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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

Assessments of ecosystem services and human well-being in Thailand build and create demand for coproductive capacity

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ABSTRACT. Assessments of ecosystem services have been proposed as one way of incorporating concerns about environmental change and ecosystem conditions into subnational development planning. In Thailand a policy window for such initiatives is opening because of a transition in national policy toward area-based planning combined with broader political reforms to expand public participation and encourage more evidence-based decision making. We explored three case studies in Thailand in which central and local government agencies and research organizations partnered to engage local communities and other stakeholders in assessments of ecosystem services and human well-being. The analysis focused on the role ecosystem assessments play in building and creating demand for coproductive capacity. By coproductive capacities we mean the ability to combine scientific resources and governance capabilities in ways that bring about informed social change. We found evidence that the assessments built capacities for governance actors to explore scientific and research-based evidence, to consult scientific experts, and then to evaluate existing policies and plans using this newly acquired information. At the same time, scientific experts also learned to explore public policy issues, to consult planners and decision makers in government, and based on this knowledge to evaluate scientific evidence and revise the scope and goals of their research and analytical activities to better meet policy needs and demands. Coproductive capacities were built when various stakeholders jointly engaged in compilation and interpretation of evidence. Doing so helped legitimize the assessment process with positive feedback on both governance and science capacities. We also found evidence, however, of significant cultural and institutional constraints to designing and making better use of ecosystem services assessments. These constraints included insufficient resources for both knowledge making and decision making. Power relations and organizational culture likewise had implications for capacities to govern and do science. Nevertheless, by creating demand for greater capacities, assessments contribute to improving the quality of evidence-based social change.

Key Words: *assessment; coproductive capacity; ecosystem services; evidence-based planning; human well-being; problem driven*

INTRODUCTION

Assessments of ecosystem services and human well-being have been proposed as one way of incorporating concerns about environmental change and poverty into regional planning and development (Millennium Ecosystem Assessment 2005, Ash et al. 2010). Assessments are social processes in which knowledge from different sources is evaluated and deliberated to inform decisions (Nowotny 2003). Assessments do boundary work between experts and other stakeholders (Hegger et al. 2012, Lebel 2013). The ultimate influence of assessments on decisions, however, depends on many factors including the way an assessment is designed and implemented (Social Learning Group 2001, van Kerkhoff and Lebel 2006). Reviews of large-scale environmental assessments, for instance, suggest that all major stakeholders must perceive an assessment process as being simultaneously legitimate, credible, and salient (Cash et al. 2003). One outstanding challenge is to ensure that assessments, through the type of knowledge they include, the selection of services they choose to focus on, and the methods they use to prioritize or evaluate alternatives, do not further disadvantage already marginalized or impoverished ecosystem users (Sikor 2013).

We propose that participatory assessments are one way to build coproductive capacities. By coproductive capacities we mean the ability to combine scientific resources and governance capabilities in ways that bring about informed social change (van Kerkhoff and Lebel 2015). By participatory we mean that the process meaningfully engages multiple stakeholders including residents and businesses and pays attention to which bodies convene and interpret evidence.

Multistakeholder participatory approaches to ecosystem assessment in South East Queensland, Australia, for example, resulted in state and local governments formally recognizing an ecosystem services framework in policy and planning documents (Maynard et al. 2011). In this instance, success was also attributed to an adaptive, learning-by-doing approach. Broadening the participation by management and experimentation are often identified as important for enhancing the resilience of ecosystem services (Walker et al. 2002, Lebel et al. 2006, Biggs et al. 2012).

In developing and lower-middle-income countries, the institutional capacities for effective governance and management of ecosystems, and the science to understand them better, are often modest or incomplete. Vertical coordination among tiers of government is often top-down, and horizontal coordination across sectors and ministries is limited. In these less-than-ideal circumstances, the practicality of carrying out ecosystem assessments to inform policy and planning at subnational levels has rarely been tested, let alone been integrated into normal planning procedures.

In this article, we show that assessments of ecosystem services in three provinces of Thailand helped build and even created demand for the coproductive capacity needed to integrate concerns about the environment with local planning and policy development. We also identified several significant cultural and institutional constraints to improving the design and use of assessments in planning and policy development at subnational levels. The settings and processes studied provide specific insights into three key themes of this special issue: the realities of working in suboptimal situations, the influence of the quality of the

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relationships between experts and other stakeholders, and the opportunities and challenges of working at multiple levels in administrative planning hierarchies.

METHODS

Assessment cases

In 2009 the Poverty-Environment Initiative, a joint global program of the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP), partnered with the Ministry of Interior and Ministry of Natural Resources and the Environment of Thailand to launch a project aimed at mainstreaming pro-poor environmentally sustainable development into the national and subnational planning and budgeting processes, with pro-poor implying a focus on assisting those living in poverty (UNDP-UNEP Poverty Environment Initiative, www.unpei.org). The project was justified by three key observations. First, policies to promote economic growth in Thailand had greatly reduced poverty but increased inequality and degraded the environment (United Nations Development Program 2009). Second, poor and vulnerable groups often lacked adequate access to the natural resources that could improve their well-being. Third, decentralization reforms in the past two decades created significant policy windows for evidence- and area-based planning at subnational levels; these are opportunities that an assessment process could inform. Ecosystem assessments alongside several other activities such as training in spatial planning and community-based research were proposed.

We present as case studies three pilot assessments in which central and local government agencies and various types of research organizations partnered to engage local stakeholders in assessments of ecosystems and well-being. The assessments were conducted in three provinces with distinct biophysical features, development issues, and primary ecosystem concerns (Table 1).

The broad aim of the assessments was to improve the understanding of the services provided by ecosystems to people in a particular place and to uncover the likely effects of development policy on these services. The assessment process followed the general framework suggested by the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment 2005, Ash et al. 2010) with modifications to suit the issues, context, and actors in each place (Fig. 1). All three assessments involved significant and diverse forms of interaction between the technical team, the local community, and the government stakeholders.

Data sources

Our analysis was based on participation in and observation of events, on reviews of reports (Well-Being and Sustainable Development Research Group 2012, Coordination Centre for Community-based Research 2013, Thailand Environment Institute 2013), and on lessons learned by the technical teams and other individuals involved in the process. We were core members of the technical advisory team that provided feedback and guidance to all three assessments throughout the project. Most of the activities analyzed here took place between the middle of 2010 and the end of 2012.

Analytical framework

To evaluate the assessment processes in the three provinces, we used an analytical framework designed to tease out the relationships between knowledge making and decision making in an assessment context (Fig. 2). That is, our primary focus was not on the content of the assessments, but rather on how the assessment process influenced coproductive capacity in the three cases.

Fig. 1. Key components of the subnational assessment processes.

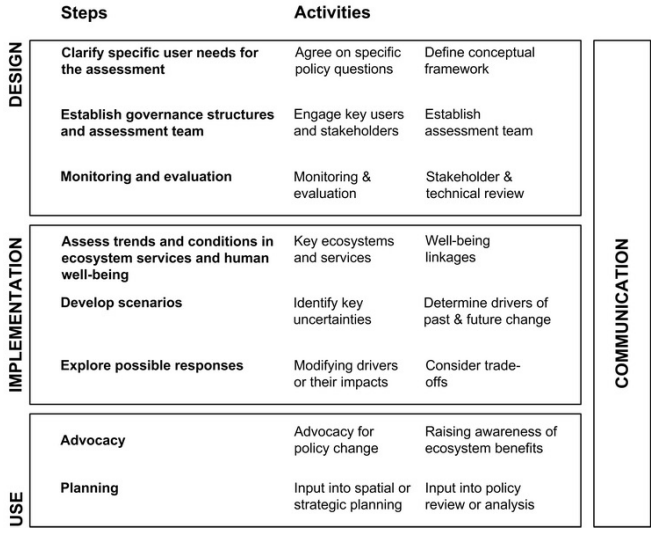
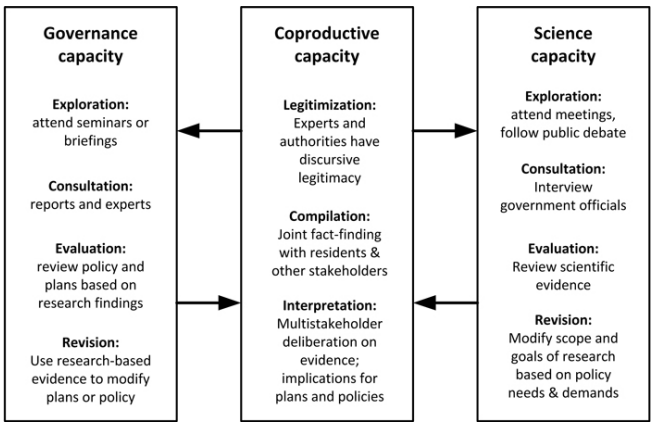


Fig. 2. Analytical framework for exploring coproductive capacity in assessments of ecosystem services and human well-being.



Analysis of governance capacity explored relationships from the perspective of governance actors: how they sought and accessed knowledge, and then evaluated and used it in their work. This analysis searched for evidence about how these actors explored new concepts and frameworks, and consulted assessment experts or reports, and whether this knowledge led to an evaluation or revision of policies or plans. Although the primary focus was on actors in subnational government agencies, we also considered business, civil society, and local community actors with governance roles, for example, as active members of advisory bodies.

Table 1. Policy question, key issues, biophysical features, and stakeholders for the assessments in three provinces.

	Khon Kaen	Nan	Samut Songkhram
Policy question	How can the Khon Kaen provincial development strategy of becoming the center for energy crops, food production, and related agroindustries be pursued in the long run without undermining ecosystem services and environment?	How can the Nan Provincial Development Policy better integrate agricultural development, which is centered on the growth of commercial crops, with conservation efforts for the enhancement of human well-being and the maintenance of ecosystem services?	Can Samut Songkhram Province divert from the mainstream development path of nearby provinces by maintaining local livelihoods and the traditional ways of life based on its three-water ecosystems, while creating added value from natural resources and ecotourism to generate income for local communities?
Key issue of concern	Agroindustry development based on a few key crops for food and energy may degrade soil and water-related services from the agricultural landscape with adverse impacts on small-scale farmers	Expansion of maize production in upper watersheds may reduce hydrological services important both upstream and downstream with consequences for livelihoods and health	National development policy emphasis on infrastructure, industrialization, and mass tourism threatens traditional livelihoods and a culture based on a three-waters ecosystem (fresh, brackish, and saline)
Biophysical features	Low rolling hills with paddy rice in valleys. High level of agricultural land use	Upland mountains with significant forest cover but also field crops on slopes and paddy in valley bottoms	Flat coastal land and river delta
Lead stakeholders	Regional Environment Office (REO 10) Governor's Office	Provincial Administration Organization Governor's Office	Regional Environment Office (REO 8) Chamber of Commerce Governor's Office
Technical team	Well-being and Sustainable Development Research Group, Khon Kaen University	Thailand Environment Institute	Thailand Research Fund's Coordination Centre for Community-based Research in Samut Songkhram and Kasetsart University
Other Stakeholders	Tambon Administrative Organizations (TAO) Sugarcane industry Local residents	TAO Maize industry Civil society organizations Provincial Agricultural Office Local residents	TAO Local residents Tourist businesses Manufacturing and heavy industries

Analysis of science capacity, in contrast, viewed relationships from the perspective of knowledge holders and knowledge makers, especially scientists and experts. It considered how knowledge actors sought to understand policy problems, evaluated scientific evidence to respond to those problems, and even adjusted goals and scope of research activities to meet policy needs (Fig. 2). It was recognized that knowledge actors belonged to different kinds of organizations and included members of the public. Most were from academic or research organizations, but in the case of Samut Songkhram, a local community-based research organization with a long history of direct interaction and consultation with residents played a major role.

Analysis of coproductive capacity zoomed in on the more symmetrical relationships in which different stakeholders have more complex roles and in which leadership of an activity or action is much more diffuse as it involves multiple actors. Apart from considering the joint compilation and interpretation of evidence, we also looked at how actors engaged in the assessment legitimized their activities and the assessment process as a whole (Fig. 2).

GOVERNANCE CAPACITY

In exploring governance capacity, we focused on how governments and, more rarely, private sector or civil society actors exercised authority and influence with respect to accessing, guiding, and using research-based and scientific knowledge (Fig. 2). We did not look at other dimensions of governance less directly associated with knowledge, such as capacities to steer or exercise power.

Exploration
Officials and local leaders attended initial meetings about the proposed assessment, eager to learn more about the concept of ecosystem services and the kind of information the assessment would produce. A strong expectation among several government stakeholders was that the assessment would provide data sets, maps, and computer-based tools that they then could use in their work, for example, in spatial planning.

Government officials from the environment ministry, business representatives, and even some technical experts were more comfortable talking about the familiar notion of environmental impact assessment of individual projects than about the effects of policies on ecosystem services. Talking about ecosystem services involved a significant reframing of how to think about development and environment because this conversation put the focus on the benefits derived from a well-managed environment. Another reason for the reticence was that exploring policies and strategies was recognized as a much broader and more complex undertaking than evaluating individual projects because it requires considering impacts of many activities on a place. After initial discussions, some officials explained that ecosystem services assessment had some advantages for looking at environment and development relationships because it explicitly addressed issues of uses and values and did not just make statements about the need for conservation. This is one of the important articulated advantages of ecosystem services assessment for planning.

Although the assessments were set up by the Poverty-Environment Initiative program with an explicit reference to poverty, in all three cases this emphasis was downplayed as the assessments proceeded. The poverty framing did not appear popular with government or civil society actors even in Nan, one of the poorest provinces in Thailand (United Nations Development Program 2009). Poverty puts too strong an emphasis on insufficiency of income and thus on failure. Governance actors shaped the framing language of the assessments during the exploration-of-ideas stage of the initial meetings. The term well-being, taken from the ecosystem services framework, was appreciated as more inclusive once it was understood; it allowed actors with capacity and influence to have a legitimate stake in the assessment. The well-being concept, it should be noted, was also consistent with the language used by monks and other community leaders in public discourse when discussing quality of life beyond income. As a more ambiguous term than poverty, however, well-being could be used in multiple, not necessarily entirely consistent, ways; several alternative variant translations were in common use during all three assessments.

Consultation
Governance actors involved closely in the assessment process consulted documents, experts, and other tiers of government to obtain and present information that might be relevant. Local governments at the subdistrict level or Tambon Administrative Organizations, for instance, often played active roles in the consultations and surveys done in their subdistrict.

Significant in-kind support from local bodies, in terms of facilities such as meeting venues and time of staff, were other indicators of acceptance and commitment from potential users of the assessment. The level of interest may also be an indicator of the desire to have some ownership, even control, of assessment products. In Samut Songkhram, local government leaders were especially active in following up the work done by the technical assessment group; they foresaw the benefits of having research and data sets from their area to help justify elements of local plans.

Evaluation
The proposition that assessments of ecosystem services might become a useful planning or policy tool was not initially supported by all key government stakeholders. Some officials in Khon Kaen, in particular, remained more interested in conventional spatial planning tools and environmental impact assessment for projects; they were not convinced that knowing more about the benefits provided by ecosystems would really help their planning. Most other actors accepted that there were complementarities between ecosystem services assessments and other conventional spatial planning tools. It may take more time for the new tool to be accepted and its appropriateness for specific problems to be appreciated. The resistance can also be seen as part of the healthy wariness of experienced bureaucrats for all tools that purport to provide decision support.

The response options emerging from the assessment process in Khon Kaen were largely in the form of mitigating the impact of current practices and trends (Table 2). In Nan there were also more explicit calls for changes in land use in parts of the watershed. More visionary than reactive options were articulated in scenario-building exercises by governance and knowledge actors, but such visions appeared difficult to then translate into realistic policy and planning responses.

Addressing the policy questions directly was challenging for two reasons. First, the overarching policy questions were complex and big, going well beyond ecosystem services issues (Table 1). Provincial and local policies and plans, potentially impacted at the level of the assessment, represented only a modest subset of the relevant drivers and levers influencing change. Second, different stakeholders had very different perspectives on the extent to which observed changes in services were priority problems. The assessment teams also had to be careful not to upset key stakeholders because that would have affected ownership of the assessment process; thus, some topics, decisions, and specific projects were not on the table.

Nevertheless, this first iteration of pilot assessments suggested that an improved understanding of ecosystem services could make a significant contribution to the review of development strategies and had the potential to contribute to planning at various levels. In Nan, it helped focus attention on the problems of monoculture of maize in the uplands; in Khon Kaen, on the importance of land-use practices for maintaining quality of soils; and in Samut Songkhram, on the joint benefits that ecosystems provide to fisheries, agriculture, and tourism.

Revision
In Nan, many stakeholders were very critical of maize monoculture before the assessment process started. The expectation was strong that the assessment would provide another argument that something must be done about maize. Stakeholders were quick to attribute deforestation, flood damage, dry season water shortages, loss of soil, and reduced water quality to the

Table 2. Examples of suggested response measures in the three assessments.

Type of measure	Khon Kaen	Nan	Samut Songkhram
Institutional	Strengthen accountability	Establish a watershed fund	Enforce land-use zoning regulations in coastal and riparian areas
	Encourage crop zoning and multifunction landscapes	Support community forestry management	
Economic and behavioral	Study payments for ecosystem services to conserve trees within agricultural landscapes	Set standards and provide incentives for good land-use practices	Increase local participation in development planning
			Promote local, traditional culture and products
Technology and knowledge	Promote water-saving technologies	Encourage alternative crops, including but not restricted to rubber	Support bank erosion control and storm protection through mangrove planting
	Promote improved farming practices to conserve soils	Identify best practices in maize cultivation for soil conservation and reduced chemical use	
	Improve productivity of crops		

impacts of maize cultivation. As the assessment proceeded, different governance actors adopted particular findings as well as elements of the process to pursue and advocate for their interests. The scenario exercise, for instance, was taken up by the Agricultural Planning Office, which used it for the development of its decadal plan. During the final policy forum in Bangkok, the Nan assessment team pushed to gain the commitment of a key private-sector actor to source maize from farms that followed good practices. This was followed up by further work by UNDP and the Thailand Feed Mills Association to explore a set of voluntary producer standards as an alternative to the existing pilot watershed fund, a payment for ecosystem services scheme, to encourage better maize cultivation practices.

In Samut Songkhram, facilitators from the assessment teams that did the scenario exercises were invited to help with the provincial four-year planning event. According to those involved, their participation would have more influence as a consequence of the evidence gathered during the assessment and the improved credibility this evidence gave to their views and positions.

The revisions observed in these two cases were restricted to informing or to adjusting existing public policy and planning processes. Implementation of revised policies that could be attributed to the assessment process was not observed.

Revision of policy because of research and assessment findings at the subnational level will likely be difficult. The experiences in the three provinces pointed to difficulties in responding to external drivers that depended much more on markets and national policy. There were also other scale issues arising from differences in the roles and traditions of governance actors working at different levels in the administrative hierarchy. Provincial plans are forward looking in the sense of pursuing visions and targets. On the other hand, subdistrict plans are mostly framed as reactions to problems that have arisen or goals that were set elsewhere. This multilevel complexity and differences in associated planning capacities make coproduction with local communities or experts more difficult.

In summary, governance capacities associated with exploring, accessing, and using scientific knowledge were influenced by the content, vocabulary, and procedures of an ecosystem services assessment. The three assessments started with similar initial designs, but diverged as governance actors interacted with and influenced the detailed agendas pursued by technical teams.

SCIENCE CAPACITY

In our analysis of science capacity, we focused on the efforts of scientists and experts to understand and engage governance actors and public processes. As for governance capacity, we considered exploration, consultation, evaluation, and revision components (Fig. 2).

Exploration

Researchers varied in their capacity to engage with public policy issues in each of the assessment areas. In Nan, the assessment team was particularly active and innovative in using different modes of communication; these included programs on local radio and drama events about the problems and future of the upland agricultural areas. Experts widely recognized that frequent communication with stakeholders was important to maintain the stakeholders' interest in the assessment process; however, an important overlooked consequence was that those engaged experts were also exposed firsthand to the opinions and positions of the stakeholders. That two-way communication was arguably an important precursor to the relationships that built coproductive capacity.

Exploration of issues with other stakeholders raised fundamental issues of language. Researchers in all assessments struggled at times to effectively translate terms from the ecosystem services and assessment framework into words and phrases that farmers, officials, and other stakeholders could understand. Several different but related terms were used in Thai, some more akin to "utility" or "usefulness" and others more allied to "benefit" or "service."

Consultation
Experts on the assessment teams moved relatively quickly from exploration to more active consultation with stakeholders by arranging meetings and carrying out interviews with government officials and civil society leaders.

The assessments in the three provinces differed in the extent to which they used information from different sources and thus in the forms and targets of the consultation activities. The assessment process in Nan placed relatively more emphasis on the perceptions and the knowledge of local residents and officials about ecosystem services. Working groups were established in the three subdistricts selected for more in-depth assessment. Meetings in these working groups were important for sharing information, discussing recommendations, and taking joint actions (Thailand Environment Institute 2013).

Secondary data sets from provincial and subdistrict levels were an important source for the assessments, but also had significant limitations. Time series were often short and the quality was uneven, reflecting histories of changes in responsibilities of different organizations for data management. In many cases relatively general information at the provincial level had to substitute for desired specific information at the subdistrict level, limiting its usefulness for the consideration of ecosystem changes. In Khon Kaen, a large foundation of agricultural research done within the province could be used to understand conditions and trends in soil- and water-related ecosystem services. Here, consultation with other experts was relatively more important than in the other two settings.

All three assessments found that a combination of quantitative, qualitative, and participatory methods were needed to fully capture the important dimensions of human well-being and their relationships to ecosystem services. In a few cases, information gained from the assessments could be cross-validated with observations by residents, surveys of residents by experts, observations or measurements with scientific instruments, and peer-reviewed literature. The scientific capacity to use multiple methods is a resource for building coproductive capacity.

Evaluation
A technical team took primary responsibility for data collection, analysis, and writing of the assessment reports in each province (Table 1). It was the first time any of the three teams had carried out an ecosystem services assessment, although each had related relevant experience, e.g., in environmental impact, well-being, or local planning studies. Achieving a clear shared understanding of ecosystem services, developing a conceptual framework, and selecting appropriate assessment methods took substantial time and effort. Each technical team faced the challenges of changes in personnel and competing demands on time. Social and environmental scientists dominated the teams; specific expertise in ecology and the policy sciences was limited.

In terms of technical content, the assessments identified or clarified important trends and relationships (Table 3) that were not widely appreciated or well understood before. For instance, all three provinces observed trends toward greater use of provisioning services that were derived from agricultural ecosystems, as well as greater benefits from these services. As a measure of flows, not stocks, this observation does not imply that the capacity of ecosystems to continue providing desired services has increased. Moreover, there were indications that specific regulating and supporting services that make provisioning possible in the long term were not being maintained. This was a highly significant contribution from the review of scientific evidence and the gathering of primary data; however, governance actors and resource users found it more difficult to appreciate the role of regulating and supporting services compared with directly observable threats such as reduced catches of fish and other aquatic organisms in inland and coastal waters.

Scientists' capacity to communicate effectively with other stakeholders about the relationships between ecosystem services and well-being was sometimes a challenge. Well-being is influenced by many factors. Health outcomes are one area, for example, in which it was not straightforward to attribute current conditions to levels of ecosystem services. Nevertheless, modest evidence was found about how changes in levels of ecosystem services may be influencing well-being (Table 3); this evidence was influential in discussions with the public and other stakeholders.

The capacity of actors to think about the environment as a source of cultural services was enhanced by the assessment. Although local residents saw clear cultural and social values in local ecosystems, these values had rarely been documented and articulated as benefits compared with the attention given to agricultural commodities and harvested products. Cultural services were perceived to have increased in several locations; in Khon Kaen, for example, there was a trend toward increased use for viewing or tourism as well as for meditation or conservation. Overall, this trend suggests that the cultural services from the remaining natural elements of the landscape are now being valued more. The benefits derived from cultural services provided by ecosystems were positively related to community relations in Khon Kaen and Samut Songkhram.

Revision
The governing structures guiding the assessment process encouraged strengthening of scientific capacity to be responsive to user or governance actor needs. The main intended users of the assessment report were also engaged in continuously setting demands for or in reviewing the ongoing assessment work.

Early in the process a key policy question drawing on the provincial and provincial cluster plan strategy statements was negotiated to be the focus of each assessment. This key policy question went through several iterations because different stakeholders wished to emphasize different framings of the key issues (Table 1), but ultimately agreement was reached among the central management group, the Poverty-Environment Initiative, and the assessment technical teams. In the case of Khon Kaen, having a negotiated, focal policy question received less emphasis than in the other two provinces; the final report, for instance, had no explicit question up-front, although earlier drafts had versions that were used in Table 1. This difference was partly because of the complexity of the issues, but also partly because of lack of adequate consensus brought about by the contested character of development in this province.

A provincial-level working group consisting of multiple stakeholders also met to review progress and provide feedback to the technical assessment teams in each province. In Khon Kaen, an external review of the draft report was also done by an independent expert panel.

Table 3. Trends and conditions of selected ecosystem services important to human well-being in the three provinces.

Ecosystem Service Type	Khon Kaen	Nan	Samut Songkhram
Provisioning	Increased overall as a result of intensification with benefits in terms of income. Concerns over ability of soil to support further expansion. Fish in water bodies declined.	Decreases in products apart from planted crops, e.g., fuel wood, herbs, forage, and clean freshwater.	Stocks in aquatic ecosystems decreased creating problems for some households.
Cultural	Benefits being derived increased. In places where cultural services are used more, community relations are better.	Aesthetic and sacred benefits from ecosystems declined.	Benefits being derived increased with greater use. In places where cultural services are used more community relations are better.
Regulating	Degradation of soil structure, fertility and carbon storage.	Decreases in watershed hydrological services such as flood control, water purification, and erosion prevention with implications for social relations and livelihood security.	Benefits being derived increased, but water quality declined suggesting inflows now exceed assimilation capacities.

Monitoring and evaluation by the central advisory group, which included several members of the management group, gave feedback on activity plans and draft reports prepared by the technical assessment team at key steps along the process. The advisory group helped the technical assessment team prioritize and deal with requests and demands from governance actors at the provincial and central levels.

Potential users and members of governing and central technical advisory bodies for an assessment were always looking for ways to extract more information and improve the quality of reports and analyses. Clear terms of reference for the team leading the assessment became important to manage expectations.

Experts responsible for technical review, data collection, and analyses needed encouragement to share their findings early and regularly with other stakeholders rather than wait until they had the best analysis or everything was complete. Key users did not want to wait until the assessment process was complete, but wanted to immediately start exploring the relevance of initial findings and evidence for their work. These are examples of tensions that arose in coproduction.

In summary, science capacities associated with exploring, accessing, and using insights from governance policy actors and processes were substantially different among the three technical assessment teams. These differences had repercussions for the details of how the ecosystem services assessment process unfolded. Examples include the degree of engagement with other scientific experts, and, even more importantly, the level of use of information from peer-reviewed scientific literature on ecological processes and depth of policy analysis.

COPRODUCTIVE CAPACITY

Our analysis of coproductive capacity considered issues of legitimization in addition to more standard explorations of evidence of collaborative compilation and interpretation.

Legitimization

The initial logic was to seek endorsement from individuals in positions at as high a level as possible, such as the governor's office. This was important for enabling the assessment process to go forward, but initial commitment did not always translate into further significant engagement. As the process unfolded, it became clear that it was also important to engage with senior bureaucrats who had a genuine interest in and motivation to be part of the process because their contributions were more likely to be sustained.

In each province, partnerships were made with key agencies striving to mainstream poverty-environment linkages and keen on incorporating the ecosystem services assessment process into their designated functions and roles (Table 1). The regional offices of The Ministry of Environment and Natural Resources were key partners in Samut Songkhram and Khon Kaen provinces. In Samut Songkhram, the chamber of commerce represented small businesses including ecotourism. In Nan, the Provincial Administrative Organization, an elected local government body at the provincial level, actively committed to the project.

The governance structures that guided the assessment, both provincial level and the central advisory group, were dominated by government officials and experts from research organizations; there was no direct representation of vulnerable or poor groups. For Samut Songkhram, an argument could be made that the community organization that led the assessment process had some

capacity to represent these interests. The private sector was an important actor in each province but was not regularly engaged by the assessment process.

In all three provinces the policy question on which the assessments were supposed to focus was a negotiated text among key stakeholders and was not politically neutral. In Samut Songkhram, the policy question reflected the interests of those concerned with conserving culture and lifestyle while pursuing a particular vision of the environment. The initial idea was to focus on industrial development on the coast, but this focus was expanded to a more general concern about the impacts of national development policies. The Regional Environmental Office, for instance, strongly argued for the need to include the tourism sector as an important stakeholder; this was done to make the activity more attractive to provincial-level policy makers concerned with the policy tension around mass versus local ecotourism models. The policy question became a boundary object around which officials and other stakeholders could continue to engage with each other. In short, the question was coproduced by the stakeholders.

Compilation

During the assessments a significant element of coproduction came about through engaging local knowledge, practices, and initiatives. In Samut Songkhram, community involvement in gathering and interpreting evidence was emphasized. Local knowledge about mangrove ecosystems had clearly played a role in efforts by residents of Samut Songkhram to protect their homes from erosion and storms. Local governments and nongovernment organizations brought in their expertise as well to support local responses.

In Nan, local understanding about the importance of upland forests for flood regulation had partly driven efforts of lowland residents to find ways to turn upland land uses away from crops like maize. A combination of the ecological and institutional knowledge of locals and experts contributed to the subsequent deliberations on the design of a watershed fund.

Some response options reflected practices or actions already under way in parts of the community. In Samut Songkhram, a coastal village was replanting mangroves behind a temporary barrier to protect their homes from bank erosion and storm surges. In Nan, community forests have emerged in many locations to protect or restore a mixture of provisioning, regulating, and cultural services. In Khon Kaen, local knowledge and responses remain important to the management of wetlands. These efforts to help maintain or improve ecosystem services were not an outcome of the assessment, but examples of local knowledge and practices already in place that could be used to illustrate possible response actions to other stakeholders.

Assessments as social processes also help manage the boundaries between technical experts and other knowledge holders and users. Although there is negotiation over scope and focus, there is also some protected space created for experts to evaluate evidence without being placed under too much pressure by vested interests.

Interpretation

An assessment process that engages multiple stakeholders in deliberation over evidence and options also helps create a culture of evidence-based reasoning and respect for differences in values and interests of stakeholders. Experiences in this study suggest that an effective process takes time, resources, and commitment. Participatory rapid rural appraisal and community-based research approaches demonstrated that local residents had significant capacity for and interest in engaging in assessment activities relevant to local planning. They had an interest in interpreting the evidence, not just in being passive subjects or source of data.

The scenario-building exercises introduced by the assessments provided some of the clearest evidence of strengthened coproductive capacity, despite some significant limitations in the content of the scenarios themselves. Scenarios were a new tool for most stakeholders. There is very little strategic planning in the lower tiers of government; conventionally, these levels are expected to just react to central directives or local problems as they arise. Most plans are responses to immediate problems or means to securing budgets. Building capacity to use tools for exploring the robustness of policies and strategies, given uncertainties about the roles key drivers will play, was recognized as valuable, especially when a plan aimed to meet objectives or realize visions.

Preparation for scenario-development exercises was important because stakeholders started with little understanding of the purpose or process. In Nan, substantial time was spent before key events making sure partners and other key participants were clear about the purpose (Thailand Environment Institute 2013). Efforts were also made to ensure that the purpose of the exercises would fit in with the work of key stakeholders. A multistakeholder working group guided the scenario development process. Initial scenario activities were carried out with subgroups of stakeholders such as farmers or youths.

Similarly, in Khon Kaen, scenario exercises were first carried out with groups of stakeholders at the subdistrict level before engaging in a province-level exercise. These early groups discussed nonagricultural land uses and livelihoods, issues otherwise likely to be overlooked by officials and experts. The importance of expanding the employment of the younger generation in manufacturing and service industries was clearly noted and led to discussions about where labor for various agricultural activities was going to come from. This important countertheme to the emphasis on agroindustry and biofuels in the provincial strategic vision was carried through to the final set of scenarios.

The value of a scenario for analysis declines if it takes on too many characteristics of a perfect or fantasy world because drivers must be either assumed to be absent or arbitrarily invoked. Most facilitators noted some challenges for scenario exercises in the Thai cultural context, where the most common way to think about the future is not to explore the implications of uncertainty but to articulate an ideal vision and then imagine pathways in that direction even if there is very low expectation of any significant movement in such a direction. In all three provinces, most individual scenarios included a mixture of features that could be viewed as benefits or costs depending on the perspective of different stakeholders. In general, however, industry-oriented scenarios tended to be portrayed negatively by participants and assessment teams.

Possible response options were discussed with stakeholders in facilitated meetings. These meetings were follow-ups to the scenario exercise. The technical findings about trends and conditions derived from review of literature and analysis of primary and secondary data during draft assessments were not extensively consulted by facilitators or participants. Rather, participants continued to draw more on their own knowledge and experience. This is an indication that coproductive capacities are still limited and need further development.

At the same time, most stakeholders accepted the need for more evidence-based planning and welcomed opportunities for greater participation and deliberation. The assessments synthesized substantial volumes of technical information from a variety of sources. In each province a significant effort was made to engage with representatives of community, government, and private-sector stakeholders. The quality of facilitation, inclusiveness of participation, and level of informed input varied over time and among assessments, but the principles were widely supported. The assessments helped strengthen capacities for multistakeholder, participatory engagement in local and provincial planning. This drawing together of scientific and local knowledge in the three provinces represented a significant enhancement of the coproductive capacities to use science and local knowledge in ecosystem management.

DISCUSSION

Each of the three subnational assessments of ecosystem services and human well-being we studied built in some modest ways the capacities of governance actors to explore scientific and research-based evidence, consult scientific experts, and evaluate existing policies and plans using this newly acquired information. At the same time, scientific experts learned to explore public policy issues, consult planners and decision makers in government, evaluate the scientific evidence, and revise the scope and goals of their research and analytical activities to better meet policy needs and demands. Coproductive capacities were built when various stakeholders, including local residents and informal community leaders, jointly engaged in the compilation and interpretation of evidence. Doing so helped legitimize the assessment process with positive feedback on both governance and science capacities. Coproductive capacities thus not only depend on but also strengthen governance and science capacities (Fig. 2). Conversely, weak science or governance capacities set limits on coproductive capacity.

Many previous ecosystem services assessments appear to have been driven by developers of decision-support systems or models looking to illustrate or test the validity of their tools and frameworks. A significant feature of the three assessments reviewed here was that they were problem and user driven, and thus much less tied to a specific tool or model. This created opportunities for coproduction of knowledge among technical team members from different disciplinary backgrounds as well as among local officials looking for evidence to support their planning objectives.

Specific elements of the assessment processes did useful boundary work. Scenario-building exercises helped stakeholders from different agencies and local residents get a better understanding of each other's interests and assumptions about development. Negotiation of the focal policy question was important for defining what issues should be the focus of each assessment. Even in the case of Khon Kaen, where full consensus and commitment were never really achieved about the precise wording of the question and thus the focus of the assessment, coproductive capacities were built as a result of the struggle over framing.

Participatory and problem-driven ecosystem services assessments complement the conventional practice of expert examination of the environmental implications of individual projects or policies one by one. For local planners there is scope for considering multiple services in an integrated way and with consideration of trade-offs, for functional planners there is scope for considering multiple scales and strategies up to the national level, and for residents and informal community leaders there are opportunities to place the interests of under-recognized services and users on the agenda. Multistakeholder approaches are important because they increase the chances that environmental assessments will be perceived by all key stakeholders as being sufficiently credible, legitimate, and salient or useful (Cash et al. 2003). Multistakeholder and citizen participation is not yet common in environmental assessments in Thailand or other neighboring countries. However, the assessments documented here illustrate that some level of participation is possible, although it was still difficult to directly engage marginalized stakeholders like migrant workers, landless people, and the poor.

The study also found evidence of significant and interrelated behavioral, cultural, and institutional constraints to building capacity through ecosystem services assessments that have major implications for the use of assessments in planning and policy review or development. These constraints arise in the design, implementation, use, and communication components (Fig. 1) of an assessment process. Such constraints need to be addressed: Table 4 presents a selection of lessons learned by the assessment technical teams and reflected on by other stakeholders in a final reporting and evaluation workshop; those lessons provide some practical guidance on how to do so. Finally, these constraints relate to scientific, governance, and coproductive capacities (Fig. 2). It is to these analytical themes we now return in more detail.

First, there were limitations to knowledge and constraints on science capacity. Scientific resources available to be assessed were quite limited in two of the cases. In Khon Kaen, the assessment drew substantially on scientific research, whereas the other two assessments placed as much or even more emphasis on local perceptions and knowledge, in part because not much relevant prior research was available. Insights from quantitative, qualitative, and participatory research were sought, but integrating these insights was not a straightforward process, and they could not always be cross-validated. Interdisciplinary teams are crucial (Table 4, Design). Technical teams also tried to adjust research goals and products to meet reasonable demands and expectations, but did not always have the communication skills necessary to do so most effectively. Thus, several lessons learned based on comparison of experiences across the three assessments underlined the importance of communication skills as a core science capacity (Table 4, Communication).

Second, there were constraints related to governance capacities. Many were institutional and related to planning and administrative procedures. Subnational planning in Thailand takes place in a multilevel hierarchy. It is still extremely difficult

Table 4. Selected lessons learned about convening ecosystem service assessment processes.

Key Lessons
Design
Decision makers need to be aware of the purpose, strengths, and weaknesses of ecosystem services and related types of assessment and decision-support tools and procedures
Endorsement of senior officials is initially necessary to enable an assessment to proceed; the commitment of the next-tier of bureaucrats is needed to sustain policy and planning inputs
An effective assessment team has a good mixture of skills covering natural and social sciences as well as individuals capable of working across disciplinary boundaries and coordinating interactions of stakeholders
The availability and quality of secondary data strongly determines the level of quantitative and spatially disaggregated analysis possible
A clear and agreed policy question should be negotiated to help guide and focus an assessment on issues most relevant to policy and planning.
A combination of quantitative and qualitative or participatory methods is needed to fully capture the important dimensions of human well-being and how they are related to provision of ecosystem services
Technical teams and stakeholders involved in an assessment should be clear on their roles and responsibilities
Implementation
Villagers can be researchers: community-based research increases acceptance and relevance of an assessment
An assessment needs to undertake and encourage careful evaluation of all relevant evidence including scientific studies and local observations
Economic valuation requires good understanding of the benefits derived from ecosystems and how these are influenced by change in land-use; this understanding may not be immediately forthcoming
A multilevel perspective on drivers and ecosystem services is important because both differ significantly among local, subnational, national, and international scales
Inclusive and deliberative processes are important to capturing the values and uses of ecosystem services by diverse stakeholders, in particular, marginalized groups
Pre-event preparation, high quality facilitators, and an engaging meeting format are essential to building scenarios and exploring response options
Use
Assessments provide a useful resource to state and nonstate actors promoting more evidence-based planning
Improved skills in scenario planning helps local governments to think more about the future as well as go beyond conventional reactive planning to higher administrative level demands
After an assessment further negotiation or advocacy will often be needed to gain commitment to change policies, plans, or future actions
An assessment that is driven by policy needs is more likely to have influence than one that is expert driven
Assessments suggest new priorities for future research by identifying major gaps in knowledge critical to policy evaluation or design
Communication
Frequent communication helps ensure there is a shared understanding among key stakeholders of the scope, purpose, and findings as they evolve
Assessment processes demand and provide valuable experience for experts to improve their skills in communicating with nontechnical stakeholders
Significant effort is needed in discussions about well-being with stakeholders and experts to distinguish and prioritize well-being issues that are linked to ecosystem services

for local community and government actors to have significant evidence-based influence on national-level decision making around drivers that affect their landscapes, livelihoods, and well-being. Area-based plans can pay much more attention to local ecosystems than national policies, but only if those plans are sufficiently flexible and enabling. A multilevel approach to evaluation of drivers and consideration of responses in an assessment is crucial (Table 4, Implementation). In addition, the administrative system is not designed to incorporate new knowledge about ecosystem services into plans and budgets. Ecosystems are not classified or thought about in the same ways as built infrastructure. They are in a box labeled “environment,” separate from issues of development. Indicators appropriate for describing conditions and trends in ecosystem services in particular places are largely distinct from indicators and targets used in public administration, planning, and budgeting.

Elsewhere, the Wealth Accounting and Valuation of Ecosystem Services (2012) partnership led by World Bank has shown that it is possible to include environmental degradation in national accounts. Experiences in this study showed that the introduction of new indicators into the planning system needs to be done at the level of the central national bureaucracy, where important political factors and inflexible organizational cultures need to be dealt with. High-level endorsement of an assessment process is one of the prerequisites for being able to link back subnational findings to national policy (Table 4, Design and Use).

Third, there were constraints more directly related to coproductive capacities. An important one that arose in the design of assessments was developing realistic and shared expectations of what both science and policy could deliver. In the three provinces, the negotiated policy problem focus was "grand," which often created very high demands regarding what an assessment tool should provide to policy and planning. Decision makers were concerned with many environment and development issues, only a few of which an ecosystem services assessment could realistically address. Researchers, on the other hand, were keen to encourage evidence-based strategies. Ensuring that there is a good understanding of what an ecosystem service assessment can provide and that technical teams and decision makers have similar expectations is crucial and takes discussion and negotiation (Table 4, Design).

Another constraint to building and exercising coproductive capacity was having to deal with controversial issues involving powerful interests. To maintain high-level participation of government, civil society, and private-sector stakeholders, assessments tended to sidestep the politically tougher issues. In Khon Kaen, for example, a controversial religious shrine project was excluded from the analysis; in Samut Songkhram, stakeholders were often split on how much emphasis should be given to the Ramsar Wetland listing controversy because listing would have implications for local access and use of ecosystem services. Although there are merits to restricting an assessment to those issues that can plausibly be addressed, there is also a risk that the values and uses of ecosystems for more marginalized social groups may be unfairly neglected or excluded (Sikor 2013). Despite the attention to multistakeholder processes and initial attention given to poverty by funders and advisors, all assessment teams in this study struggled to effectively engage and represent disadvantaged groups. To protect against powerful interests, assessment processes need to be made as inclusive and deliberative as possible from the start (Table 4, Design). Local residents in Samut Songkhram foresaw that information gained in the assessment process would be useful for advocacy and informing local planning exercises in the future (Table 4, Use). Building coproductive capacities depends not just on the contributions of scientific experts and governing authorities, but also on the quality and extent of wider stakeholder engagement.

Given these constraints, it is worthwhile considering whether the ecosystem services assessments and the framework adopted by these studies were the most effective ways of bringing concerns about the environment and poverty into subnational development planning or building coproductive capacities. Several alternatives were discussed by stakeholders in meetings where the assessments were being planned, as well as later when the assessments were being evaluated. It was suggested that for some policy and planning problems, strategic environmental assessments may be a more appropriate set of procedures than the ecosystem services framework. A strategic environmental assessment uses participatory and analytical tools to evaluate the environmental impacts of policies, plans, and programs (Organisation for Economic Co-operation and Development 2006), but it is not confined to considerations of ecosystem services, although it may be informed by them (Geneletti 2011). Like ecosystem services assessments, strategic environmental assessments are usually applied at levels above individual projects. Likewise, it was recognized that when the real concern was a specific new project such as a large infrastructure or industrial project, environmental impact assessment tools would often be more appropriate. Neither of these tools, however, was on its own sufficient for dealing with analysis of poverty implications. On the other hand, it was thought that assessments of ecosystem services were likely to be most useful when there were serious concerns over how development drivers were disrupting ecosystem functions important to human well-being. With respect to building coproductive capacities, other processes such as high-quality communication of science, joint fact-finding activities on specific contested problems, and future-oriented development dialogues might be even more effective than complex ecosystem service assessments.

Our analysis of ecosystem services assessment in Thailand has important implications for efforts to build coproductive capacities elsewhere. Decentralization reforms along with calls for more evidence-based planning are under way in many parts of the world. Demand for assessments and related tools to assist with development planning at subnational levels are likely to increase. The lessons learned in Thailand in this study (Table 4) are likely to be most relevant in other developing countries where constraints and opportunities with respect to the ecological research base and human resource capacities at subnational levels are similar to those of the Thai cases. Participatory ecosystem services assessments in these situations can be adjusted to fit local realities. In particular, they may be more effective than tool- and expert-driven assessments because they do not overly privilege science; in fact, they encourage practitioners and local communities to share knowledge and perspectives on policy problems and possible responses. This simultaneous engagement of governance actors and scientists has the potential to lead to better decisions and to empower residents in local planning and development. Our analysis also highlights how building coproductive capacities faces many constraints and barriers; recognizing these is a first step to addressing them. It also points to a need for further study of diverse assessment processes in developing countries. This research would help to determine the merits and limitations of the ecosystem services assessment framework compared with alternative approaches to supporting formal planning and policy development as well as to building coproductive capacity.

CONCLUSIONS

These three subnational assessments of ecosystem services each had their own strengths and weaknesses; as a set, they provided significant insights into the challenges and opportunities associated with building coproductive capacities through participatory problem-oriented assessments in Thailand and

countries with similar levels of scientific and institutional development. Assessments of ecosystem services are a useful way of explaining how natural and modified landscapes affect human well-being, for better or worse. Thus, they are a valuable complementary tool for development planning and policy evaluation at subnational levels. Like any other approach, however, these assessments have some important limitations and constraints. These are related to the levels of understanding of ecosystems in particular places, to the time investments needed to share understanding among stakeholders, and to the recurrent challenges of dealing with differences in interests and motivations. Some actors will seek to use an assessment to support their pre-existing plans, policies, or positions. Other actors will note that the special value of an assessment lies not in telling people things they already know, but in identifying important relationships they do not understand well enough. In either case, by creating demand for greater capacities, assessments can improve the quality of evidence- and science-informed social change.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/6527

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