional obstacles, including problems of fit, interplay and scale, trust and cohesion, leadership and equality, these challenges have generated dissapointing outcomes in pactice. To some extent, CBNRM does help to protect vulnerable resources from improper use or illegal activities, but it is not delivering satisfactory results, especially once support to implement CBNRM plans ends.

Current institutional arrangements for CBNRM do not fit in terms of both spatial scale and interplay between existing and emerging actors. The misfit of spatial scale and interplay here refers to incompatibility between local community capacities and the scope and complexity of social-ecological systems in which interconnected and nested interactions exist. For CF, the geographical boundaries and large numbers of active community members are clearly beyond CF groups' capacity to patrol and manage. With little financial support and lack of vertical and horizontal coordination, CF groups do whatever they can within their limited scope to deal with illegal activities. The same situation applies to CFi, specifically since the second wave of fisheries reform. For FWUCs, although Provincial Departments of Water Resources and Meteorology to some extent play their roles, some coordination-related issues – mainly to do with public sector limitations in both human and financial resources – are observed. CBET fares similarly to other types of CBNRM; however, in this case study, CBET operations were self-financing. Both Thmatboey and Kompong Pluk demonstrate the benefit of good coordination between actors through long-term support from NGOs and development partners.

The poor use of existing knowledge about the in situ conservation and sustainable management of natural resources, not to mention planning for an uncertain future brought on by climate change, undermine the promise and performance of CBNRM as a mechanism for environmental sustainability and resilience. Many studies on CBNRM emphasise the need to link local/ indigenous knowledge with scientific knowledge. However, Cambodia, given its very small scientific community, is lagging in this regard. Responsibility should be transferred to local communities and coupled with capacity building; but current arrangements consist of "learning-by-doing" rather than instruction or guidance. Although legal support is in place, actual implementation is undermined by weak capacity and too few financial and institutional supports. Local communities might have indigenous technical knowledge but they also need scientific knowledge about resilience concepts, especially for coping with or adapting to future uncertainties. Communities that receive a lot of support for capacity building are getting better knowledge and understanding about natural resource management and conservation.

4.2 How can stakeholders optimise the benefits of CBNRM?

In highlighting the challenges that need to be faced to improve the outcomes of CBNRM, it seems that the different stakeholder groups – state agencies, local authorities, CBOs and development partners – have different degrees of potential to contribute to addressing each challenge.

State agencies play a vital role in promoting CBNRM as a mechanism for empowering local communities and CBOs to manage local resources in the context of localised adaptation to climate change. They support specific capacity building activities for subnational and local stakeholders and provide financial assistance to enable local CBOs and subnational authorities to handle the tasks transferred to them. They also invest in physical infrastructure including road networks and irrigation facilities necessary for CBOs to function.

Deconcentration and decentralisation reforms need to be speeded up to ease and sustain the empowerment of local and subnational authorities in claiming their rights and exercising their responsibilities. Legal recognition of local knowledge systems would be one step towards the incorporation of indigenous knowledge into local management planning. The promotion of cooperation between subnational authorities and CBOs would enhance the implementation of sanctions.

The problems of fit and scale should be addressed by reconsidering the capacity of local CBOs and the extent of support to ensure the sustainability of resource communities as well as achieve the three goals (empowerment, economic benefit, and conservation) of transferring responsibility to local CBOs.

The sustainable extraction and use of natural resources should be promoted. Knowing and understanding *what* resources to extract and *how* and *when* to extract them is important for CBOs and subnational authorities to sustain and conserve resources. This requires scientific and local knowledge.

Key climate change strategies and actions for climate-sensitive sectors – forestry, fisheries, water and agriculture – should be mainstreamed at local and subnational levels. Moreover, downscaled climate projections should be produced in preparation for future environmental conditions and stresses.

Local authorities cooperate with CBOs to manage resources, provide technical assistance, patrols, conflict mediation and sanctions, and link CBOs with state institutions and NGOs. They can improve the implementation of CBNRM by supporting local knowledge and learning to build resilience, working collectively with CBOs to find markets for agricultural produce, forest products and ecotourism, and promoting diversified and sustainable livelihood options.

CBOs take on various roles in sustainable resource use and management via social and economic incentives, but their management capacity needs to be reconsidered. Greater levels of participation from local people in community operations and activities can be gained through promoting transparency in community affairs, raising awareness about climate change and risks, elevating local voices, sanctioning wrongdoers and sharing benefits equally. CBOs should take advantage of any opportunity to build knowledge about resource and ecosystem dynamics and associated best management practices in their local environment. Collecting and documenting local knowledge to inform resource management is recommended.

Development partners and NGOs are the main providers of technical and financial support. Technical support is very important for CBOs and subnational authorities to perform their roles as technical advisors, as well as for ensuring sustainable resource consumption and production. Financial support is also closely linked with the sustainability of CBNRM and should be a priority in the design and implementation of interventions.

5. Conclusion

CBNRM practice in Cambodia, whether in the form of ecotourism, forestry, fisheries or irrigation management, has struggled to live up to the expectations of social incentives, economic benefits and environmental conservation. Given that the first two have proved quite hard to achieve in most of our CBNRM case studies, it is perhaps not surprising that the third aim remains a distant reality, not to mention dealing with the effects of climate change. However, CBNRM is still advocated as one of the approaches for empowering the right people to control resources. The move towards more localised initiatives needs to take into account delay in the devolution of functions, responsibilities and legislative power, while access to technical and financial resources remains inseparable from the building of sustainable communities able to manage and use resources effectively and mobilising the collective participation of local people. To optimise the benefits of CBNRM, it is important that all stakeholders involved perform their roles well and strengthen their ability to interact with one another.

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