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The relevance of a coproductive capacity framework to climate change adaptation: Investigating the health and water sectors in Cambodia

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Abstract

Multiple active partnerships in the health and water sectors in Cambodia exist to address climate change adaptation, operating beyond typical sectoral and organizational divides. Decisions around national adaptation policy are made predominantly by the relevant lead ministry, contrasting with where funding originates from (i.e., major donors, multilaterals, United Nation agencies). Adaptation policy is thus the result of a process of coproduction by state and nonstate actors. The research we present sought to understand the relationships that exist between knowledge- and decision-makers with respect to climate change adaptation in the health and water sectors in Cambodia, and the factors that enabled or constrained these relationships. Forty-four interviews were conducted with representatives of 32 organizations. We found that coproductive relationships were most effective when there were clearly defined roles and responsibilities, coordination of technical and financial resources, and trust. The two key factors of coproductive capacity that enabled and supported these partnerships were scientific resources and governance capability. Ultimately, the roles and responsibilities given to various actors requires commensurate funding and greater consideration of existing relationships and power dynamics. The reliance on international scientific expertise also needs to be challenged so that local research capabilities can be developed and locally relevant, problem-specific information can be provided. The ongoing funding, codevelopment, and sharing of such knowledge would significantly enhance trust and cooperation.

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Research, part of a Special Feature on Science and Governance in a Diverse World: Coproduction and Coproductive Capacities for Environmental Management

The relevance of a coproductive capacity framework to climate change adaptation: investigating the health and water sectors in Cambodia

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ABSTRACT. Multiple active partnerships in the health and water sectors in Cambodia exist to address climate change adaptation, operating beyond typical sectoral and organizational divides. Decisions around national adaptation policy are made predominantly by the relevant lead ministry, contrasting with where funding originates from (i.e., major donors, multilaterals, United Nation agencies). Adaptation policy is thus the result of a process of coproduction by state and nonstate actors. The research we present sought to understand the relationships that exist between knowledge- and decision-makers with respect to climate change adaptation in the health and water sectors in Cambodia, and the factors that enabled or constrained these relationships. Forty-four interviews were conducted with representatives of 32 organizations. We found that coproductive relationships were most effective when there were clearly defined roles and responsibilities, coordination of technical and financial resources, and trust. The two key factors of coproductive capacity that enabled and supported these partnerships were scientific resources and governance capability. Ultimately, the roles and responsibilities given to various actors requires commensurate funding and greater consideration of existing relationships and power dynamics. The reliance on international scientific expertise also needs to be challenged so that local research capabilities can be developed and locally relevant, problem-specific information can be provided. The ongoing funding, codevelopment, and sharing of such knowledge would significantly enhance trust and cooperation.

Key Words: *actionable knowledge; Cambodia; climate change adaptation; knowledge production process; multiparty collaboration; social networks*

INTRODUCTION

Cambodia, like other least developed countries, is highly vulnerable to the multifaceted impacts of climate change (RGC 2007, Yusuf and Francisco 2009, UNDP 2011). To respond to and reduce this vulnerability, there is an increasing influx of funding from a variety of international donors for climate change mitigation and adaptation activities. Given this increase in funding, it is important to understand the relationships between knowledge- and decision-making, which underpin the success of program- and policy-level climate change activities. We aim to build on the discussion of "coproductive capacity" within this Special Issue by using a case study of climate change adaptation (CCA) in Cambodia to explore the factors that enable and constrain productive partnerships between knowledge- and decision-making.

In the existing CCA literature, considerable attention is paid to the concept of adaptive capacity, which is defined as "the ability of a system to adjust to climate change" (McCarthy et al. 2001:982). Research on adaptive capacity focuses on the social vulnerability of communities, regions, and nation states, and considers a range of factors that may enable them to adjust to changing environmental and social conditions (Adger and Kelly 1999, O'Brien et al. 2004). The factors that are most commonly considered include information and skills, economic wealth, technology, infrastructure, equity, and institutions (McCarthy et al. 2001). Equally important but less studied factors are those that are less tangible, such as community cohesion, social inclusion, and governance structures. In particular, little attention has been paid to the interface between knowledge-making (science) and decision-making (governance) and the social, cultural, and political contexts that affect these relationships. We seek to contribute to the literature on adaptive capacity by addressing this gap on coproduction.

We also seek to contribute to the growing body of research on coproduction and coproductive capacity by studying interactions between knowledge- and decision-making in a real-world context —CCA in Cambodia—and applying understandings from the adaptive capacity literature. In doing so, we combine both of the current theoretical underpinnings of the concept of coproduction: (1) the coproduction of knowledge at the project or program level (Mitchell et al. 2004), and (2) the recognition that coproduction does not happen in a vacuum: it is shaped by a multitude of external factors, including wider social, cultural, and political norms (as per Jasanoff [2010] and Hulme [2010]). We see these factors as constituting coproductive capacity (as defined by Kerhoff and Lebel, this issue) because they shape the extent to which Cambodian knowledge- and decision-making institutions interact to effect social change. While van Kerhoff and Lebel (2015) argue that coproductive capacity is primarily about "scientific resources and governance capability," our previous experience in Cambodia suggests that coproductive capacity is also determined by governance resources and scientific capability. Thus, we take a broader perspective on coproductive capacity.

With respect to the knowledge-making dimension of coproduction, we take a broad perspective on science. We use the term "knowledge base" to refer to science in a traditional "normal science" sense, as well as informal science. Like Amaru and Chhetri (2013), we believe that informal science can be as

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important as traditional science for generating innovation for CCA. We also recognize, like Vogel et al. (2007), that the science and practice of CCA is highly contested. A more coproduced mode of decision-making requires recognition that knowledge is value-laden and that the science–practice interface involves complex negotiations between scientists, researchers, practitioners, policy-makers, private actors, and community members (Brugnach and Ingram 2012).

We seek to understand the nature of the coproduction of science (knowledge-making) and governance (decision-making) in the context of CCA in the health and water sectors in Cambodia, and the foundations from which coproduction takes place (coproductive capacity). To achieve this, we begin by providing an overview of the governance and science contexts, relevant climate change policies, and the links between health, water, and CCA in Cambodia. We then provide an overview of our research methods, which sought to explore the nature of interactions between key stakeholders and the factors that enhance or constrain these partnerships. From the analysis of the results, we propose a conceptual framework for the key components of coproduction and coproductive capacity in CCA in Cambodia. Finally, we discuss the implications of considering these components as fundamental foci for current and future CCA activities in Cambodia and other developing countries.

Governance context in Cambodia

Politics (and hence governance processes) remain highly centralized in Cambodia (Cock 2010) despite the recent policy reforms that have attempted to strengthen deconcentration and decentralization activities. Cambodia also substantially depends on overseas development assistance and external expertise (Hughes 2002, Sophal 2007, Sato et al. 2011). Due to a low tax base, aid as a proportion of total public expenditure has remained at nearly 90% since 2005 (Sato et al. 2011). This high dependency on foreign aid and expertise indicates a governance context that is susceptible to strong outside influence.

Climate change governance structures reflect these same patterns of centralization and external influence. The most extensive organization with climate change responsibilities is the National Climate Change Committee (NCCC), which represents 15 ministries and three committees, including the Council of Ministers (Cambodia's highest decision-making body) (RGC 2006*b*). The committee is chaired (in an honorary capacity) by the Prime Minister. The committee's main responsibility is to enhance cooperation and facilitate implementation of the United Nations Framework Convention on Climate Change (UNFCCC).

The chairperson of the NCCC is the Minister for the Environment. The Ministry of Environment is the country focal point for the UNFCCC. Within the Ministry, the Climate Change Department (CCD) is responsible for undertaking all technical activities related to implementing the UNFCCC, advising the government on national policies, identifying and assessing new technologies, organizing training courses, liaising with national and international agencies, and promoting research activities, among other responsibilities (RGC 2009). The CCD is the secretariat for the NCCC and manages the Cambodian Climate Change Alliance (CCCA). The CCCA was initiated with multidonor support to mainstream climate change adaptation (and mitigation) across sectors and at all levels, develop institutional capacity development, and promote knowledge and awareness sharing.

This national governance CCA framework in Cambodia is complicated by the involvement of many nongovernmental and supranational organizations, which are involved in CCA funding as well as policy design and implementation. These organizations include nongovernmental organizations (NGOs), such as the Red Cross and Oxfam; UN agencies, including the United Nations Development Programme (UNDP) and the World Health Organization (WHO); development banks, such as the World Bank; and bilateral donors, including the Australian Agency for International Development and the U.S. Agency for International Development.

There are two main CCA resources—the previously mentioned CCCA and the Pilot Program for Climate Resilience (PPCR) funded by the World Bank. The CCCA has more influence on climate change policy because it supports the development of national and sectoral climate change strategies; these will eventually be mainstreamed into national development plans. The anticipated challenges rest on the realization of the plans due to the limited resources available for implementation. The PPCR, on the other hand, aims to mainstream climate change into development projects and introduce a "climate-proof" approach to infrastructure development. Introducing the climate-proof concept for infrastructure development in Cambodia is a great challenge, and is uncertain due to limited local experts and knowledge in this field, including in the areas of climate modeling, meteorological information, socioeconomic development, and local and regional environment and development challenges. The PPCR remains a pilot project and is still in the early stage of its implementation; thus, further critique is not possible at this point. Nevertheless, introducing the climate-proof concept for infrastructure development in Cambodia is a great challenge and may generate new problems if infrastructure is not pursued in an integrated, flexible, and adaptive way that considers local social and ecological impacts of particular infrastructure developments.

Climate change adaptation policy context

There are a plethora of policy and strategy documents that inform CCA programs and projects in Cambodia (Table 1). Three key guiding strategies and plans are discussed here. The Rectangular Strategy is the highest governmental strategy: it is directly generated from the political agenda of the ruling political party (the Cambodian People's Party). The strategy is comprehensive and covers several aspects of development, including improving health services, water resources, and irrigation. Good governance, including public administrative and legal and judicial reform, is positioned as the core of the strategy. If such public reforms are active, it will be favorable for CCA mainstreaming in the development agenda (Willems 2004). However, public reforms in Cambodia progress slowly (Schwab 2009, 2010, 2011, 2012), making CCA mainstreaming less effective.

The National Strategic Development Plan (NSDP) is a whole-of-government strategic development plan coordinated by the Ministry of Planning in collaboration with all governmental ministries. Due to concerns over the escalating risks of climate variability and climate change, more climate considerations have been integrated into the current NSDP (2009–2013) (RGC 2010).

Table 1. Key policies, strategies, and reports that have influenced climate change adaptation in Cambodia.

Agency	Policy	Purpose
Royal Government of Cambodia	National Strategic Development Plan	To steer the development of Cambodia and to facilitate overseas development assistance to Cambodia
	Rectangular Strategy	The national political and policy agenda of the government
Ministry of Environment (MOE)	National Adaptation Programme of Action to Climate Change (NAPA)	To reduce climate vulnerability and to facilitate more climate resilient development in Cambodia
	National Communication Report to the United Nations Framework Convention on Climate Change (UNFCCC)	To communicate the Cambodian greenhouse gas inventory to the UNFCCC
	National climate change strategies	To facilitate more climate-resilient development via mainstreaming climate change into the development agenda
National Committee for Disaster Management	Disaster Risk Reduction Strategic National Action Plan	To facilitate disaster risk reduction for social, economic, and environmental development
MOE and United Nations Development Programme (UNDP)	UNDP Human Development Report	To identify the development challenges posed by climate change to Cambodia and thus better prepare for it

However, there is lack of clear direction about what climate change programs/projects/activities should be implemented. Looking forward, the CCCA and some ministries, which have been progressing climate change sectoral development plans, have been working to ensure that the next NSDP (2014–2018) includes more climate change considerations with clearer adaptation plans.

The National Adaptation Programme of Action to Climate Change (NAPA), coordinated by the Ministry of Environment, was developed in line with the government's rectangular strategies. The NAPA identified 39 CCA priority projects across a number of sectors, including water resources, agriculture, coastal resources, and health, and also cross-cutting sectors (RGC 2006*a*). The identified projects consist of either "hard" (e.g., infrastructure) or "soft" (e.g., education and training) adaptation technologies, which, if implemented, would likely strengthen adaptive capacity of sectors to better address climate vulnerability. The way such projects are designed for implementation greatly shapes their outcomes and impacts on either reducing climate vulnerability or increasing local adaptive capacity. A small number of projects identified in the NAPA are now being implemented.

Overall, the policies presented in Table 1 indicate that considerable efforts are being made to address CCA in Cambodia. To date, though, these efforts have been hampered by both knowledge-making and decision-making processes. For example, in its review of the governance challenge presented by climate change in Cambodia, the UNDP Cambodia Human Development Report identified that there "is a need for more adaptive, responsive, inclusive and accountable development institutions and processes that draw on wide sources of information, and that create space for informed, critical public debate and decision-making" (UNDP 2011:viii). Such a conclusion reinforces the need for an improved understanding of coproductive capacity, as addressed in this paper. The next section briefly explains the context of knowledge-making on CCA in Cambodia.

Climate change adaptation knowledge context

As indicated, a number of individuals and organizations are involved in CCA activities in Cambodia at the central level, and hence produce knowledge that contributes to the understanding of adaptation responses. An example of this knowledge generation is shown via the process of developing the NAPA, where projects were identified based primarily on field investigation (RGC 2005) and prioritized against national sustainable development criteria using experts' opinions. A diverse approach was taken in relation to the knowledge base that was used for the NAPA's development; for example, stakeholders involved in the process included national and international experts, government officials, academics, and consultants. In addition, the information base that was drawn upon was varied and included an extensive household survey as well as climate modeling. The development of the NAPA as a fundamental document that sets the scene for adaptation policy and activities was reported as having a very useful cobenefit in that the process of its development was indicated by stakeholders as perhaps more important than its content (Bowen et al. 2013).

Climate-sensitive health and water governance in Cambodia

It has long been acknowledged that health and water are two of the most critical sectors requiring investment to improve human development around the world; at least five of the Millennium Development Goals are directly related to water and health issues. While slow progress is being made with some of these goals, these gains in human development are also directly threatened by climate change. The health and water sectors, together with agriculture and energy, are particularly vulnerable to the impacts of climate change, especially in the Asia Pacific region (Cruz et al. 2007).

Water management in Cambodia is highly fragmented, as in many other countries worldwide, despite a long-term push toward integrated water resource management since the Dublin Conference on Water and the Rio Earth Summit in 1992 (United Nations Sustainable Development 1992). In Cambodia, the responsibility for water-related issues falls across at least six ministries, including the Ministries of Water Resources Management and Meteorology (MoWRM); Agriculture, Forestry and Fisheries; Rural Development; Environment; Industry, Mines and Energy; and Public Work and Transportation. Strong partnerships between these organizations

Table 2. Stakeholder stratification by sector and organization.

Sector / Type of organization	Health	Water	Agriculture	Disaster	Cross-cutting†	Subtotal
Government agency	6	5	1	2	8	**22**
Nongovernmental organization	1	1	3	3	14	**22**
Subtotal	**7**	**6**	**4**	**5**	**22**	
Total						**44**

† See *Methods* section.

are critical yet challenging. In addition, the fundamental nature of water in underpinning human health, livelihoods, economics, and ecosystems requires coordination and collaboration across an even wider number of sectors and organizations. Such collaboration could take the form of the coproduction of knowledge in the area of adaptation through jointly designed and implemented studies, such as regional or community-based vulnerability assessments.

The management of health issues exhibits much less fragmentation than the water sector. The Ministry of Health is the focal point for most health activities and policy development. In relation to CCA, it is evident that the health sector is under-recognized. The extent to which health has been considered in the NAPA remains limited to malaria; meanwhile, many other waterborne and vector-borne diseases that are prevalent in Cambodia and are likely to worsen with climate change have been overlooked. Work is underway to improve this situation, however, with the development of health-specific documents, including the Cambodian Climate Change Strategy for Public Health and the (draft) National Action Plan for Climate Change and Public Health. These two documents largely inform the health component of the Cambodia Climate Change Strategic Plan currently being developed by the CCD.

There are a number of important issues that arise at the nexus between water and health, including improving access to clean, reliable, and sufficient water and sanitation to address the ongoing prevalence of waterborne diseases; improving food insecurity (availability, access, use, and stability); reducing disaster vulnerability (especially to droughts, storms, and floods); and maintaining water levels and quality to ensure healthy ecosystems (Kovats 2000, McMichael et al. 2008). Thus, the connections between water and health are strong, with investments in the above areas directly contributing to improvements in health and well-being, especially among the most vulnerable communities. The challenge of improving partnerships and collaboration between sectors becomes critical, especially given the sensitivity of the health and water sectors to the impacts of climate change.

METHODS

Our aim was to evaluate the factors that enable and inhibit the development of CCA policy and activities within Cambodia. The study focused on the health and water sectors, given their underlying vulnerability to climate change impacts and need for cross-sectoral collaboration. Indepth, semistructured interviews were used to investigate the nexus between knowledge- and decision-making and the factors that determine coproductive capacity in the context of health and water CCA in Cambodia.

During the field research period in Cambodia, 44 semistructured interviews were conducted with 47 stakeholders from 32 organizations (Table 2). Stakeholders were identified through an initial stakeholder analysis as well as via snowballing. Stakeholders represented a broad spectrum of organizations, including government, donor agencies, NGOs, and UN agencies. All relevant sectors participated, including health, water, agriculture, disasters, and cross-cutting sectors.

Cross-cutting indicates those organizations that work across more than one sector (Table 2). This group comprised predominantly bilateral and multilateral development partners.

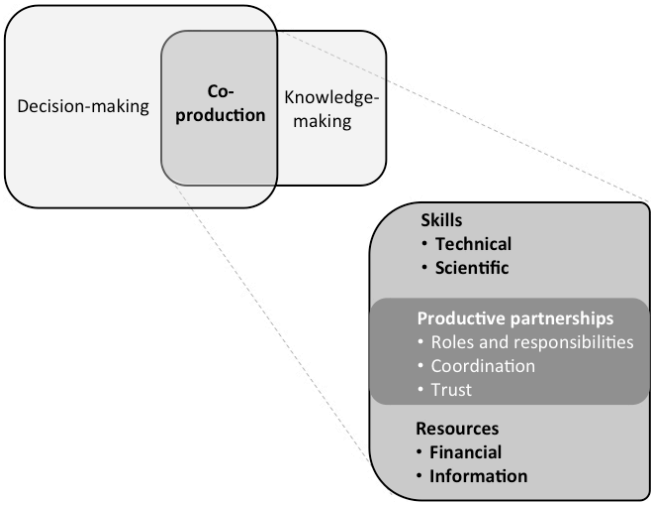
There were two key sets of questions in the interviews that pertained to coproductive capacity. The first set sought to identify factors—financial resources, availability of information, training, opportunities for coordination between actors, and the policy context—that enable and inhibit the ability of organizations to incorporate climate change considerations into their activities. The second set of questions explored in detail the diversity and strength of formal and informal organizational partnerships that exist at the nexus between knowledge- and decision-making on CCA.

The interview questions were all translated and back translated into the local language, Khmer. When appropriate, interviews were conducted in the local language by local research officers. The interviews were recorded, transcribed, and then translated back into English. The transcripts were thematically coded using NVivo, and information on social networks was input into UCINet for quantitative analysis.

RESULTS

Analysis of the interviews revealed that partnerships between knowledge- and decision-makers concerned with CCA in Cambodia were most productive when there were clearly defined roles and responsibilities, coordination of technical and financial resources, and trust. The two key factors that enabled and supported these partnerships were scientific and governance resources and skills. Fig. 1 shows how we conceptualize these results on coproduction and coproductive capacity. We recognize that some partnerships exist wholly within the sphere of decision-making or knowledge making; coproduction refers to partnerships that occur at the interface between knowledge- and decision-making. These coproduction partnerships are productive if they are supported by coproductive capacity, which comprises both resources and skills. The dynamics of coproduction and coproductive capacity in the context of CCA in Cambodia will be elaborated on in the following three subsections.

Fig. 1. Schematic representation of the components of coproduction and coproductive capacity in the context of climate change adaptation in the health and water sectors in Cambodia, as identified through interviews with key stakeholders.



Productive partnerships

Social networks are critical to CCA decision-making in Cambodia; they are central to information sharing and accessing necessary resources. The objective of the social network analysis in this study was to assess the types (formal, informal, influential) and extent of partnerships that exist between organizations active in the CCA arena, with respect to both health and water issues. Figs. 2 and 3 present the results of the social network analysis for the health and water sectors, respectively. Stakeholders interviewed are depicted in blue, while those who were nominated but not interviewed are in white. The size of the nodes represents the number of nominations given to and received from the organizations.

In both the health and water sectors there existed complex arrays of partnerships that crossed sectors and types of organizations (governmental, UN agencies, and NGOs). In both cases, the structures of the networks were similar: core organizations surrounded by bridging organizations that partnered with more peripheral organizations.

In the case of health, there were four organizations at the center of the network. These were the Ministry of Health, CCD, WHO, and UNDP. In the case of water, the MoWRM was the most central organization. In both networks, the core organization/s partnered with bridging organizations, such as the National Committee for Disaster Management, which in turn partnered with more peripheral organizations, such as the Culture and Environmental Preservation Association and the International Organisation for Migration.

There was considerable overlap in the organizations that existed in each network. Indeed, some of the core organizations in the health network acted as bridging organizations in the water network, and vice versa. For example, MoWRM was a key bridging organization in the health network, and the Ministry of Health was a key bridging organization for the water network.

When stakeholders discussed the nature of these partnerships, three key themes emerged: roles and responsibilities, coordination, and trust.

Roles and responsibilities were identified by stakeholders interviewed as being a key barrier to effective partnerships. There were two aspects to this issue. First, many of the roles and responsibilities among key government agencies overlap and are unclearly defined. For example, it was noted that the roles of the NCCC, the CCD, and development partners were unclear. Second, there is a disconnect between who has particular roles and responsibilities and their centrality in the network. For example, the Ministry of Environment is the lead government agency on climate change issues overall; however, in both the health and water sectors, the Ministry of Environment is a bridging, rather than a core, organization. The Ministry of Health and the MoWRM are the central players in the health and water networks, respectively, but do not have the requisite roles and responsibilities to drive the CCA agenda.

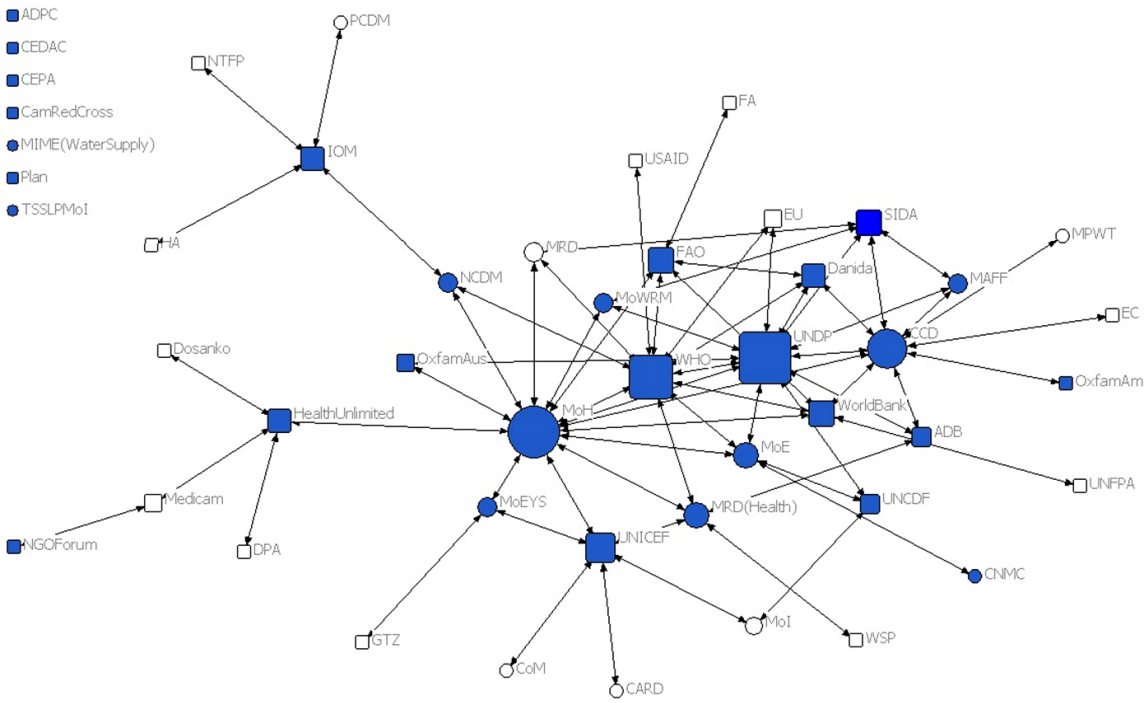
Aside from clearly defining roles and responsibilities, stakeholders identified the coordination of organizational partnerships as a major challenge to the development of adaptation strategies. Although, bridging organizations were identified as an important link between disparate organizations and provided important opportunities for coordination. Coordination between development partners and between government ministries was identified as being particularly problematic. Overall, stakeholders identified that technical cooperation—cooperation based on a defined project or activity—was easier than financial cooperation. Indeed, financial coordination was not only reported as difficult across all types of organizations but was also seen to be undermined by competition for limited government funding. More details on this are provided in *Results: Resources*.

Trust was the third key issue that was deemed to be important for effective partnerships, and it brings together concerns regarding roles and responsibilities, and coordination. Stakeholders indicated that trust among NGOs was high but that considerable distrust existed among NGOs and government organizations. Distrust arose from competition for limited funding, perceptions that resources were unfairly distributed, and a belief that government organizations, such as the NCCC, were not meeting their responsibilities. This lack of trust was identified as a key reason for poor cooperation and coordination of knowledge generation, policy, and action on climate change between development partners and government agencies.

Resources for climate change adaptation

There were two main types of resources[1]—financial and information on vulnerability and adaptation—that limited organizations' abilities to implement key CCA activities. An increase in financial resources was ranked as the highest priority by stakeholders in terms of climate change capacity issues. Overall, 60% of stakeholders reported having inadequate funding for the implementation of priority CCA activities. Overall,

Fig. 2. Health and climate change partnerships in Cambodia.



government organizations were twice as likely to identify that they are challenged by inadequate financial resources compared to NGOs.

The availability of information on climate change-related vulnerability and adaptation greatly affected coproduction. The quality and detail of information on vulnerability and adaptation was identified as insufficient in both the water and health sectors (as identified by 79% and 83% of respondents, respectively). Specifically, concerns were raised, particularly in the water sector, that the depth of information was highly variable. For example, information was more readily available on irrigation systems than on droughts. On the whole, more nongovernment than government stakeholders reported that there was a sufficient level of quality and detail of vulnerability and adaptation information available, although they found accessing information from government organizations to be difficult.

Skills for climate change adaptation

Analysis of the interviews revealed that knowledge- and decision-making organizations not only need to have access to finances and information but they also need to have the capability to make use of those resources. In addition, efforts need to be made to build more capability within Cambodia rather than relying on external capabilities.

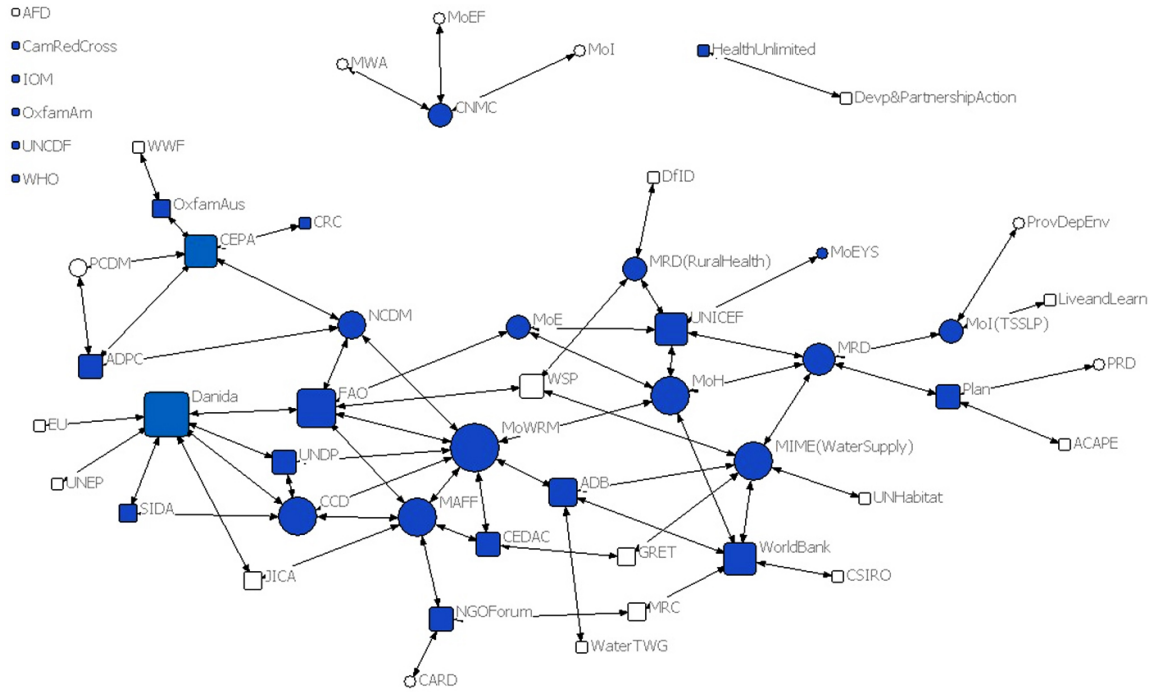
Many factors were identified that supported decision-making organizations' efforts to develop adaptation strategies. These ranged from participation in climate change forums and workshops to involvement with national-level policy processes such as the development of the NAPA. While such capability building opportunities were identified as being important to CCA decision-making, they were generally considered to be insufficient and were not sufficiently climate change specific. For example, within the health sector, research stakeholders acknowledged the training on climate change impacts on the health sector, which was co-organized by the Ministry of Health and WHO. However, research stakeholders indicated a need for additional specific and indepth training on CCA for the health sector. They identified that in the short term, such adaptation-specific training may require assistance from international research organizations, given the limitation of local expertise, but that ultimately, such training needs to be drawn from within the country.

Knowledge-making organizations also required capability building, as revealed by the widely reported lack of locally relevant climate change reference material. Stakeholders attributed this lack of locally relevant information to the lack of availability of local expertise and the limited amount of research conducted by local Cambodians. The lack of local knowledge-making and locally relevant expertise is produced and reproduced by an ongoing reliance on climate change material produced at regional and international scales due to a dearth of specifically scoped studies and data directly applicable to the Cambodian context. The lack of human capital and resources to produce such locally relevant knowledge meant that there was a low level of government capacity to absorb CCA funding for this purpose.

DISCUSSION

There are three key conditions that facilitate and inhibit coproduction in Cambodia: clear definition of roles and responsibilities, financial and technical coordination, and trust. To some extent these conditions are consistent with those that have previously been identified. For example, Brugnach and Ingram (2012) argued that knowledge coproduction in the

Fig. 3. Water and climate change partnerships in Cambodia.



management of water resources needs to recognize interdependencies, create the decision space that supports collaboration, and build good relationships, which includes establishing trust. Similarly, Van de Ven and Johnson (2006) found that project-level coproduction of knowledge requires clarification of commitments, roles, responsibilities, and expectations; regular communication; building trust; and opportunities for reflection. These studies, among others, focus on the social-relational and content dimensions of coproduction; i.e., "who" is being included and excluded and "what" is being understood and decided upon (Brugnach and Ingram 2012). In Cambodia, the "what" and "who" of coproduction cannot be considered in isolation from the "how"; i.e., the skills and resources of knowledge- and decision-makers or the governance and policy contexts in which they operate. It is this important nexus between coproduction and coproductive capacity that will be discussed here.

Roles and responsibilities

Past research on CCA suggests that there are at least two reasons why defining roles and responsibilities for CCA in countries like Cambodia is challenging. First, if there is existing institutional complexity, then trying to mainstream CCA is likely to further add to the complexity (Klein et al. 2005). This is because mainstreaming CCA requires a holistic approach that shifts responsibilities from individual ministries to all relevant sectors of government, the private sector, academia, and civil society (Schipper and Pelling 2006). Such an approach will be effective only if existing policy and institutional structures are successfully dealing with current policy challenges and have the resources and capability to integrate CCA into current approaches.

The second challenge comes from the way in which dominant CCA responses reinforce existing development pathways (St. Clair 2010). According to St. Clair (2010) and Bizikova et al. (2010), there needs to be a critical examination of the way in which development has proceeded in countries like Cambodia, and the extent to which past development pathways constrain action. With respect to defining roles and responsibilities, questions need to be asked about the extent to which past development pathways have created the existing power relations between the various government and nongovernment actors, why particular organizations hold particular positions in the existing social networks, and why particular organizations have the resources and skills that they do. Answering such questions will provide insights into the way in which roles and responsibilities can be built upon and adapted so that they better address current policy challenges and also accommodate CCA.

Coordination

The involvement of many different types of organizations may be vital to the success of knowledge coproduction and adaptation measures. This is because differences in competencies and interests enable more penetrating and insightful understandings and solutions to be developed (Van de Ven and Johnson 2006), and extend the benefits of resources, like science and technology (Amaru and Chhetri 2013).

In Cambodia, such benefits were observable but were mostly contained within particular types of organizations. For example, NGOs acted as bridging organizations and benefited from the power that being in such positions brings (Eden 2005); NGOs found it easier to share information and resources. There were far

fewer synergies reported within the government sector. One of the reasons for this appeared to be the nature of funding arrangements. The competitive nature of funding by those who support Cambodian organizations reduced cooperation among various government actors. This is consistent with past research that has found that competition can undermine cooperation in institutional settings (Lachapelle et al. 2003).

At the boundary between government and nongovernmental agencies there appeared to be some coordination. For example, technical working groups exist where representatives of knowledge- and decision-making organizations meet monthly to engage in joint decision-making. In practice, while government organizations chair the processes, much of the work is done by international and national consultants under the facilitation of the funding agencies. The result is that many of the policy documents are not well used. In these groups there is an assumption that officials will readily use the knowledge produced by experts. Such a technical–rational model of coproduction has been heavily critiqued (see Owens 2005). Instead, ongoing opportunities need to be created so that research can respond to the trans-scientific questions posed by policy-makers (Owens 2005). In the case of Cambodia, opportunities also need to be created to enable locally specific and locally produced research to answer such policy questions in the long term. This underlines the importance of knowledge that is coproduced by actors that work across professional, disciplinary, and epistemological divides.

Trust

It is often argued that trust is a prerequisite for achieving cooperation (Gambetta 1988, Mayer et al. 1995, Ferrin et al. 2007), although much of the evidence comes from interpersonal rather than interinstitutional relationships. Trust between institutions is argued to derive from perceptions about the stability of institutional structures (Hardin 1991) and a sense that the people who comprise them apply the institutional rules in a consistent and trustworthy manner (Weinstock 1999). Both concerns are evident in the distrust expressed by respondents concerning the provision of adequate resources that are distributed fairly. This suggests that institutional trust in Cambodia is intimately intertwined with resources and capability, which has ramifications for cooperation.

In the relationships between NGOs and government organizations, distrust was expressed by NGOs that did not believe that government organizations were meeting their responsibilities. Some progress was made with the establishment of the NCCC, the highest governmental steering committee, because it was seen to be a significant structural change that supported CCA works. It is therefore critical for the NCCC to be adequately supported so that governmental institutions can demonstrate that they can consistently meet expectations, and thereby enable trust to grow and cooperation to be achieved.

CONCLUSION

There are at least three components to successful coproduction in Cambodia: clearly defined roles and responsibilities, coordination, and trust. These components are enabled, or hindered, through two dimensions of coproductive capacity: resources—funding and locally relevant, problem-specific information; and skills—technical and scientific. While evidence of the three dimensions of coproduction have been identified in past research, they are rarely discussed in conjunction with coproductive capacity. Furthermore, coproductive capacity usually focuses on scientific resources and governance capabilities and not on scientific capability and governance resources; in Cambodia, both are important for coproduction.

Locally based scientific capability is critical to the future success of coproduction of CCA in Cambodia. Not one national university or research organization was nominated as a partner within the social network analysis. Thus, new relationships need to be forged between national decision-makers and national researchers, particularly in universities and independent research institutes. This will be achieved only when local research organizations are trusted to meet the knowledge needs of decision-makers. Thus, strengthening this local knowledge capability requires stronger research ties between national and international researchers. Within the context of this research project, working in partnership with local researchers was key to facilitating two-way learning on research methods and the research context among the research team. This was a clear cobenefit, and it is important that more research includes local researchers in key research positions in order to support greater upskilling.

Intimately intertwined with scientific capability are governance resources. In Cambodia, the funding situation, like in other least developed countries, is unlikely to change substantially in the foreseeable future. However, there is the potential to substantially improve informational resources. At present, the knowledge base on climate change threats, impacts, and vulnerability in the health and water sectors is poor, especially in terms of quality and accessibility. This is significant given that availability of CCA material that is both relevant and useful to different audiences (e.g., national, subnational, government, nongovernment, communities, cross-sectoral) underpins evidence-based CCA decision-making. One way to improve this resource is to incorporate knowledge not only from science but also from the communities themselves (Miller and Bowen 2013). Documenting indigenous knowledge and experience on coping and adaptation may significantly improve locally relevant, problem-specific information. The benefits of such knowledge may be multiplied if greater sharing of information is established. This is a distinct step away from the status quo, where there is often great difficulty accessing information from government.

In terms of the extent to which the results may be generalized to other settings, given that climate change adaptation activities are heavily context-dependent, it is anticipated that the results may be applicable to other least developed countries with similar funding arrangements and level of international involvement. However, governance arrangements in individual countries would require independent analysis.

The main limitation of this research was that it was not able to consider, to any great extent, coproduction and coproductive capacity at a subnational scale. Given the local nature of CCA activities, understanding the extent to which subnational actors, including communities, are involved in knowledge- and decision-making is critical to the success of adaptation. Therefore, an extension of the research conducted here could consider how

CCA partnerships extend from the national to the subnational and community levels, and vice versa. It is imperative to know to what extent productive partnerships exist and what form they take.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/6864

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[1] A more detailed discussion of the resource issues is presented in Dany et al. (2014).

APPENDIX 1. Acronym list for social network research
Appendix A: Acronym list for social network research

ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Centre
AusAID	Australian Agency for International Development
CARD	Council for Agriculture and Rural Development
CCD	Climate Change Department
CEDAC	Cambodian Centre for Study and Development in Agriculture
CEPA	Culture and Environment Preservation Organization
CoM	Council of Ministers
CNMC	Cambodian National Mekong Committee
DANIDA	Danish Development Agency
DPA	Development and Partnership in Action
DRRForum	Disaster Risk Reduction Forum
EC	European Commission
EU	European Union
FA	Forestry Administration of Cambodia
FAO	Food and Agriculture Organisation
GERES	Group for the Environment, Renewable Energy and Solidarity
GRET	Research Group on Technology Exchange
GTZ	German Development Agency
HA	Highlanders Association
IFID	International Financial Institutions Department
IOM	International Organisation for Migration
MAFF	Ministry of Agriculture, Forestry and Fisheries
MIME	Ministry of Industry, Mining and Energy
MoC	Ministry of Commerce
MoE	Ministry of Environment

(con'd)

MoEF	Ministry of Economics and Finance
MoEYS	Ministry of Education, Youth and Sport
MoH	Ministry of Health
MoI	Ministry of Interior
MoP	Ministry of Planning
MoPWT	Ministry of Public Works and Transport
MoWRM	Ministry of Water Resources Management
MRC	Mekong River Commission
MRD	Ministry of Rural Development
NCCC	National Committee for Climate Change
NCDM	National Committee for Disaster Management
NTFP	Non-Timber Forest Products Exchange Program
PCDM	Provincial Committee for Disaster Management
SIDA	Swedish Development Agency
TSSLP MoI	Tonle Sap Sustainable Livelihoods Project, Ministry of Interior
TWGWatsan	Technical Working Group Water and Sanitation
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Development Agency
WATSAN	Water and Sanitation
WFP	World Food Program
WHO	World Health Organisation
WSP	Water and Sanitation Program