The Trouble with the Trees: Can Community-Based Forestry Succeed in Panama and Around the World?

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Abstract

Community-based forestry (CBF), a forest management strategy in which communities take a more active role in the management of local forests, has expanded quickly around the world since the 1990s. Since communities are thought to have local knowledge and a stake in the long-term sustainability of the resource base, CBF is theoretically positioned to produce more sustainable outcomes for people and the environment. Evaluations of CBF performance, however, have generally found mixed results. For many researchers, enthusiasm is ceding to skepticism, and more research into how CBF performs in a diversity of contexts around the world is needed. This thesis first reviews the literature on CBF's theory and performance before presenting a case study of CBF's current status in Panama. As a developing country in the tropics facing both high rural poverty rates and ongoing deforestation, Panama is viewed as a good candidate for CBF implementation. However, using an evaluative framework developed by Gilmour (2016) finds that the country is not fully ready on political or economic grounds to support successful CBF. CBF policy studies in other countries have reported similar results. Governments are usually reluctant to devolve power and communities often lack the technical capacity to carry out management activities. Noting the persistence of these problems, the next section reflects on the broad trajectory of CBF research. By applying a computational linguistic technique called topic modeling to a database of 1,112 abstracts of CBF research articles published between 1990 and 2017, prominent topics of CBF research are identified. Trends in the proportional occurrence of research topics, including the growing influence of carbon sequestration and local outcomes research, are described. The final part of the thesis discusses what these results say about the state of CBF research and argues for complex adaptive systems theory as a good candidate to inform innovative approaches that may further advance CBF research.

Résumé

La gestion forestière communautaire (GFC), une stratégie de gestion forestière dans laquelle les communautés prennent un rôle actif dans la gestion de leurs forêts, s'est popularisée mondialement depuis 1990. Puisque les communautés ont des connaissances locales et un intérêt pour la durabilité des forêts à long terme, théoriquement, la GFC devrait produire plus de résultats durables pour les communautés et l'environnement. Cependant, les évaluations de la performance de la GFC produisent des résultats partagés. L'enthousiasme de plusieurs chercheurs s'est transformé en scepticisme, donc il est nécessaire d'approfondir la recherche sur la performance de la GFC dans divers contextes. Cette thèse débute par un examen de la littérature existante sur la théorie et la performance de la GFC et poursuit par la présentation d'une étude de cas sur son application au Panama. En tant que pays tropical en voie de développement qui fait face à un taux élevé de pauvreté rurale et de déforestation, le Panama est un bon candidat pour l'utilisation de la GFC. Toutefois, une analyse utilisant un cadre d'évaluation développé par Gilmour (2016) démontre que le pays n'a pas la capacité économique ou politique pour supporter la mise en œuvre réussie de la GFC. Des études de politiques sur la GFC dans d'autres pays ont publié des résultats similaires. Les gouvernements se montrent réticents à l'idée de décentraliser leur pouvoir et les communautés manquent de capacités techniques pour exécuter leur plan de gestion. Vue la persistance de ces problèmes, la prochaine section de la recherche reflète sur les avenues de la recherche sur la GFC. Les thèmes de recherche prioritaires de la GFC ont été identifiés en utilisant une technique en linguistique informatique sur une base de données de 1 112 abstraits d'articles sur la GFC publiés entre 1990 et 2017. Les tendances de sujets de recherche en proportion avec leur occurrence, incluant l'importance accrue de la séquestration de carbone et la recherche sur les contextes locaux, sont décrites. La dernière section de la thèse discute de l'implication des résultats pour la recherche en GFC et argumente que la théorie sur les systèmes complexes adaptifs devrait informer des avenues innovatrices de recherche en GFC.

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My co-supervisor Dr. Maria del Carmen Ruiz-Jaen ensured that I returned from the Panamanian jungle without having lost a limb or acquired a debilitating tropical disease. Every day, she brings an amazing amount of determination and energy to her work. That has inspired me to do the same, a lesson I will remember long after I have left McGill.

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Thesis style and co-author contributions

This is a manuscript-based thesis, with Chapters 2 and 3 to be published independently as stand-alone research papers in scientific journals. This means that there is some repetition across the different sections and references are presented at the end of each chapter.

Chapter 1 provides a general introduction, lays out the objectives of the study, and presents a literature review to inform the thesis's conceptual framework. Chapter 2 presents a case study assessing community-based forestry policies in Panama and considering their potential to meet objectives. Chapter 3, building on a gap between research and policy observed in Chapter 2, reflects on the general trajectory of community-based forestry research literature over the past several decades using bibliometric analysis and statistical topic modelling. Chapter 4 concludes the thesis with a general discussion and suggestions for future research.

Data collection for the case study research took place in Panama between February and May 2017. I led the data collection with support from my co-supervisor Dr. Ruiz-Jaen and her colleagues at the Meso-American office of the Food and Agriculture Organization of the United Nations (FAO). The FAO, the Worldwide Fund for Nature (WWF), and the Smithsonian Tropical Research Institute (STRI) provided logistical support during my field work. Research assistance and field guidance was provided by Esteban Guerra. Lillisbeth Rodriguez and Nelson Cruz assisted with translation.

I am the lead author of all chapters. My co-supervisor Dr. Hickey is a co-author of Chapters 2 and 3. Dr. Ruiz-Jaen is a co-author of Chapter 2. Dr. Hickey assisted with conceptual framing, research design, interpretation and editing and contributed some writing to Chapters 2 and 3. Dr. Ruiz-Jaen also assisted with conceptual framing and editing for Chapter 2.

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Chapter 1: Introduction, Objectives, and Literature Review

"There is unrest in the forest
There is trouble with the trees
For the maples want more sunlight
And the oaks ignore their pleas"

-Rush, "The Trees" (1978)

1.1. Introduction

Countries around the world are faced with the twin problems of rural poverty and forest degradation (Wunder, 2001; Reardon and Vosti, 1995). Many people benefit from the ecosystem services that forests provide, including the provision of building supplies, food, medicine, and cultural opportunities and regulation of local climate (Egoh et al., 2008; Chan, Satterfield, and Goldstein, 2012). Yet important income-generating opportunities, especially those related to timber production or agricultural expansion, can drive deforestation (Chomitz, Buy, de Luca, Thomas, and Wertz-Kanounnikoff., 2007). These trade-offs, combined with population expansion and global economic growth, have contributed to systemic global deforestation (Humphreys, 2006). For example, from 2000 to 2012 the world suffered a net global forest loss of 1.5 million square kilometers (Hansen et al., 2013).

In addition to the services that forests provide for local communities, they are also valued internationally for the carbon they sequester and the biodiversity they support (Diaz, Hector, and Wardle, 2009; Lindenmayer and Franklin, 2002; Gardner et al., 2009). Concerns regarding the rate and scale of tropical forest degradation and deforestation have prompted researchers, non-governmental organizations (NGOs) and governments to seek new policy responses. These have included the establishment of protected areas (Kramer, van Schaik, and Johnson, 1997; Porter-Bolland et al., 2012), sustainable forestry (Tollefson, 1999), and agroforestry (Mbow, Smith, Skole, Duguma, and Bustamante, 2014; Kang 1996). Another strategy, community-based forestry (CBF), is considered among the most promising of these approaches (Sikor, 2006; Gilmour, 2016). CBF refers to "initiatives, sciences, policies, institutions and processes that are intended to increase the role of local people in governing and managing forest resources" (Center

for People and Forests, 2013). By leveraging local knowledge and giving local communities a greater stake in the long-term health of forest ecosystems, CBF, at least in theory, offers the attractive possibility of simultaneously pursuing the economic, social, and environmental goals of sustainable forest management and community development.

This thesis contributes to a global research effort to understand the extent to which CBF is fulfilling its theoretical potential. Internationally, researchers are involved in advocating for CBF policies (e.g. Center for People and Forests, 2013; Gilmour, 2016), implementing them at country and community levels (e.g. Robinson, Albers, Meshack, and Lokina, 2008; Masozera, Alavalapati, Jacobson, and Shrestha; 2006), and evaluating their performance to assess how they can be improved to bring about better outcomes for people and forests (e.g. Sunderlin, 2006; Agrawal and Ostrom, 2008; Acharya, 2002).

1.2. Objectives

The objectives of this thesis are to (1) describe the current extent and regulatory status of CBF in Panama; (2) assess the potential for CBF to succeed in Panama and present relevant recommendations for policy actors; and (3) model the global development of the CBF literature to assess the extent to which the field has progressed.

The rest of Chapter 1 is devoted to a brief review of the relevant literature. Chapter 2 presents the Panamanian case study and some policy recommendations that result from the analysis, addressing objectives (1) and (2). After identifying some common shortcomings of CBF efforts internationally, Chapter 3 assesses the trajectory of CBF research since 1990 using novel computational linguistic techniques, addressing objective (3). Finally, Chapter 4 discusses the overall findings of the thesis and considers future research needs.

1.3. Literature Review

1.3.1. History of community-based forestry

Across Asia, Africa, Europe, and the Americas, communities are playing a greater role in forest management. In this thesis, the term *community-based forestry*[1] (CBF) is used to reference the

[1] C*ommunity forestry* and *community-based forestry* are often used interchangeably in the literature. In this thesis I use the latter term. Bullock and Hanna (2012) note that CBF generally includes a broader class of management

broad range of forest management strategies that involve greater local control (Bullock and Hanna, 2012). CBF is now a "major modality" of global forest governance (Gilmour, 2016).

Although forest communities have obtained benefits from forests for millennia, *de jure* CBF as a formal state policy is relatively young (Charnley and Poe, 2007). Emerging as a successor to reforestation-focused social forestry programs in Asia in the 1970s, CBF has existed as a formal strategy for fewer than 50 years (Charnley and Poe, 2007; Gilmour, 2016). Nevertheless, such decentralization has become a major feature of modern forest governance (Agrawal, Chhatre, and Hardin, 2008; FAO, 2015). For example, Nepal, the Philippines, and India pioneered CBF policies between 1978 and 1995, and CBF spread throughout Africa, Latin America, and the rest of Asia in the 1990s (Charnley and Poe, 2007; Gilmour, 2016). This expansion reflected a "new forest agenda" (Scherr, White, and Kaimowitz, 2003) that better recognized the linked fates of forests and rural people.

CBF was originally promoted mainly as a solution to resource overexploitation by industrial logging operations in developing area contexts (Charnley and Poe, 2007). However as CBF regimes have matured and new issues have emerged, the goals of CBF have expanded to include more social, economic, and political concerns (Gilmour, 2016). Pagdee, Kim, and Daugherty (2006) found that fulfillment of local needs, improvement in forest condition, consideration of environmental issues, and more equitable benefit sharing are the most-commonly-discussed goals of CBF. Conditions set by international donors, domestic demands for control over local resources, and pressure from intergovernmental institutions to address rural poverty and tenure demands have influenced its adoption by governments, especially in the developing world (Agrawal et al., 2008). In some cases, CBF is pursued to reduce government budgets related to forest monitoring and rule enforcement (Charnley and Poe, 2007). A greater focus on links between environmental and social issues and a shift to more 'bottom-up' development strategies have also encouraged greater community involvement in resource management (Scherr et al., 2003; Tole, 2010). In recent years, grassroots and international pressures to recognize land rights of Indigenous and local communities have become highly influential (Gilmour, 2016).

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schemes than community forestry, which typically refers only to regimes in which communities have strict tenure rights.

Researchers have also played an important role in supporting the development and adoption of CBF. Elinor Ostrom's common pool resource theory, elaborated in 1990's *Governing the Commons*, described empirically how communities with secure property rights can organize themselves to sustainably manage resources. This presented an alternative vision to Garrett Hardin's "tragedy of the commons" dilemma which suggested that either centralized management or assigning individual property rights were the most reliable responses to avoid the over-exploitation of commons (Gilmour, 2016). It is now better recognized that local communities often have several advantages as resource managers (Scherr et al., 2003). These include a vested interest in the sustainability of the resource base, a sense of ownership, local knowledge, and proximity to the resource which could allow them to better design and enforce effective harvesting rules (Charnley and Poe, 2007).

1.3.2. CBF in Latin America

CBF is prevalent across Latin America (Tole, 2010; Larson, Pacheco, Toni, and Vallejo, 2007; de Jong et al., 2010; Charnley and Poe 2007; Cossío, Menton, Cronkleton, and Larson, 2014) and has been especially well-researched in Mexico, Guatemala, Nicaragua, Bolivia, and Brazil (de Jong et al., 2010). International lending conditions and state budget downsizing have been important drivers of CBF in Latin America (Tole, 2010), albeit with some "back and forth" movement (Larson et al., 2007). Progress has often been the result of community pressure on government through demanding tenure rights, not the desire for CBF in particular (Larson et al., 2007). As a result, decentralization usually takes place "case-by-case," with permits and contracts awarded one community at a time (Larson et al., 2007). This strategy tends to construe public forest access as a "privilege" rather than a right (Ribot, 2005), or makes the rights "soft" rather than "hard" and thus more easily revoked (Gilmour, 2016).

Relatively little information is available regarding CBF in Panama specifically. Oestreicher et al. (2009) examined the potential for community participation and benefit-sharing in monitoring protected areas in the country, but did not address CBF in particular. Other research has assessed the potential for community-based ecotourism in parts of the country (Cusack and Dixon, 2006) and compared forest conservation outcomes in Indigenous territories to non-Indigenous territories (Vergara-Asenjo and Potvin, 2014). A report from the WWF documented the agency's efforts supporting CBF in the Darien region of Panama (Ordoñez et al., 2011). However, to the

best of my knowledge, no peer-reviewed studies have focused specifically on the status, performance, or potential of CBF in Panama.

1.3.3. CBF Performance

Among researchers, skepticism towards CBF is overtaking enthusiasm (Tole, 2010), with recent evaluations of CBF outcomes returning mixed results (Gilmour, 2016; Tole, 2010; Bowler et al., 2012). Seeking to identify the root causes of this underperformance, Charnley and Poe (2007) identified five hypotheses underlying the CBF model: (1) "that discrete communities exist and can become the locus for management," (2) that some management responsibility is decentralized, (3) that forest use can be compatible with biodiversity conservation, (4) that local control will lead to more sustainable practices, and (5) that local control will bring social and economic benefits to the community.

Regarding the first hypothesis, Charnley and Poe (2007) argue that CBF advocates have tended to oversimplify the notion of "community." They note that social, political, and spatial relations *within* communities affect CBF functioning. Thus, construing a community as a geographically-delimited entity risks obscuring intracommunity hierarchies and power differentials that can marginalize some groups (Charnley and Poe, 2007). For example, local elites and corporate actors are known to often use their access to information and resources to secure favourable conditions from governments and navigate complex regulatory environments (Larson and Ribot, 2007).

Another common issue, challenging the second hypothesis listed above, is that full devolution is rare in practice (Gilmour, 2016; Charnley and Poe, 2007). Since the first CBF programs were implemented, government officials have been reluctant to transfer significant power to community authorities or forest users (FAO 1991; Gilmour, 2016). Commitments made in legal and political rhetoric are rarely borne out in practice (Charnley and Poe, 2007). This can be especially true when highly valuable timber resources are being contended (FAO, 1991). Partial devolution gives communities limited control (Tole, 2010). Gilmour (2016) contends that this produces "fragile" CBF regimes in which communities only control degraded forests, are denied access to valuable resources, or are tasked with protecting rather than managing a resource. CBF has sometimes meant that communities bear the costs of management responsibilities without securing tenure rights or reliable commercial benefits (Arnold

2001). That being said, joint management or community-state partnerships can be beneficial even without full management decentralization. For example, the state can provide functional support in the form of conflict resolution services or financial and technical resources (Charnley and Poe 2007). Furthermore, improvements in community participation, accountability, and equity have been observed even under partial decentralization (Charnley and Poe 2007). Full devolution is not a panacea (Ostrom and Cox 2010) and a range of experiences around the world demonstrates that a variety of institutional and tenure arrangements can bring about sustainable management outcomes (Agrawal et al., 2008).

Whether the multiple goals of CBF are reconcilable is also being debated in the literature. It is especially unclear whether hypothesis 3 above, namely that forest use and biodiversity conservation can be pursued simultaneously, holds. Evidence suggests that environmental effects are more influenced by how timber and non-timber forest products are used than whether or not they are used at all (Charnley and Poe 2007). Both Vergara-Asenjo and Potvin (2014) and Porter-Bolland et al. (2011) found that community-managed forests showed lower and less variable annual deforestation rates than protected forests. There is increasing evidence from Mexico that CBF can help to conserve forests better than centralized management approaches (Bray et al., 2005). There is also some evidence that more forest conservation may come at the expense of local livelihood improvements (or vice versa) (Acharya, 2002; Thoms, 2008). However, it has not been common for studies to consider the multiple CBF goals together (Pagdee et al., 2006) with standard metrics that may facilitate this often underdeveloped (Persha et al., 2011).

After gaining control over resources, small-scale producers may find it difficult to compete in markets (Scherr et al., 2003). While Tole (2010) finds evidence that "fairly well-run" CBF programs have generally been able to generate income, de Jong et al. (2010) argue that CBF generally has "limited financial potential." Input requirements are high and revenues are low (de Jong et al., 2010). Gaining access to financial benefits requires CBF producers to participate in markets and value chains that may be unfamiliar (de Jong et al., 2010). Certification schemes, which have the potential to give CBF producers access to premium markets, are usually helpful only if community enterprises have direct links to wholesale exporters and are already operating at standards close to those demanded by the certification bodies (Scherr et al., 2003). Additional

income to support CBF programs may be accessed through payment-for-ecosystem-services (PES) programs which further incentivize ecologically-sustainable management (Tole 2010), but there are few examples of such programs being implemented. In recent years, the United Nations Reducing Emissions from Deforestation and forest Degradation (REDD+) program has emerged as a potentially-transformative vehicle for carbon sequestration and forest management in developing areas (Agrawal and Angelsen 2009). However, REDD+ also raises concerns regarding recentralization (Phelps et al., 2010) and the imposition of unwanted programs on communities and Indigenous peoples (Larson, 2011).

There are examples where CBF policies have improved local livelihoods and made forest management more sustainable (Gilmour, 2016). For example, studies in Brazil and Mexico have found lower rates of deforestation in community-managed forests (Nepstad et al., 2006; Bray et al., 2004). However, despite its prominence, many of the enabling conditions for CBF tend to remain unmet and CBF generally performs "below expectations" (Gilmour, 2016). It is generally thought that a lack of attention has been paid to institutional and socioeconomic dimensions of CBF management (Tole 2010). While community control of forests may advance sustainable management and conservation, it clearly does not guarantee it (Charnley and Poe 2007).

1.3.4. Interventions by external actors

NGOs like the WWF and intergovernmental organizations like the UN FAO have been influential advocates of CBF in developing areas. These organizations have leveraged their financial, technical, and organizational resources to encourage national governments to support CBF (Charnley and Poe 2007, Gilmour, 2016). They have also worked at the community level to train and support CBF organizations and strengthen local management institutions (Pretty and Ward 2001). In Bolivia, for example, Andersson (2004) and Asquith et al. (2008) found evidence that NGO involvement correlated with more effective community institutions and forest conservation. Barnes and van Laeverhoven (2015) found that NGOs focused on giving local actors knowledge, resources, and management and communication skills to ensure *durable* collective action. However, those authors also noted deficiencies in NGO support of *functioning* collective action, represented by regular meetings, rules, and enforcement mechanisms (Barnes and van Laeverhoven 2015). In this vein, Pretty and Ward (2001) observed

that NGOs tend to focus on creating participatory community processes that were then expected to produce effective forestry associations capable of making their own rules.

The involvement of NGOs and intergovernmental organizations in CBF has been controversial. Wright and Andersson (2013) found little evidence that NGO interventions had any effect on the development of local institutions or deforestation rates. Concerns have also been raised that external actors are not accountable to local communities, have their own incentive structures, and may lack knowledge of local perspectives (Mohan 2002, Jepson 2005). A lack of accountability can lead to inequitable treatment and neglect of local needs (Tole 2010), though organizations may try to mitigate this by obtaining Free, Prior, and Informed Consent from communities (FAO, 2016). Making lasting changes to community rules and practices is difficult and requires multi-level, long-term investments (Barnes et al., 2017) that many NGOs may be unwilling or unable to meet.

1.3.5. Success factors for national policies and local institutions

The factors that influence CBF success span ecological, social, and economic concerns (Pagdee et al., 2006). Gilmour (2016) identified six conditions without which CBF cannot reach its full potential. These "keys to effective CBF" are: (1) secure tenure, (2) an enabling regulatory framework, (3) strong governance, (4) viable technology, (5) adequate market knowledge, and (6) a supportive bureaucracy (Gilmour, 2016). Agrawal (2001) posited up to 40 factors relevant to CBF success, separated into resource system characteristics, group characteristics, institutional arrangements, and external environment. Most scholars identify property rights, effective local institutions, and community incentives as important determinants of success (Pagdee et al., 2006). Ostrom (1990) identified eight principles relevant for effective common property resource management, though Cox et al. (2010) found that not all were equally important. Other studies have expanded Ostrom's set of principles to include aspects of the biophysical environment and external socioeconomic influences (Pagdee et al., 2006).

Some researchers worry that CBF has come to be seen as a panacea by certain advocates and policy-makers (Ostrom and Cox 2010). They caution that policies must be contextualized, as the type of governance is less important than its local suitability, development process, and legitimacy (Ostrom and Cox 2010). Many of the variables are context-sensitive which makes it difficult to generalize strategies across different cases. The number of variables also means

policy-makers and local managers must contend with incomplete information and unpredictable effects of decisions (Underdal, 2010; Rammel et al., 2007). Strong local institutions can help reduce this uncertainty (Cox et al., 2010). Accordingly, policy recommendations have shifted from guaranteeing property rights to developing effective local institutions which codify behavior and promote group action by signaling commitment to sustainability (Ostrom and Cox 2010; Gibson et al., 2005). Functional institutions are supported by community trust and reciprocity (Cox et al., 2010). However, exactly which institutions are important for CBF is contested (Cox et al., 2010; Ostrom and Cox, 2010). For this reason, program design needs to be informed by adaptive management principles and allow for learning and adaptation over time (Barnes et al., 2017; Pagdee et al. 2006; Gilmour, 2016). Participatory processes can help to mitigate conflict between national policies and local institutions (Kamoto, Clarkson, Dorward, and Shepherd, 2013).

While the importance of local institutions is well-recognized, larger political and economic forces should also be considered when assessing CBF potential (Charnley and Poe, 2007). Communities engaging in CBF often interact with markets and integrate in value chains when commercializing timber and other forest products (de Jong et al., 2010). Scherr et al. (2003) argue that where market conditions are unfavourable, small-scale community producers will not be able to compete with industrial producers and should instead focus on developing environmental and subsistence values. Antinori and Bray (2005) found few examples of CBF creating successful commercial entities, with Mexico a notable exception.

1.3.6. Research Gap

The lack of empirical evidence on CBF effectiveness in achieving environmental, social, and economic goals has been commonly highlighted as an important research gap (Bowler et al., 2012; Arnold 2001). In particular, Bowler et al. (2012) called for a greater systematization of relevant variables to be compared to baselines and counterfactuals. Gilmour (2016) called for researchers to investigate the variety of forms that CBF has taken around the world as a result of its spread over the past 25 years. Agrawal et al. (2008), noting that forest ownership and management responsibility are decoupled to various degrees in different countries, suggested that researching the influence of diverse institutional arrangements on management outcomes would be helpful.

1.4. General Methodology

1.4.1. Case study research

Chapter 2 presents an exploratory, qualitative case study of CBF policy in Panama. The case study method allows researchers to study phenomena "within their contexts" (Baxter and Jack, 2008, p. 544) and qualitative data analysis is especially useful for applied policy analyses that deal with complex behaviours and systems (Ritchie and Spencer, 2002). As opposed to experimental research designs, case studies investigate "naturally occurring" phenomena and how they influence and are influenced by their contexts (Rose, Spinks, and Canhoto, 2014). A large amount of data about many different features of the case is typically collected from a range of data sources (Gomm, 2000; Yin, 1998). Taking an exploratory approach also allows unanticipated themes to emerge during data collection and analysis (Yin, 1998).

This was a valuable approach for this thesis because, again, to the best of my knowledge this is the first study that specifically addresses CBF in Panama. Both "contextual" and "evaluative" questions may be addressed in a case study (Ritche and Spencer, 2002, p. 174). This means that CBF's status, operation, and effectiveness in Panama can be considered together. Case study approaches have previously been employed to study CBF in many other countries, including Nepal (e.g. Prasad Timsina, 2003; Thoms, 2008); Bangladesh (e.g. Salam, Noguchi, and Koike, 2005); Cambodia, Laos, and Vietnam (e.g. Sunderlin 2006); Mexico (e.g. Klooster, 2000); and Brazil (e.g. Humphries et al., 2012). A meta-study by Pagdee et al. (2006) identified 69 CBF case studies drawn from 31 articles.

When conducting case study research it is important to address issues of bias and reliability (Golafshani, 2003). Interviewing informants from a range of relevant organizations and roles to get multiple perspectives on the issues at hand can enhance validity (Weiss, 1995). Data triangulation, i.e. comparing data from multiple independent sources, enhances reliability (Golafshani, 2003). Data is triangulated in Chapter 2 by integrating information from various informants, research from academic and civil society actors, economic and financial data, and direct observation. The specific measures taken to minimize bias and enhance validity, in addition to the study's limitations, are described in more detail in section 2.2.4.

1.4.2. Topic modelling

Chapter 3 of this thesis uses a computational linguistics technique called *probabilistic topic modelling* to investigate the development of the CBF literature. While the specifics of the method will be further elaborated in that chapter, a brief review of the relevant topic modelling literature is presented here.

Researchers in many different fields have used topic models to analyze large document archives and annotate them with thematic information (Blei, 2012). The models assume that a set of latent topics was used to generate the words observed in the documents. The specific kind of topic modelling used in this thesis is based on latent Dirichlet allocation (LDA), first presented in Blei, Ng, and Jordan (2003). LDA assumes that "each document is generated by choosing a distribution over topics and then choosing each word in the document from a topic selected according to this distribution" (Griffiths and Steyvers, 2004). Thus documents can be represented as multinomial distributions over a set of underlying topics, and topics as multinomial distributions over a set of words (Bohr and Dunlap, 2017).

Several previous papers have used LDA to represent the prevalence, distribution, and relationships of ideas or topics in a scientific field. Griffiths and Steyvers (2004) analyzed abstracts published in the Proceedings of the National Academy of Sciences between 1991 and 2001. Papers included in the Association for Computational Linguistics Anthology were analyzed by Hall, Jurafsky, and Manning (2008) to identify trends in the field and assess whether the field is becoming more applied. Bohr and Dunlap (2017) assessed the abstracts of environmental sociology articles published between 1990 and 2014 to identify key topics in the literature.

The advantage of topic modelling is that it allows researchers to explore thematic patterns for a much larger set of documents than could be coded manually (Blei, 2012). The structure of the topics reveals hidden thematic structures in the documents (Blei, 2012). Roberts et al. (2014) showed that unsupervised machine learning techniques can be as reliable as hand coding, and Griffiths and Steyvers (2004) showed that a topic model for scientific papers was consistent with the disciplinary classifications reported by the papers' authors. Their accuracy and

interpretability make topic models a powerful analytical technique for analyzing large amounts of text-based data, such as papers in a scientific field.

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Preface to Chapter 2

After reviewing the history and general performance of CBF policies in Chapter 1, a specific case study of what the design and implementation of these policies can look like at a country level is presented in Chapter 2. The focus is Panama, a small, developing country in the tropics. A bridge between Central and South America and an important center of international banking and shipping, Panama faces high rural poverty rates and a suite of environmental problems related to deforestation and forest degradation. With the support of several international organizations, the country's government has reformed regulatory frameworks and development programs to support CBF in hopes of addressing these problems. This chapter describes these reforms and evaluates their potential to support CBF.

Chapter 2: Assessing Panama's Readiness to Support Community Forestry

Abstract

Community-based forestry (CBF) has been increasingly promoted as a potentially effective sustainable resource management strategy, particularly in developing area contexts. Panama, a country experiencing widespread degradation and loss of tropical forests and high rates of rural poverty, has been identified as potentially benefiting from CBF programs. For this reason, several prominent forest policy actors in Panama, including the Worldwide Fund for Nature (WWF) and the Food and Agriculture Organization of the United Nations (FAO), have been piloting numerous community forestry projects in order to assess the potential for upscaling. While there are many reasons to be optimistic about the role of CBF in delivering more equitable forest management outcomes, successful policy implementation in other countries has been inconsistent. This paper reports on current CBF initiatives in Panama and assesses the country's readiness to support widespread program adoption. The analytical framework is based on the six keys to effective community-based forestry identified by Gilmour (2016): secure tenure, an enabling regulatory framework, strong governance, adequate market knowledge, viable technology, and a supportive bureaucracy. Using qualitative and quantitative data drawn from document analysis, program evaluations, and key informant interviews with policy actors we identify insights for community forestry policy in Panama with important lessons for other contexts.

Keywords: sustainable development; environmental policy; community-based forestry

2.1. Introduction

Community-based forestry (CBF) continues to spread globally, fuelled by interest from stakeholders who believe it offers a management strategy that can help to better conserve forests, empower communities, and improve rural livelihoods through more sustainable resource use (Agrawal et al., 2008; Bowler et al., 2012). CBF is defined as "initiatives, sciences, policies, institutions and processes that are intended to increase the role of local people in governing and managing forest resources" (Center for People and Forests, 2013). In contrast to a more centralized system in which public forests are managed by the state, communities under CBF regimes take an active role in planning and implementing management strategies for their local forests. Sometimes, but not always, CBF implementation involves communities gaining ownership or tenure rights to the forests they are managing (Ostrom, 1990). This is thought to incentivize good governance by giving communities a greater stake in the effectiveness and sustainability of their management.

The prospect of aligning the goals of forest conservation and rural economic empowerment is attractive. Yet evaluative studies of CBF, conducted in response to calls for greater assessment of the associated social and ecological outcomes, have returned mixed results (Bowler et al., 2012; Tole, 2010). Despite the theoretical promise of CBF programs, "in reality, the benefits … have often failed to materialize" (Tole, 2010, p. 1313). According to Bowler et al. (2012), there remains a need for more evaluation due to a relative dearth of empirical evidence and the difficulty of comparing CBF regimes across different contexts. A wide range of factors, including ecological, socioeconomic, relational and institutional variables, influence the outcomes of CBF projects in different contexts (Ostrom and Cox, 2010; Tole, 2010). Failure to account for complexity in the design and development of CBF programs therefore jeopardizes their likelihood of success (Ostrom and Cox, 2010; Baynes, Herbohn, Smith, Fisher, and Bray, 2015).

2.1.1. The context of Panama

In Panama, a developing country in the tropics, several policy actors have been actively fostering a small but growing network of CBF projects. Through these projects they are hoping to address some of Panama's multiple social, economic and environmental challenges. Forestry makes up a

small proportion of Panama's economy, with wood products accounting for approximately 1.1 percent of the value of the country's exports in 2015 (Simoes and Hidalgo, 2017). Public revenue reported from all forestry activities in 2010 was 5.04 million USD while total government revenue was 5.01 billion USD (FAO, 2015; Organization for Economic Cooperation and Development, 2017). Instead the country's rapidly growing economy is being driven by a large financial sector and the recently-expanded Panama Canal (Economic Commission for Latin America and the Caribbean, 2017). Yet the country has long been experiencing degradation and loss of its forests, with a net forest loss of 19,505 hectares a year from 2000 to 2012 (FAO, 2015). Bridging the gap between South and Central America, Panama's forests form part of the Mesoamerican biological corridor and host thousands of native plant and animal species (Dettman, 2006). The country also faces high rural poverty rates. In 2014, 10.2 percent of the population lived in extreme poverty; in rural areas, though, the extreme poverty rate was 27 percent and in the country's legally recognized Indigenous territories, or *comarcas*, it was more than 40 percent (World Bank, 2017). These phenomena are linked, as deforestation is driven in part by a reliance on clearing forests for agriculture, one of the only economic strategies open to poor, often landless, rural households (Larson, 2006). At the same time, healthy forests provide ecosystem services including food, medicine, and building supplies to rural people (Isbell et al., 2011; Campbell and Luckert, 2002). Also important is the fact that the majority of Panama's remaining forests are found within the country's Indigenous territories (Vergara-Asenjo and Potvin, 2014).

Hoping to address some of these social issues and better conserve Panama's rich biodiversity, the Worldwide Fund for Nature (WWF) has, since 1993, been supporting CBF efforts in Panama's east and, since 2004, in the west (Ordoñez et al., 2011) (see Figure 2.1). More recently, the United Nations Food and Agriculture Organization (FAO) has taken an interest in supporting these programs as part of its mission to advance sustainable resource development in the country. Panama's national government also wants to revisit the legal structures governing the country's forestry industry to facilitate its participation in the United Nations' Reducing Emissions from Deforestation and Forest Degradation program (REDD+) (Aguilar-Støen, Toni, and Hirsch, 2016; Holmes, Potvin, and Coomes, 2017). These factors have the potential to open the door for meaningful change in both the regulatory frameworks and incentive structures that have contributed to CBF's successes and failures elsewhere in the world.

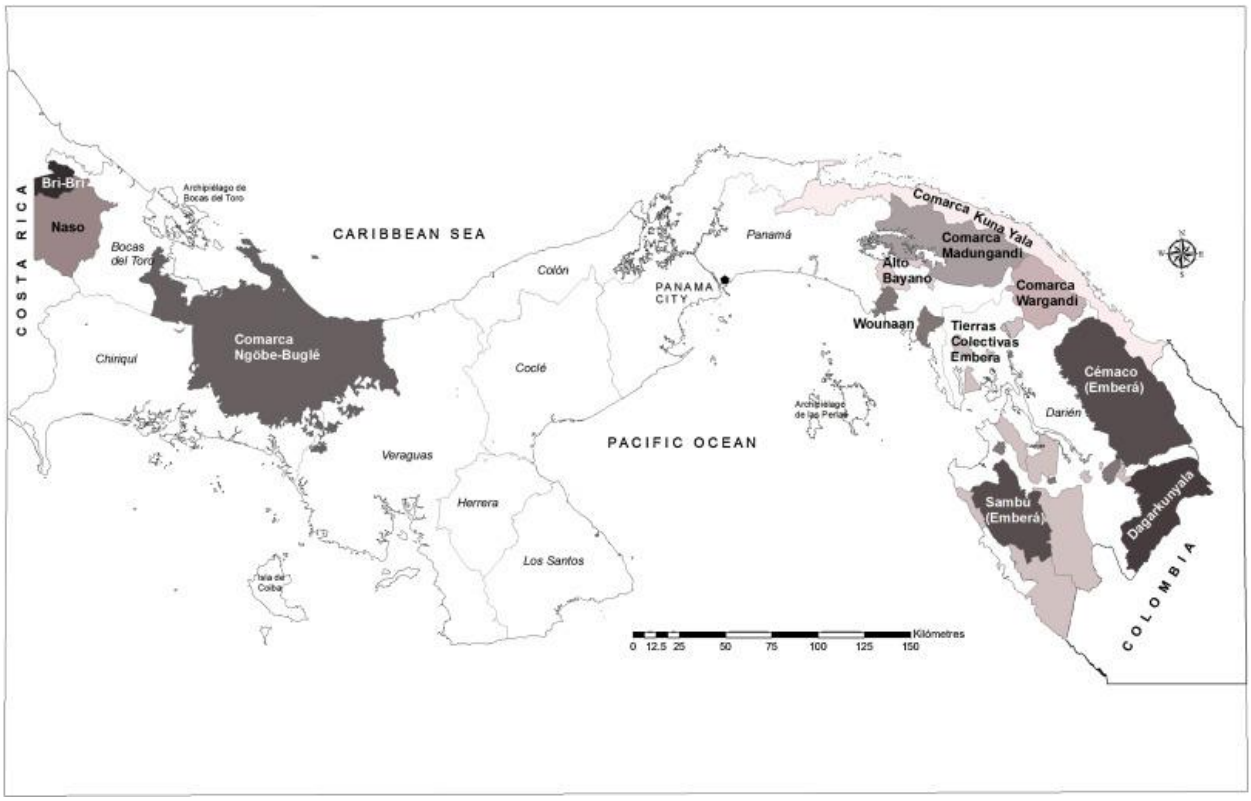

Figure 2.1: Map of Indigenous territories in Panama, including comarcas and claimed lands (map from Vergara-Asenjo and Potvin, 2014).

2.1.2. Conceptual Framework

Recognizing the need for more empirical evidence on CBF initiatives, this paper presents a case study of Panama's readiness to support CBF. It intends to both inform policy actors working on forest management issues in Panama and contribute to the growing database of CBF experiences in different contexts globally. This is to our knowledge the first formal, in-depth study focused on CBF programs and experiences in Panama. Recognizing the complexity of CBF and the importance of systemic factors, we seek to study these programs "within their contexts" (Baxter and Jack, 2008, p. 544). Although we adopted a unit of analysis to focus data collection, we also followed an exploratory case study method so that unanticipated themes could emerge during data collection and analysis (Yin, 1998).

To frame our unit of analysis, we used Gilmour's (2016) evaluative conceptual framework (Figure 2.2). Following a systematic evaluation of CBF's development and current state worldwide, Gilmour identified six "keys" that a country must possess to remove the major

impediments to robust CBF. This is a significant new iteration of a framing first proposed by Byron (2001). These six keys are (1) secure tenure, (2) an enabling regulatory framework, (3) strong governance, (4) viable technology, (5) adequate market knowledge, and (6) a supportive bureaucracy. While the idea of 'keys' may make for "a somewhat reductionist view of a very complex set of issues and situations which are often context specific," (Gilmour, 2016, p. 79), the framework is accessible and distills lessons from the CBF literature to facilitate analysis and discussion among policy-makers and researchers.

Investments by governments and NGOs in CBF programs can be significant in terms of time, personnel, and money. Therefore, it is worthwhile to understand the factors influencing the program's potential for success. In this paper, we assess the extent to which each of the six keys can be considered present in Panama. We also identify other factors of concern identified by stakeholders that are not well covered by Gilmour's six keys. We then conclude with an overall assessment of CBF's potential as a transformative policy program in Panama and reflect on possible next steps for CBF proponents in the country.

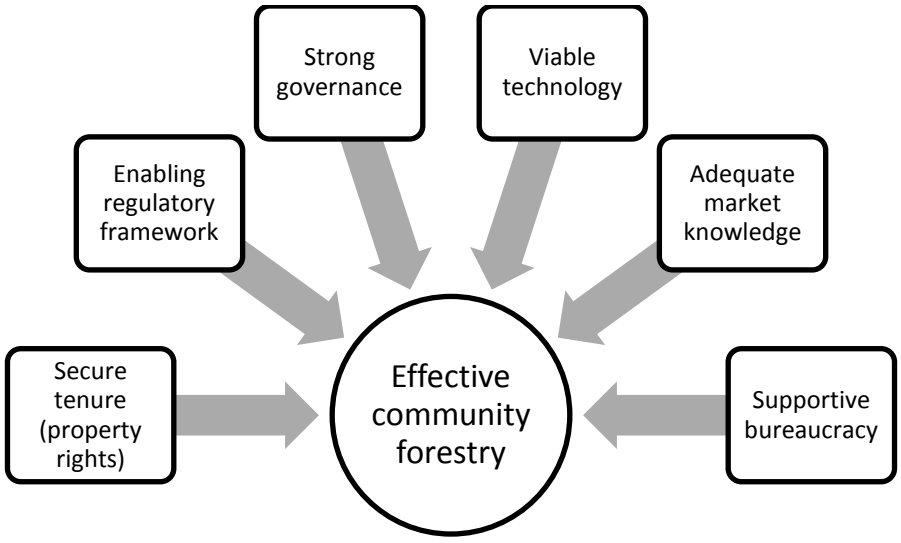

Figure 2.2: The keys to effective community forestry (Gilmour, 2016)

2.2. Methods

2.2.1. Case Study

CBF in Panama operates in two contexts: 1) in pine plantations located in the mountainous western regions of Veraguas and Ngäbe-Bugle, and 2) in natural tropical forests located in the eastern regions of Embera-Wounaan and Darien (see Figure 2.1). Both Ngäbe-Bugle and Embera-Wounaan are *comarcas*, formal Indigenous territories recognized by the state (Vergara-Asenjo and Potvin, 2014). While the history and ecology differ between the western and eastern contexts, they share a regulatory framework and civil society support system.

The western pine plantations were first established as part of a rural development program jointly supported by the government and the United Nations World Food Programme in the 1970s. People living in the area, which had been extensively deforested, were paid or given food in exchange for planting and managing the plantations (Ordoñez et al., 2011). Pine, though not native to Panama, was chosen as a hardy, fast-growing, commercially-viable species. Since then, these plantations have developed into mature homogenous stands. Though most of these plantations are located within the comarca Ngäbe-Bugle, they remain state-owned as they were planted prior to the comarca's official recognition in 1997 (Ordoñez et al., 2011). However, local communities are permitted to manage, extract, and make use of them, subject to government oversight. There are now twelve community forestry enterprises (CFEs), including businesses, cooperatives, and associations, operating in the region.

Eastern Panama has a much higher percentage of natural forest cover remaining, especially in the region's Indigenous territories. Although communities in the *comarca* Embera-Wounaan territories have a long history of "informal" community resource management, formal CBF was established in the region when the national government passed Law 1 in 1994, the Forestry Law. That law established a system of community permits for Indigenous communities. These allowed the communities to extract and market their local forestry resources, provided the income earned was reinvested in community development projects. Commercial forestry interests also supported the changes, wanting the government to formalize a system of wood extraction in Indigenous territories to provide a new source of raw material for the industry (Ordoñez et al., 2011).

2.2.2. Data collection

This study employed a mixed-methods data collection strategy centered on semi-structured key informant interviews, document analysis, and observation by the authors. Semi-structured interviews were conducted with eighteen key informants (see Table 2.1). Initial respondents were selected purposively to ensure that individuals with the greatest insight into the research questions, or "information-rich cases," were consulted (Devers and Frankel, 2000). In these interviews, snowball sampling methods were then employed with key informants asked to identify other information-rich cases. Those people most commonly cited by key informants were then invited to participate in interviews (Kemper, Stringfield, and Teddlie, 2003).

Our sample of key informants included Panamanian government officials, NGO staff members, academic experts, and industry professionals, representing a diverse set of perspectives on the Panamanian forestry system (Table 2.1). An semi-structured interview guide was used to direct the interviews, with questions designed to solicit information regarding the current extent and scale of CBF in Panama, the country's status with respect to Gilmour's 'six keys,' and the institutional structures and relationships between relevant policy actors. The interviews were designed to allow probing follow-up questions to be asked, as each informant held a different role within the system and reported different experiences.

Eight of the informants were interviewed in English, and ten were interviewed in Spanish with the assistance of a translator. For the interviews conducted in Spanish, questions were first read in English and then translated for the informant. The informant's answer was then translated into English during the interview to allow the interviewer to ask follow-up questions. A breakdown of the key informants is found in the table below. All interviews were recorded and transcribed for analysis.

Table 2.1: Summary of informant groups, organizations, and roles

Stakeholder Group	***Description of informant's organization/role***	***Informant role***
Government	National government department that designs environmental regulations, makes policy recommendations, oversees project implementation, and issues resource extraction permits, among other duties	Director
		Forest Engineer
		Forest Engineer
		Forest Engineer
		Biologist
	National government institution that sets research priorities and distributes funds. Has funded research into the biological and social dimensions of community forestry	Director
NGO / Civil society	A national organization focused on conservation and reforestation projects and campaigns	Executive Director
	International organizations that manages a large grants program for projects with environmental aspects	National Coordinator
	International environmental organization with conservation, reforestation, and community development programs in Panama	Regional Director
	Latin American environmental organization with regional projects in Panama related to sustainable production and conservation	Engineer
	International organization that promotes sustainable agriculture worldwide with programs in Panama related to food security and environmental sustainability	Technical Advisor
		Forestry Official
Academia	Forestry professor with experience as a consultant on forestry projects with communities, farmers, and the Panamanian government	Professor
	Scientist with extensive experience working with Panamanian Indigenous communities on conservation projects and consulting for governments and agencies on Indigenous and development issues	Researcher and community advocate
	Conservation professional and researcher with experience in community-based work in development and conservation	Researcher
	Ecologist with experience working with communities on sustainability and reforestation projects	Researcher
Industry	National forestry company focused on improving sustainable sourcing	Executive
	Management consultancy experienced with forest product certification procedures	Director

All interviews were conducted between May and August 2017

Publicly-available documents such as Panamanian forestry laws and directives and NGO program reports were also collected and analyzed. Additional documentation such as community management plans and financial information about the forestry industry were also analyzed when provided by research participants.

2.2.3. Data analysis

Interview data and documents were thematically analyzed using the software MaxQDA following a "hybrid approach" that combined inductive and deductive coding for theme development (Fereday and Muir-Cochrane, 2006). Gilmour's keys to effective CBF served as our initial code manual. Inductive codes were then added to the manual as new themes were discovered in the interview or document texts. From this process, a code that captured the informants' descriptions of how economic factors affect CBF in Panama was created. Next, the coded segments were organized into a matrix to allow for comparisons and pattern matching across categories and informants. The perceptions of informants are summarized in Section 2.8.1.

2.2.4. Assumptions and limitations

When adopting a purposive sampling strategy to conduct case study research there is a need to explicitly address issues of bias and reliability. To enhance internal validity, we sought key informants from different roles, organizations, and experiences with CBF in order to capture an accurate picture of Panama's CBF system (Weiss, 1995). Our semi-structured interview guide was developed following the structure recommended by the United Nations Development Programme (2016). Construct validity was maximized by using Gilmour's six keys to structure the questions and analysis. Interviewer and confirmation biases were minimized through pre-testing the interview guide with two respondents, whose responses were then checked to ensure the questions were being understood as intended and not leading the participants' answers. Manually coding and analyzing the interview transcripts in MaxQDA made the analysis, including each step in theme identification, auditable and transparent. Reliability was also enhanced through data triangulation, which involved comparing the perceptions of informants from different parts of the system, comparing the study results to the results of similar studies in the CBF case study literature (e.g. Medina, Pokorny, and Johnson, 2009; Moktan, Norbu, and

Choden, 2016; Kamoto et al., 2011), and consulting studies from industry and civil society groups (e.g. de Jong et al., 2010; RECOFTC, 2016). Direct observation also provided an opportunity for data triangulation. The lead author observed CBF operations during field visits to multiple sites in eastern and western Panama between March 2017 and May 2017.

2.3. Results

2.3.1. Key 1: Tenure status

Many authors have highlighted the importance of communities having tenure rights to their local forests that allow them to make decisions regarding the use of the resource (Gilmour, 2016; Scherr, White, and Kaimowitz, 2003; Cox, Arnold, and Villamayor Tomás, 2010). In CBF projects, these rights should generally be "hard" rather than "soft," which means they should be embedded in formal law or regulation so that they are insulated from the shifting whims of the bureaucracy (Gilmour, 2016). In Panama, the tenure status differs between the pine plantations in the west and the natural forest in the east.

The pine plantations have remained state property and local communities are permitted to "make use of them" (NGO informant). CFEs, usually in the form of cooperatives, operate largely independently, but tend to directly involve a smaller proportion of the community in their daily operations. In addition to taking trees from the plantations, these CFEs are tasked by the government with reforestation duties.

> *"While it is true that we are trying to improve relations with Indigenous communities it is also true that we must have a little control to ensure sustainable forest management and ensure the sustainability of our forests." (Government informant)*

The tenure situation is more complicated in eastern Panama where the natural forest falls within the Embera-Wounaan *comarca*. Using Gilmour's terminology, the tenure rights here are "hard" rather than "soft" and very unlikely to be revoked. In accordance with the rules in the *Carta Organica*, the Indigenous law, the forests are communal property (Ministerio Público de Panama, 2015). However, forest management plans submitted to the government and contracts agreed to with timber companies are signed by the *noko*, the local community leader. Although

these communities possess "hard" tenure rights, they do not operate autonomously. All extraction is subject to approval by the government.

In addition to the established, state-recognized Indigenous territories, the comarcas, there are several more claimed Indigenous territories currently undergoing complex legalization processes (Vergara-Asenjo and Potvin, 2014). Should policy actors decide to significantly scale up CBF in this region, resolving the uncertain tenure status of forest-based communities will be essential. There are positive signs that such resolution is possible, with some agreements between Panamanian authorities and indigenous communities continuing to be reached ("Autoridades e indígenas Wounaan logran acuerdo," 2018)

2.3.2. Key 2: Regulatory framework

According to Gilmour (2016), the regulatory framework is the system of taxes and legal responsibilities related to planning, managing, and investing with which CFEs must comply. Following these procedures correctly can involve significant transaction costs which can limit the viability and competitiveness of CFEs (Adhikari and Lovett, 2006; Scherr, White, and Kaimowitz, 2003).

2.3.2.1. Adequacy of current framework

The 1994 Forestry Law is central to the regulatory framework in Panama. It was this law that first distributed extraction permits to communities, subject to the Ministry of Environment's approval of a Forest Inventory and a Forest Management Plan. An important part of this management plan is that communities develop a social investment strategy for the proceeds from extraction. Profits must be reinvested in community development activities.

> *"I think the regulatory frameworks are probably in place. Panama probably has fairly good laws already in place to be able to advance." (Academic informant)*

Informants were divided on the current regulatory framework's suitability for CBF. All recognized that CBF requires "favourable" laws to succeed, but some indicated the need for regulatory reform while others were satisfied with the current environment. The fact that the government has a sustainable forest management strategy and the community permit system was considered promising. However, the accessibility of these mechanisms was questioned.

"They need to change the law of forestry in order to incentivize people that work in reforestation or in management, to incentivize their actions […] because there's still a lot of requirements that communities might not be able to meet." (NGO informant)

2.3.2.2. Imposition of up-front costs

The most pressing concern raised by participants was the cost of developing management plans. Such plans require the technical and legal advice of consultants who must be hired to conduct forest inventories, define harvest rates, and ensure all legal requirements are fulfilled. This is a serious cost that generally needs to be paid up-front, before timber extraction can commence. Respondents noted that timber companies typically pay these costs in exchange for guaranteed low prices for timber once harvesting commences. Communities often have little leverage in this situation and may have to accept below-market prices for their timber resources. This situation was seen as limiting the potential revenue of CBF projects, a result that is exacerbated by further taxes and fees on the extraction of wood and the submission of the management plan to the government.

"It's absolutely nonsense, the cost of an environmental impact assessment. Each year you have to submit a closing plan which requires water quality information that you have to provide to the government, field trips, a bunch of paperwork that you have to submit each year after you finish your harvesting cycle. And a number of taxes that you have to pay." (NGO informant)

Some of our informants noted that the government is aware of the burden such fees place on communities and that reform is possible. Almost all spoke about increasing financial incentives for CBF as a necessary next step. Compliance costs were identified as needing to be reduced so that CFEs can compete with alternative sources of timber from illegal logging or land clearing for agriculture. Panama's forthcoming *"Alianza por el Millon de Hectareas"* ("Alliance for a Million Hectares"), a reforestation program developed with an eye towards accessing REDD+ funds and complying with national commitments made in the Paris climate agreement, was often referred to by our interviewees as a potential fund for sustainable forestry incentives. The exact mechanisms by which this could be realized, however, remained unclear.

2.3.3. Key 3: Strong governance

Governance of CBF regimes typically takes place at multiple levels (Gilmour, 2016). Locally, fair and effective CBF requires inclusive and deliberative processes, norms, and strong leadership (Gilmour, 2016). Higher-level governments must also be supportive and responsive to the dynamic needs of CBF programs (Gilmour, 2016). Finally, all these rules must be enforced (Tacconi, 2007; Kaimowitz, 2003).

2.3.3.1. Lack of enforcement capacity

Our informants were generally most skeptical of CBF's ability to succeed in Panama when discussing issues related to enforcement. In particular, they questioned the government's capacity to enforce laws to stop illegal extraction and ensure proper management of CBF funds.

> *"The laws as such are fine, the detail is compliance with them and the mechanisms for this are not yet adequate." (Academic informant)*

Very little of the wood extracted in Panama is certified by third parties like the Forest Stewardship Council, which closed its office in Panama in the mid-2000s. Ensuring that timber is harvested legally remains a core responsibility of government officials and forest engineers working in the field. Multiple participants reported that these checkpoints are easily by-passed by companies.

> *"Plus, you pay people from the Ministry of Environment minimum wage. One of these trucks goes by and will double or triple their monthly salary with one truck… why are you going to stop that truck, if it gets in the way of your livelihood?" (Academic informant)*

The Panamanian government has recently implemented a modern timber-tracking system meant to combat deforestation and illegal wood harvesting (Ministerio de Ambiente, 2018). While supported by WWF, FAO, and the International Tropical Timber Organization, the system's effectiveness is unproven.

2.3.3.2. Systemic corruption

Systemic corruption was described as a serious and persistent challenge. For example, companies that harvest timber illegally by carrying out "backroom dealings" at the community level and

then paying regional enforcement officials to overlook this at checkpoints were reported. Without the risk of formal penalty, such illegal logging, free from the constraints of management plans and harvest limits, is very profitable.

> *"One of the biggest failures that we've had is that illegal harvesting of wood is very profitable. … It has made us fail in a lot of the sustainable forestry projects, because nobody wants to do it sustainably. On paper they want to, but in reality they are doing also illegal logging." (NGO informant)*

Governance inside the comarcas, Panama's Indigenous regions, was also described as a challenge. Program administrators and industry representatives alike noted that uncertainty in contract compliance and fund management can make industry actors reluctant to do business with Indigenous communities.

> *"Sometimes in the communities different parts appear within the same group and that starts to create conflict, and that creates unnecessary delays and expenses in the process. That is a troubling part when one does business with the communities." (Industry informant)*

Some informants connected this with a "clash of worldviews" and wider problems of ongoing discrimination in Panama against Indigenous people. Others thought that a bottom-up strategy of empowering communities to demand more of their leaders was the best solution.

> *"At the end of the day there are community directors who give in to the temptation of the resources, of the income that the community is generating, so they use the money capriciously, they waste it, they don't follow up on their promises of development works; for that reason, we're asking the communities to be more vigilant and to demand of the directors that they be accountable." (NGO informant)*

2.3.4. Key 4: Market knowledge and access

When selling their products CFEs need to compete against both other domestic producers and international exporters. To successfully commercialize their products CFEs need market

knowledge, defined broadly as “information on market trends, prices and value chains,” (Gilmour, 2016, p. 88) in addition to market access.

2.3.4.1. Lack of market knowledge

Informants reported that most Panamanian CFEs lack knowledge required to compete in markets. Without knowledge of international timber markets, CFEs often cannot know the going market rate for their timber. Because of this, different communities in Panama sell their timber for vastly different prices, with some communities securing prices three or four times higher than others.

2.3.4.2. Geographic and cultural divides

Market access can also be difficult for geographic and social reasons. The communities in eastern Panama are remote, often not connected by good roads. Harvesting activities are extremely difficult or impossible when it rains and the ground becomes muddy. Several participants also mentioned cultural divides, with Indigenous groups separated from markets by language barriers and systemic discrimination.

2.3.5. Key 5: Viable technology

Gilmour considers viable technology as to be both the physical capital and the technical knowledge needed to successfully set up and operate harvesting. Scientific or traditional knowledge is required to sustainably manage forests and business skills are needed to produce, market, and distribute products. Gilmour also notes that CFEs can serve multiple functions in their communities, requiring a range of skills. This appeared to be the case in Panama, where the proceeds of CBF activities are needed to fund community development projects and where, especially in the west of the country, CFEs are often set up as cooperatives that operate stores and provide other services in their communities.

2.3.5.1. Need for stable, formal capacity-building programs

Our respondents were divided on the state of this key in Panama. Integration with the established Panamanian forestry industry means that equipment and harvesting knowledge are available to communities, albeit at a cost. Yet there was also a clear need for capacity-building in both science and business at the community level. Several informants reported resource degradation in the past due to overexploitation stemming from a lack of ecological knowledge in local

communities. Others reported business failures from a lack of knowledge about marketing or commercialization. In response, there were calls for more formal training programs in CBF. Existing capacity-building programs were reportedly run by civil society organizations like WWF, the Panamanian Cooperative Institute, or the Catholic Church. These programs differed in their effectiveness and were not considered sustainable in the long term. CFEs therefore need to be able to operate autonomously, both in the field and in the market.

> *"There has to be a formal program that provides technical assistance to the communities, because at the start a lot of technical assistance is needed; if the communities don't have the opportunity to have that technical support, well, it will be very difficult; the possibilities are limited" (NGO informant)*

2.3.5.2. Panamanian cultural effects

Wider trends within Panama affect technical capacity at the community level. Almost all informants reported a general lack of interest in forestry, or "forestry culture," in Panama, leading to a gap in the supply of qualified forest technicians. One government informant called this the "great challenge" for sustainable forestry in Panama. Recent efforts on behalf of the government and the Technological University of Panama to start a new Forestry Engineer training program attest to this need. Some participants, while noting the technical capacity gap, were confident that it could be bridged by new training and education measures.

> *"We are requesting more staff because practically the staff we have is very small and the engineers that are here are almost in the final stretch [of their careers]. So we need a generational hand-off." (Government informant)*

2.3.6. Key 6: Supportive bureaucracy

Gilmour writes that, because CBF is so sensitive to an "unfriendly" regulatory environment, it cannot thrive in a country without a supportive and responsive bureaucracy that is willing to entertain community concerns, adapt rules accordingly, and enforce those rules. The bureaucracy also should be willing to support decentralization processes that shift power and decision-making authority (Gilmour, 2016).

2.3.6.1. Government interest

Most of our informants were positive about the state of this key. The Panamanian government has launched consultation procedures to inform its regulatory reform of state forestry laws. Additionally, it has supported efforts by WWF and FAO to pilot new CBF projects in the country, albeit only after seeing positive results.

> *"We are working on updating the forest law, always looking for sustainable forest management. The recent administration that [came into power] in 2014 started the process to create the Directorate of Forest Management, to play a larger role in the primary regions of Darién and Panama where we are practically left without forests for production." (Government informant)*

Several informants did raise issues relating to the bureaucracy's involvement. They also noted that the relatively small role forestry, and especially CBF, plays in Panama in terms of employment and state revenue limits the size of the government's stake in its success.

> *"Just looking at the numbers, they aren't paying much attention to you because forestry … is not seen in the income of the state as something big." (Industry informant)*

> *"If one looks at government plans the concept of community forestry as a government action does not appear anywhere. We have even found that there are officials from the Ministry of Environment who find it hard to believe that communities are capable to doing what we now understand to be community forestry." (NGO informant)*

2.3.6.2. Is the bureaucracy motivated long-term?

There were also concerns related to policy instability and the historical relationship between the bureaucracy and communities, particularly Indigenous communities.

> *"I think it will still be difficult for us to do things properly … Because politicians do not have a solid vision, a vision in support of the Indigenous people rather than seeing them as a hindrance. They think that the Indigenous people will have too many forests without producing from them … and they don't share any values.*

I think it will be difficult for us to reconcile those two worlds." (Academic informant)

The timing of the renewed government interest in CBF was also considered strategic, coinciding with the development of the "Alliance for a Million Hectares" reforestation program and Panama's REDD+ readiness procedures. It remains to be seen whether the bureaucracy will continue to invest in CBF development if REDD+ financial incentives not be as large as anticipated. Some informants also expressed concern about the potential for perverse results from incentive programs. They reported that in the past, for example, teak reforestation incentive schemes were exploited by wealthy land-owners for personal gain, leaving stands of ignored, stunted teak trees.

2.3.7. Emergent Key: Economic Viability

Many informants were concerned with economic competitiveness of CBF programs. During the coding process, these concerns did not seem to fit with any of Gilmour's keys. The amount of business knowledge or skill possessed by a community was separated from the market opportunities open to it. Therefore we added a seventh code to our codebook, labelled 'Economic Viability.' Informant contributions that spoke to market competitiveness and economic sustainability were brought together under this theme.

2.3.7.1. Ability of CFEs to break into markets

Many of our key informants reported that CFEs struggle to compete with industrial producers. Their smaller scale limits their ability to benefit from economies of scale and the need to meet sustainable management requirements limits the amount of product they can harvest in any given year. Instead they may have to rely on certain consumers being willing to pay more for sustainably-sourced products.

"[CFEs] can't compete. […] the opportunities that the communities do have are to access a market in which the other people are prepared to pay for [the forestry products] because they come from a community, and because they want to support the community, and because the community is doing conservation work." (NGO informant)

However, predictions of market premiums for sustainable-certified products have not usually been fulfilled (Butterfield et al., 2005). In Panama specifically the market has been, to this point, negligible (Miyata, 2007). As a result, sustainable wood certification is not prevalent in the country. As reported by government and NGO informants, as well as Ordoñez et al. (2011), the first formal CBF programs in 1994 enjoyed significant government and institutional support and oversight. This encouraged and enabled the CFEs to have their wood certified as sustainable by an independent third party. Over time, though, this certification was lost and only one CFE is reported by industry informants to have regained it.

Several participants mentioned the importance of integrating CBF with other economic activities. Some spoke of a "landscape vision," i.e. encouraging other activities like agroforestry and non-timber forest product development alongside CBF work. In the end, CBF was described more as a source of income that complements money and food production from other activities in the community. This is consistent with the results of several other studies that have investigated the size and distribution of incomes from CBF (Meshack et al., 2006; Mokten, Norbu, and Choden, 2016).

2.4. Discussion

2.4.1. Status of the Six Keys to Effective CBF in Panama

Based on our case study analysis, at this time none of the keys to effective CBF can be said to be fully present in Panama. Our evaluation for each key is summarized in table 2.2. These results suggest that CBF's ability to act as a vehicle for sustainable rural development and forest conservation may be limited.

CBF operations across Panama face very different tenure situations. The western pine plantations, first planted in the 1970s, are found both in and outside of the *comarca* Ngabe-Bugle. In all cases, though, they remain state property, with management and commercialization rights assigned to local CFEs on a case-by-base basis. Nevertheless informants indicated that these CFEs enjoy a high degree of autonomy and are generally free to pursue a variety of land management strategies, subject to government approval of management plans.

As legislated in the *Carta Organica* of the *comarca* Embera-Wounaan (*Ley 22 de 8 de noviembre de 1982*), the natural tropical forests in the east of the country are collectively owned by the Indigenous people within whose territory they fall. Communities are responsible for local forests, and in some cases nearby communities cooperate in preparing and implementing management plans. Although national government officials must approve the management plans, communities are usually able to pursue a range of conservation, agriculture, or forestry goals.

Several Indigenous groups have outstanding territorial claims that are in the process of adjudication under Law 72 (Vergara-Asenjo and Potvin 2014). However, Panama has a constitutional commitment to recognize Indigenous land rights, legal mechanisms to resolve land claims, and five *comarcas* with their own governance structures. These factors contributed to Ortega's (2004) classification of Panama's Indigenous legal frameworks as "superior." Few of our informants felt that secure tenure was a barrier to effective CBF implementation in Panama.

The 'supportive bureaucracy' and 'enabling regulatory framework' keys are closely connected. True devolution of forestry decision-making to communities often faces political and bureaucratic opposition (Baynes et al., 2015; Gauld, 2000). In Panama, while the existing regulatory framework's acknowledgement of CBF and community permits is constructive, a high degree of centralization is also maintained. Especially at the beginning, immediately following implementation of the 1994 Forestry Law, the national government was closely involved in CBF projects at the community level. While its involvement at the time of our study was, as described by informants, more at the regulatory level, there remained indications that the national government was reluctant to fully decentralize management authority. Officials in Panama reported a sense that communities need to be monitored because without government oversight, unsustainable harvesting is inevitable. Although this belief may be accurate in certain cases, it leads to stricter legal obligations for communities. This increases compliance costs which negatively impact CFEs' market competitiveness (Scherr et al., 2003; Adhikari and Lovett, 2006). At the same time, reluctance from policy-makers to devolve decision-making to communities has been well-documented in other case studies of forestry decentralization (e.g. Gauld, 2000). Forestry officials, in Panama as in many other countries, are technically proficient biologists and engineers but not specifically trained in community development.

At the community level, our analysis indicates that the ‘secure tenure’ and ‘viable technology’ keys are partially present while serious deficiencies remain in attaining the ‘strong governance’ and ‘adequate market knowledge’ keys. Communities whose tenure claims have been resolved now control management of their forests and, with the help of industry and development actors, can commercialize their timber. However, whether the technical capacity needed for efficient and sustainable management is present, or can be built, is an open question. Investments so far by NGOs (chiefly WWF and FAO) have managed to get many CFEs started, but communities remain heavily-dependent on funds and technical direction from the agencies. Such dependency has also been observed in other contexts (see Pokorny and Johnson, 2008 and Medina, Pokorny, and Johnson, 2011). At the time of writing there were no indications that the government was planning to invest in supporting CFEs through long-term, formal training programs in Panama. Neither was there an indication that the existing governance structures in rural forested regions can reliably enforce laws and address claims of corruption. Without those steps, CFEs are likely to be outcompeted by illegal forestry operations which harvest timber more cheaply and in greater volumes.

Table 2.2: Summary of the keys to effective CBF

Key	***Status***	***Summary***
Secure tenure	Partially present	Communities' right to forest within comarcas is recognized. Pine plantations remain state property. Several claimed Indigenous territories have not been formally adjudicated.
Strong governance	Absent	Government and community capacity to enforce laws regarding tenure and sustainability is severely lacking.
Adequate market knowledge	Absent	CFE operators lack key management and business skills and knowledge. External organizations are attempting to provide training and information but these efforts are small.
Viable technology	Partially present	CFEs can harvest, usually with the help of industrial partners. Technical skills are still lacking and there is no formal program to build them.
Supportive bureaucracy	Partially present	The government is motivated to change practices and reform the forestry regulatory framework. However full devolution of decision-making responsibilities is resisted.
Enabling regulatory framework	Partially present	The community permit system reflects a willingness and desire for community-based forestry, but associated costs and taxes are prohibitive.
Emergent key: Economic viability	Absent	Most CFEs currently struggle to compete against industrial competitors and develop businesses without external assistance.

The Panamanian government has good intentions and the civil society is enthusiastic, but in promoting CBF both work against wider socioeconomic trends. These include Panama's unique socioeconomic context and a chronic capacity gap in forest law enforcement. Forestry is negligible as an economic driver in Panama's economy, which is dominated by global services like banking and shipping (ECLAC, 2017). Our key industry informants describe Panamanian forestry as an industry in decline, uncompetitive in a globalized market. This may help to explain many of our informants' other concerns: that the government is not willing to commit many resources to effectively enforce regulations in a sector that does not bring in much revenue; that the populace does not know much about sustainable forestry and so does not demand it; and that few young people are interested in pursuing forestry-related careers. External investors have many other opportunities and global timber markets are not well networked in the country. Without a diverse array of financing options, communities were reported as relying on NGOs or forestry companies to pay start-up costs. This leads to dependence in the former case and exploitation in the latter, neither of which serves the vision of CBF.

There are reasons for optimism with an interested government, committed civil society, and the prospect of increased funding through international carbon-offset mechanisms. The latter point may prove vital. All informants talked about the potential for new incentive schemes to facilitate CBF expansion by providing new investment opportunities. In other contexts, strong financial incentives from international funding have accelerated formal CBF adoption (Pagdee, Kim, and Daugherty, 2006; Gauld, 2000). A primary challenge will be to find a way to make CBF attractive to investors and consumers in a context where regulatory and technical capacity in forestry is scarce.

2.4.2. Future directions

Panama is far from the only country struggling to successfully implement community forestry. Many countries in Latin America have attempted formal forestry decentralization since the early 1990s, yet few have achieved their stated social, environmental, and economic goals (Larson et al, 2007; de Jong et al, 2010; Sabogal et al, 2014). Across the globe there is a persistent and worrisome gap between CBF theory and practice (Charnley and Poe, 2007; Tole, 2010). Science, policy, and practice in the field remain poorly connected, which partly explains the dearth of improvements in "field practice" and "policy discourse" (Gilmour, 2016). As a result, "more

time and effort are required for CBF to reach its potential in most countries" (Gilmour, 2016, p. 111).

It is important to note, though, that CBF policies are developed by actors within governments with their own incentive structures. These actors operate within a policy environment where decisions must be made with incomplete information, in unstable circumstances, and on short deadlines. There is no guarantee that more information will lead to better policies (Underdal 2010; Armitage et al 2009). In Panama, for example, government informants spoke about how new legislative initiatives like the "Alliance for a Million Hectares" or supranational programs like REDD+, neither of which existed when CBF policies were first being developed for the country, greatly affected their decisions in designing new CBF policies. For these reasons, we contend that actors interested in expanding and improving CBF policies must take new approaches in their work.

Advocates of CBF in Panama might better focus their attention and resources on "leverage points" where interventions can be highly impactful (West et al 2014). Our analysis highlights CFEs as both an important and underperforming aspect of CBF in Panama. CFEs play a crucial role in developing the economic benefits of CBF and distributing them in the communities, but lack technical and managerial capacity. Closing this capacity gap is a priority. Local capacity is needed for effective local management and resilience to economic, political, and environmental shocks (Barnes et al 2017; Underdal 2010; Larson et al 2007). Reliable investments in capacity building could also be helpful, perhaps building on the past efforts of the WWF and the Panamanian Cooperative Institute. However, more research at the community level is also needed to better understand how current capacity-building programs are falling short and how future investments can be made more effective.

Efforts to address corruption and enforce forest-related rules in rural areas are another possible leverage point for CBF in Panama. Informants noted that stemming the trade in illegally-harvested wood would make CFEs more competitive, build trust between the government, communities, and consumers, and ease pressure on forest communities from the threat of territorial incursions. Field-based enforcement has been a key component of efforts to curb illegal forest activities in other tropical countries like Brazil (Börner et al., 2014). Such measures, if not applied carefully, can have drawbacks in the form of physical threats, job losses, and

community political disenfranchisement (Kaimowitz, 2003). However, these threats can be mitigated by focusing enforcement efforts on large violators or on laws that favor community producers.

Future research could seek to understand what kind of enforcement actions are most likely to benefit and not harm CBF projects. Third-party wood certification or modern tracking systems may play a role by making it more difficult to bring illegally-harvested wood to market (Asia Network for Sustainable Agriculture and Bioresources, 2010). Some informants hoped certification would allow communities to access premium markets. For this reason, trying to raise consumer awareness or change consumption patterns in Panama was suggested as a possible next step. These information campaigns, though, have had limited success in comparable cases (Verplanken, 2011; Butterfield et al., 2005).

On a broader scale, the influence of teleconnections, i.e. underlying social and ecological drivers, should be considered (Chapman et al 2017; Liu et al 2007). This concept has been used to help explain shifts in tropical deforestation drivers from rural population growth to market globalization (Cardille and Bennett, 2010). In our research, multiple informants worried about the Panamanian forestry industry's reliance on stochastic markets in Asia and vulnerability to competitors in North and South America. Regulatory processes, subsidies, and institutional supports are also volatile. Problems arose in the mid-2000s, for example, when a sudden shift in foreign aid priorities in the USA led to the failure of USAID-supported CBF operations in Panama. In practice it is not possible to accurately forecast the future socioeconomic landscape in which CBF programs will operate. Instead, practitioners should consider an "envelope of possible futures" (Costanza 1993, p. 579) and develop contingency plans. Such planning will draw on the already-stretched resources devoted to developing CBF, but are likely crucial for making CBF programs more resilient.

2.4.3. Reflection on Gilmour's Framework

The factors affecting CBF success are highly interrelated. Bureaucratic attitudes shape the strength of community tenure security and regulatory requirements. Weak governance and rule enforcement in the field affect the market realities with which communities must contend. Our analysis found the six keys identified by Gilmour useful in navigating this complexity. However, our iterative coding method also identified a theme of informant concerns not captured by

Gilmour's keys. Many informants referred to the economic competitiveness or viability of CFEs as an important condition for CBF's success in Panama, which relates to several of the keys, including the regulatory framework and market knowledge. However, the influence of broader economic forces such as international timber markets and domestic support for the forestry industry did not seem to be well-captured by any of original keys. For that reason we included a seventh, 'Economic Viability' key in our coding guide.

Gilmour uses the metaphor of an obtainable key to represent the policy conditions required for successful CBF. A challenge with this framework that emerged during our analysis is that it is difficult to establish whether or not a key has been obtained. Informant perspectives varied widely. Even after considering informant biases and consulting reports and legal documents, the status of four of Gilmour's six keys is best summarized as 'partially present' (see Table 2.2). This partly stems from the complexity of CBF programs, which operate at multiple scales. For example, evaluating the 'secure tenure' key requires the analyst to consider both national-level policy frameworks and local-level realities. Panamanian legal frameworks recognize Indigenous tenure rights and processes exist to resolve land claims, but tenure security varies widely between different territories. This makes it misleading to say the key has been obtained, but too pessimistic to say that it is absent.

Such uncertainty is an inherent property of multi-scalar natural resource management systems (Rammel et al. 2007). It is important to consider local contexts as similar policies may lead to significantly different outcomes in different biophysical and institutional settings (Ostrom and Cox 2010). Recognizing this, it may be helpful to see each condition as a continuous rather than discrete variable. Perhaps a more descriptive metaphor could represent the conditions as 'meters' to be filled rather than 'keys' to be obtained. As policies are developed, adopted, and implemented, the meter can be filled. Sub-goals designed for tracking progress at multiple scales could potentially be set beforehand. Furthermore, since CBF policies are often dynamic, involving learning and adaptation at both the national and local level (Underdal, 2010; de Jong et al., 2010), the meter metaphor may allow for the back-and-forth, halting nature of policy implementation to be better captured.

Overall, we found the framework useful, especially as a starting point for designing our interview coding guide. Gilmour recognizes that his framework is "somewhat reductionist",

noting that his goal was to make it "workable" in order to stimulate discussion among practitioners (Gilmour, 2016, p. 79). Our experience suggests that an enhanced version of Gilmour's framework could be used to generate a deeper, yet comprehensible, snapshot of a country's CBF policies.

2.5. Conclusion

Community-based forestry faces some difficult challenges to realizing full and effective implementation in Panama. Costs are high; investment is unreliable; the market is not easily accessed. If CBF cannot fulfill the promise of a "greener revolution" (Agrawal and Lemos, 2007) for Panama, is it still worth pursuing? Our analysis suggests so. One NGO informant described the positive changes that even small CBF programs have brought remote communities in Panama:

> *"15 years ago one saw in the communities that the houses were falling down, and today in the communities where there is active community forestry one can see that there have been improvements in the community infrastructure, in the homes, there weren't roads before and the people now have the possibility to use some low-impact roads, to do their business selling their agricultural products."*

This is especially promising considering that we could not identify any of the six keys to effective community-based forestry as fully present in Panama; there remains room for improvement. A commitment to local capacity-building, together with a focus on financial incentives to level the playing field for CFEs, could address multiple issues at once. With that, Panama could take another step on the rocky path towards "successful" implementation of community-based forestry.

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2.8. Additional tables and figures

2.8.1. Summary of informant perceptions

The perceptions of the informants regarding Gilmour's six keys are summarized in Table 2.3. The theme of "economic viability," which emerged during interview coding, is included. The "secure tenure" key is omitted from the table because fewer than half of the informants were knowledgeable about the communities' tenure status. Three informants, one each from the government, NGO, and academia groups, are also omitted due to a lack of data across all themes in their responses.

Table 2.3: Summary of informant perceptions

		Themes					
		Enabling regulatory framework	Strong governance	Viable technology	Adequate market knowledge	Supportive bureaucracy	Economic viability
Informants	Government 1						
	Government 2						
	Government 3						
	Government 4						
	Government 5						
	NGO 1						
	NGO 2						
	NGO 3						
	NGO 4						
	NGO 5						
	Academia 1						
	Academia 2						
	Academia 3						
	Industry 1						
	Industry 2						

Legend

= Informant indicated key is currently present

= Informant indicated key is not currently present but thought it would be obtained

= Informant indicated key is not currently present and did not think it would be obtained

Preface to Chapter 3

Chapter 2 identifies a number of CBF challenges that are common to other contexts, including government suspicion towards devolution and communities struggling to obtain benefits. The seeming intractability of these issues and the persistent gap observed between CBF theory and practice has led to calls for researchers to shift from "promotion to critical analysis" of CBF internationally (Arnold, 2001) in order to move the field forward. Has there been a response to this call? Seeking to answer this question, in Chapter 3 I explore how the topics addressed by available CBF research literature have changed since 1990.

Chapter 3: Using a Structural Topic Model to Assess Changes in Community Forestry Research

Abstract

How is community-based forestry (CBF) research changing as CBF policies mature around the world? In this research note we use bibliometrics and topic modelling to display trends in the geographic focus and research topics present in CBF-related research papers published between 1990 and 2017. We find that studies of CBF in South Asia make up a substantial proportion of the literature, although CBF research in Africa, Southeast Asia, and Latin America has also advanced. Our structural topic model found four major research areas and 20 topics latent in text of the abstracts analyzed. The trends of topic proportions over time provide evidence of a general research shift from broad policy reform to local outcomes and show the influence of a growing interest in carbon sequestration. These results provide a 'snapshot' of the important topics in CBF research and demonstrate the potential of topic models to provide useful insight to scientific literature.

Keywords: bibliometrics; topic modelling; community-based forestry

3.1. Introduction

How has community-based forestry (CBF) research been changing as CBF policies mature around the world? Formal CBF, referring to "initiatives, sciences, policies, institutions and processes that are intended to increase the role of local people in governing and managing forest resources" (Center for People and Forests, 2013), is now responsible for managing more than 732 million hectares of forest around the world (FAO, 2015) and represents a "major modality" of global forest governance (Gilmour, 2016). Academic researchers have long played an important role in designing and advocating for CBF policies (Charnley and Poe, 2007). Several researchers, however, have called for CBF research to focus more on understanding the function of CBF policies and addressing the weaknesses that have arisen (Arnold, 2001; Tole, 2010; Bowler et al., 2012; Gilmour, 2016). In this research note, we assess how CBF research has changed as CBF policies have spread around the world. We apply bibliometric analysis and statistical topic modeling to a database comprising the abstracts of 1,112 CBF-related research papers published between 1990 and 2017 to explore trends in the geographic focus and prominent topics of research.

3.2. Methods

3.2.1. Data collection

We developed a database of all abstracts returned by searches on Scopus and Web of Science (WoS) using the terms "community forestry", "community forest management", or "community-based forestry", resulting in 1,481 unique entries. We then removed articles addressing "urban" forestry and articles whose abstracts did not mention "communities," "decentralization," "smallholders," or "local management", resulting in a final database (corpus) comprising 1,112 entries. These entries were limited to journal articles published in English and excluded most books and government reports as they are generally not indexed by WoS or Scopus. Nevertheless, the volume of data returned by our search includes the majority of CBF-related research publications over the study period and was deemed adequate to reflect the general trends of CBF research.

Once the corpus was finalized, each article was reviewed and manually coded with location data. For each article that presented a case study of, or used data from, a single country, the country

was recorded. Articles that compared multiple countries were coded as "Multiple." Articles that presented meta-analyses or literature reviews were coded as "Review." All other articles, i.e. those lacking a specific geographic focus but presenting original research, were coded as "Theory." Finally, a "Region" variable was recorded for each article, grouping the different countries into larger geographic regions.

3.2.2. Data analysis

Topic modelling was used to extract latent topics from the text-based data. Documents in the corpus were first considered as collections of words. Then, co-occurring words were identified to reflect the underlying themes that the author of each document sought to address. We used Roberts, Stewart, and Tingey's Structural Topic Model (STM) package for R. STM uses a Latent Dirichlet allocation (LDA) model where each document in a corpus is represented as a multinomial distribution across the set of topics in the corpus, and each topic as a multinomial distribution over the set of words in the corpus (Roberts, Stewart, and Tingey, n.d.). Highly related words indicate a topic's theme and associations (Mohr and Bogdanov, 2013). The STM package is particularly useful for topic modelling because it assumes that topics can be correlated with each other and that their distribution over the documents is structured by some observed covariates (Roberts, Stewart, and Airolid, 2016). Blei (2012) gives a more in-depth, but still accessible, overview of topic modelling.

Our data were organized in a comma separated values file with each row recording an article's abstract, publication data, and location data. The STM package was used to process and analyze data. The *textProcessor* function, for example, removes punctuation and words appearing in fewer than five articles and "stems" words. Stemming ensures that terms like "manage," "management," "manager," and "managing" are all contained in the token "manag". After processing, the corpus comprised 2,358 terms and 81,563 'tokens'. Since STM is capable of processing millions of words at a time, this is a relatively small database. However, other authors have presented meaningful findings from databases of similar size. Bohr and Dunlap (2017), for example, built a topic model for the environmental sociology literature using 815 abstracts.

Finally, a model was estimated using the STM function. STM requires the analyst to specify a certain number of topics (*K*) before model estimation. Although there is no "best" number of

topics for a given corpus, several metrics exist to guide *K* specification. A "semantic coherence" score serves as a reasonable approximation of topic interpretability. When the most probable words for each topic often occur together within documents, the model will score highly on semantic coherence. "Topic exclusivity" scores are used to find models in which highly-frequent words are divided across multiple topics. In practice, model selection is an iterative process. Multiple models are run and the most sensibly interpretable one is then chosen by the researcher (Bohr and Dunlap, 2017). Semantic coherence and topic exclusivity suggested a model of approximately 20 topics for our corpus. After running models for Ks of 16 through 24, the 20-topic model was selected for additional analysis.

3.2.3. Assumptions and limitations

The data export capabilities of Scopus and WoS make it easy to construct a comprehensive database of research abstracts, but cannot be used to gather full research papers. Our analysis therefore assumes that useful information about a paper's research topics is present in its research abstract. Although previous research has used the abstracts of papers to construct topic models (e.g. Griffiths and Steyvers, 2004; Bohr and Dunlap, 2017), we recognize that abstracts may be inconsistent with the text of the full paper (Pitkin, Branagan, and Burmeister; 1999). However, Griffiths and Steyvers (2004) note that one of the main purposes of an abstract is to inform readers of the topics addressed in a paper, and there is evidence that research topics are usually presented in abstracts (Dos Santos, 1996). Nevertheless it should be noted that the model presented here strictly represents topics present in the abstracts of the papers gathered through database searches.

It is also important to keep in mind the nature of the topics generated by topic model. In these models a topic is defined as a "distribution over a fixed vocabulary" (Blei, 2012). Mohr and Bogdanov (2013) describe it as the "constellation of words that tend to come up in a discussion". Topics represent "hidden structure" in documents, which are assumed to have been generated by selecting topics to write about and then selecting words associated with those topics (Blei, 2012). The reliability of these models depends on the concordance between the hidden linguistic structure they represent and the thematic patterns in which we are interested (Blei, 2012). To enhance validity, models are generated iteratively and models with "substantive interpretability" are selected for further analysis (DiMaggio, Nag, and Blei, 2013). Model selection is also guided

by metrics such as a semantic coherence score, which has been shown to reflect human judgements of topic quality (Chang, Gerrish, Wang, Boyd-Graber, and Blei, 2009; Mimno, Wallach, Talley, Leenders, and McCallum, 2011). However, Roberts et al. (2014) caution that such models do not replace human judgement. The insight provided by the model is maximized for readers who are already familiar with the literature under examination. The value added by a topic model is the ability to quickly analyze large sets of documents and compare the results against a researcher's theoretical expectations (Blei, 2012; Roberts et al., 2014).

In this paper, the topics are presented and then labelled. Those labels, meant to enhance data visualization, are our thematic interpretations of the words that were highly associated with each topic and were not generated by the model itself.

3.3. Results

3.3.1 Growth of CBF research

Based on our results, CBF research has expanded greatly around the globe, especially since 2000. Figure 3.1 shows the cumulative articles published for each region since 1990.

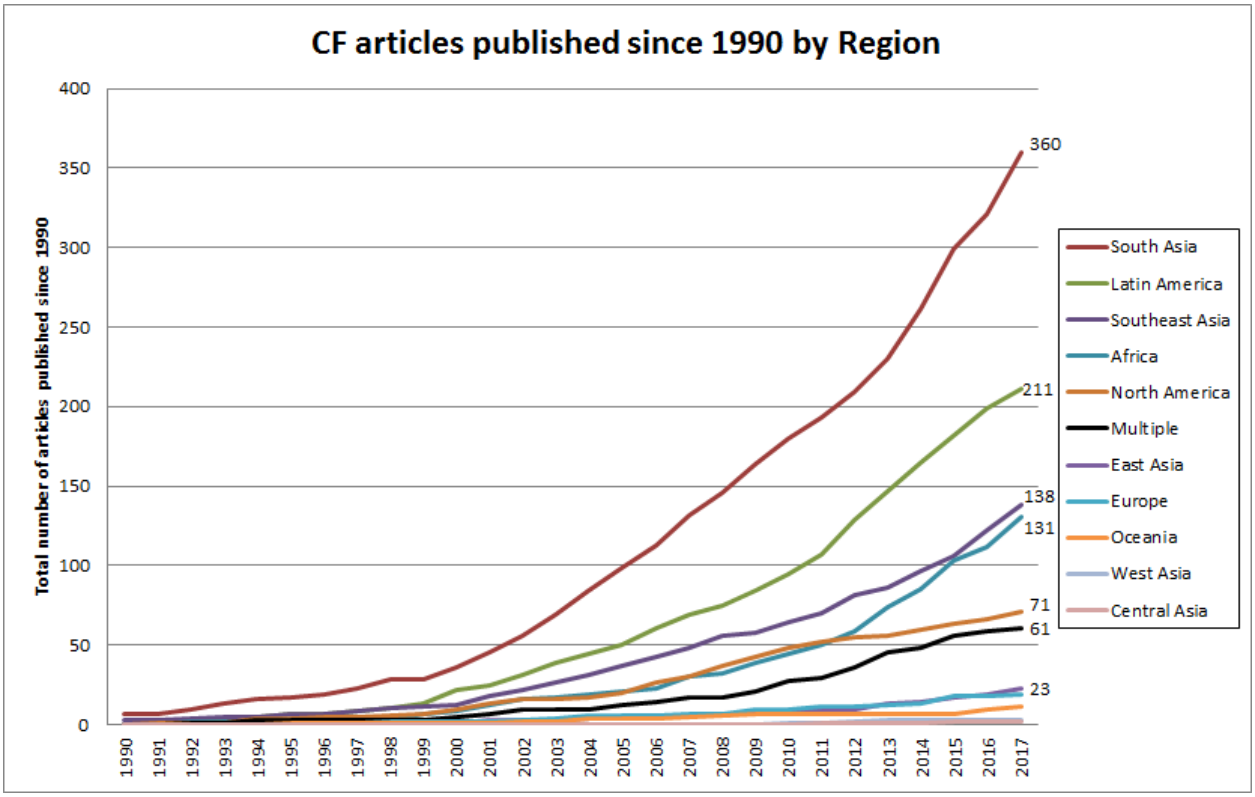

Figure 3.1: Total number of CBF articles published by region

South Asia is the focus of more than twice as many papers as any other region except Latin America. The gap between CBF research in South Asia and the other regions has continually widened, with a noticeable increase in the rate of publications since 2013. Both Latin America and Africa have been the focus of more articles in the last five years, with, respectively, 211 and 131 total studies published as of 2017. Southeast Asia is the only other region with more than 100 studies documenting CBF outcomes in the region. These data also show a decline in the rate of publication of North America-focused studies, with just 16 studies published since 2012.

Overall, annual CBF research, as measured by articles published per year, has been increasing polynomially since 1990 (see Figure 3.2). The rate of output shows noticeable jumps in the years 2000 and 2012. 2015 and 2017 were the most productive years.

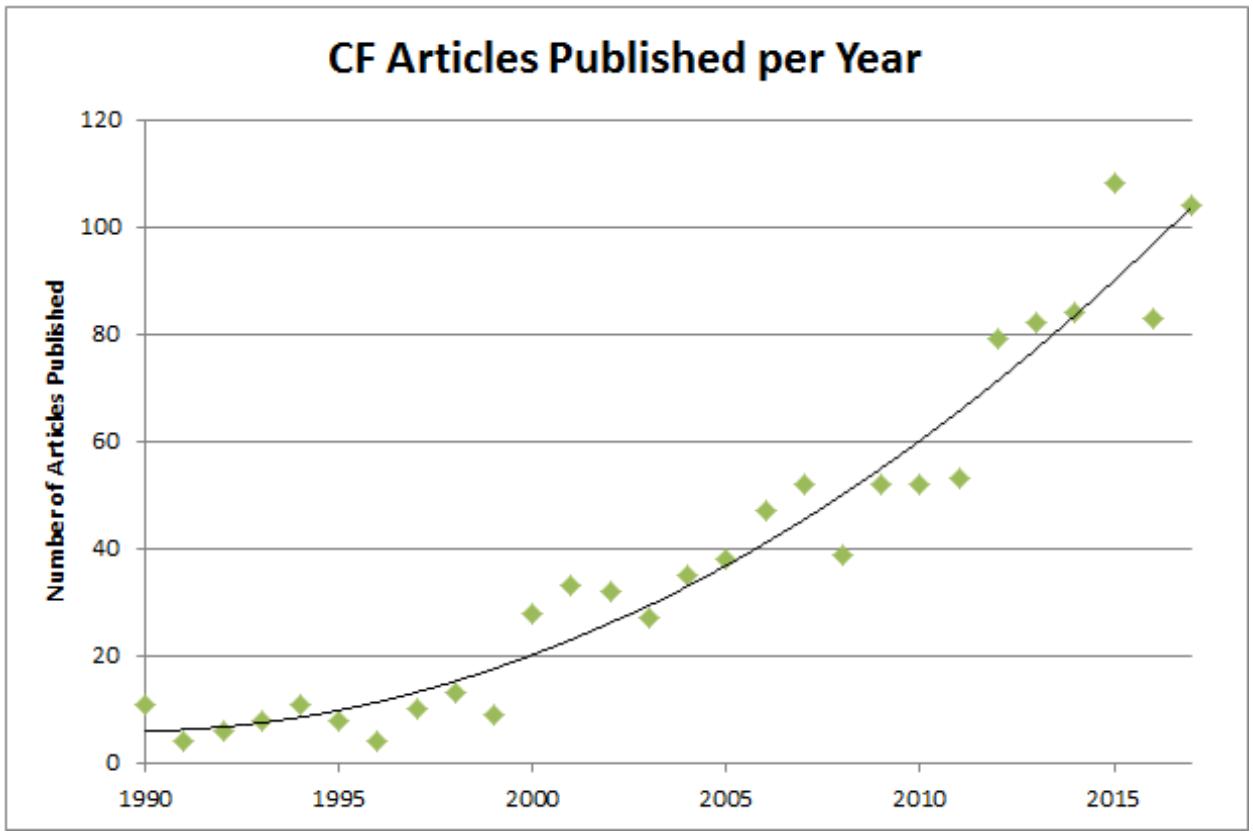

Figure 3.2: Total number of CBF articles published per year

The number of published articles without a geographic focus has also consistently increased since 1990, with review articles increasing, particularly since 2010 (Figure 3.3).

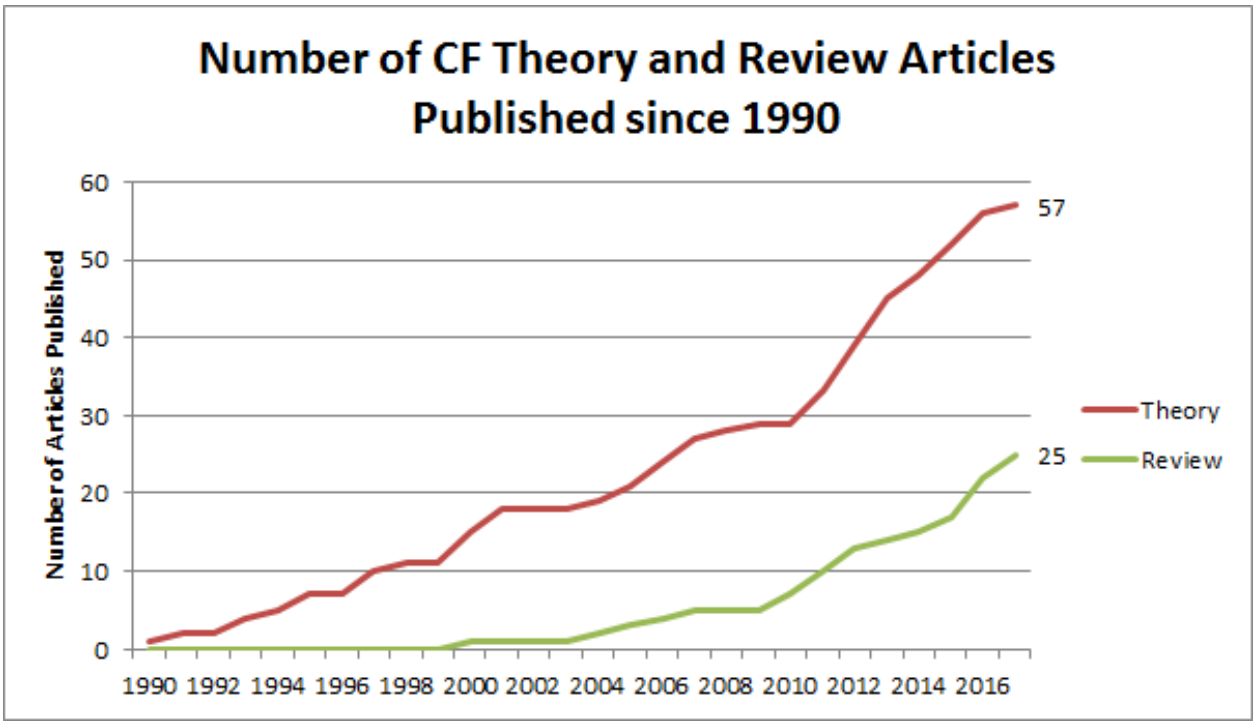

Figure 3.3: Number of CBF articles without a geographic focus published, 1990-2017

3.3.2. Topic proportions

Figure 3.4 lists the topics in descending order of relative proportion alongside the three words that are most closely associated with each topic. Again, these words are stemmed by the model to group related terms (e.g. "manag" includes management, manager, managed, and managing in one term). The most prevalent topics in the abstracts appear to deal with policy questions. Topic 1 makes up almost eight percent of the total discussion. It is highly associated with words including "policies," "reform," "govern," "programme," and "decade." These indicate that abstracts associated with this topic tend to discuss policy changes and government programs. Other prevalent topics appear to focus on management arrangements and community involvement. Topic 3, for example, is associated with words like "institutions," "arrangements," "state," and "rights," while Topic 13 focuses on words like "use," "stakeholder," "knowledge," and "plan." Topic 9, the second most-prevalent topic in the corpus, involves terms like "household," "benefits," "income," and "poor."

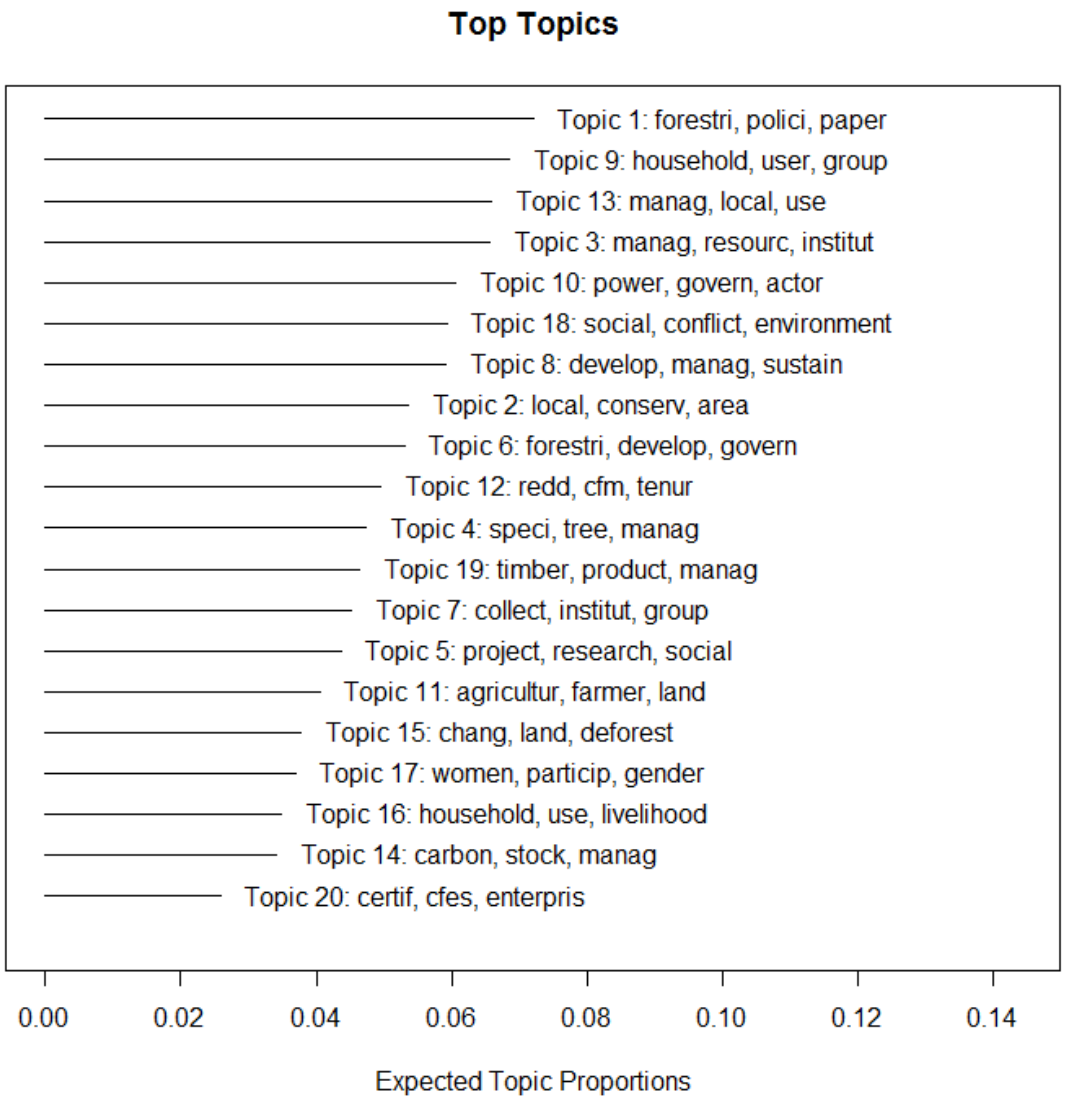

Figure 3.4: All topics listed in descending order of expected proportion over the entire corpus

At the bottom of Figure 3.4 are topics related to more specific domains of research within the CBF literature. Topic 20 accounts for only about 2.5 percent of the corpus and associates with technical terms like "certify," "logging," and "costs." Topics 15 and 14 are similarly technical. Topic 15 appears to be associated with abstracts that discuss land cover changes. Topic 14 is clearly related to carbon accounting and includes the term REDD, a reference to the United Nations' "Reducing Emissions from Deforestation and Forest Degradation program" (REDD+). The fact that language relating to tenure and language relating to REDD+ and carbon sequestration co-occurred so often that the model combines them into one topic is telling.

Several authors have noted that tenure concerns are one of the most controversial aspects of the REDD+ (Larson, 2011; Cotula and Mayers, 2009) and this model indicates that one is rarely discussed without referencing the other.

We label the topics to improve data visualization in the following sections. A list of all the topic labels, which summarizes the theme suggested by the words that are highly-associated with the topic or are frequent in, and exclusive to, that topic (FREX), can be found in the Appendix

3.3.3. Topic correlations

The STM package also shows how topics correlate by assessing how often they co-occur within the same document. Figure 3.5 maps these relationships. Topic pairs with covariance > .01 are connected. At this level of tie strength, four distinct groups of correlated topics emerge. Those four research groups are numbered on the topic correlation map and described in Figure 3.5. The topics separate into a "policy and power" group (1), a "community institutions and outcomes" group (2), a "carbon sequestration and tenure" group (3) that includes REDD+ discussion, and a large group of topics relating to "economic activities" including logging, agriculture, and community forest enterprises (CFEs).

'CF Policies,' 'Local Institutions,' and 'Resource Users' are the three most prevalent topics in the corpus and are all correlated with multiple other topics. This may indicate that these are core CBF topics, as they are both often discussed in article abstracts and are more likely to be connected to other topics. In contrast, 'Local Management,' 'Development Projects,' and 'Land Cover Change' are not correlated with any other topics. This indicates that article abstracts that reference these topics tend not to use language associated with other topics.

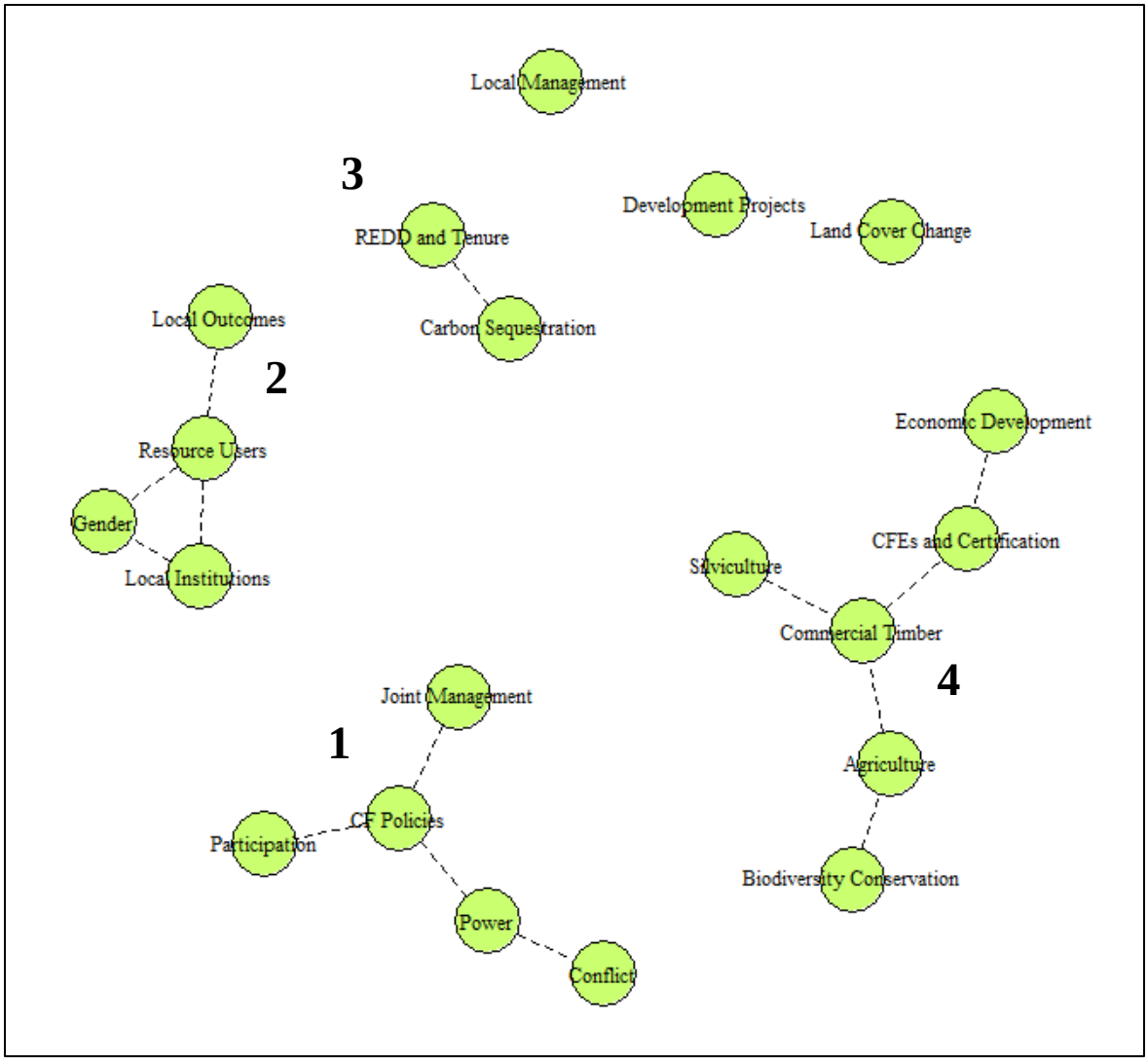

Figure 3.5: Topic correlation map. Dashed lines indicate topic pairs with covariance > 0.01

3.3.4 Changes in topic prevalence

One of STM's most powerful aspects is its ability to use document metadata to explain topical prevalence. By including each abstract's year of publication in the topic model, changes in topic prevalence over time can be assessed. Graphs of relative proportion from 1990 to 2017 for all 20 topics can be found in Section 3.8, Figure 3.8. This section of the paper examines trends in expected topic proportions to assess how CBF research as expressed in research abstracts has changed.

Figure 3.6 shows topic proportion over time for the four topics which show the greatest increase since 1990. Abstracts have become much more likely to mention REDD+ and carbon sequestration. This increase is unsurprising since the UN-REDD program was first founded only in 2008 (Cotula and Mayers 2009). Nevertheless the extent to which these issues have grown in importance is striking. Despite its recent emergence, the topic concerning REDD+ and Tenure is the tenth most prevalent in the entire corpus. For the past two years, 'REDD and Tenure' is one of the most commonly discussed topics in the corpus (for comparison with all topics, see Figure 3.8).

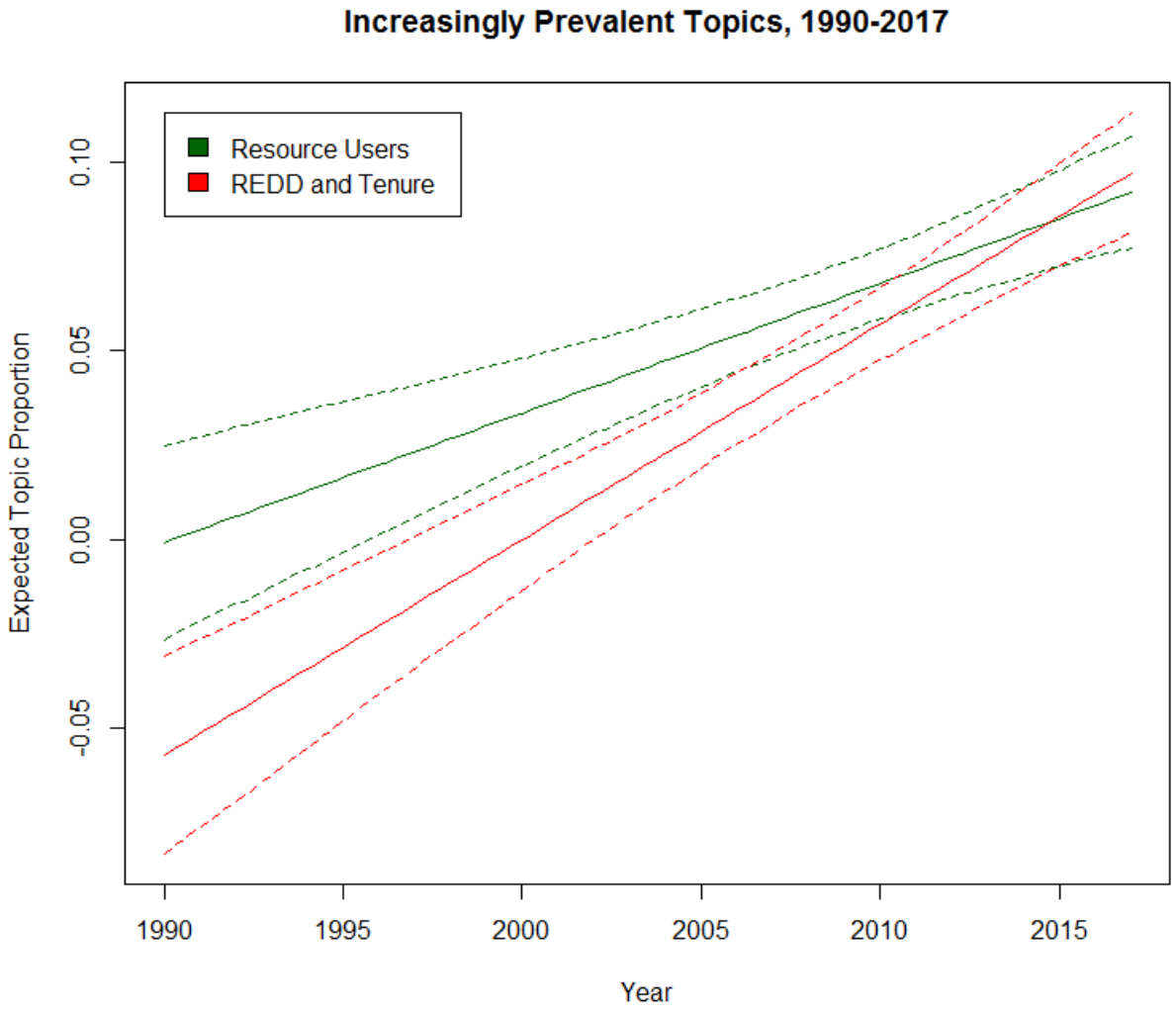

Figure 3.6: Prevalence trends for 'Resource Users' and 'REDD and Tenure' topics, 90% confidence intervals.

‘Resource Users’ and ‘Local Outcomes’ are the other topics which display a marked increase in proportion. The rise of these topics, which share highly associated words like “households,” “users,” and “benefits,” may show that research has become more likely to investigate the effects of CBF policies in terms of their benefits for local users and households.

Topic changes are assessed according to their relative proportion in the corpus, so rising discussion of some topics must come at the expense of certain other topics. Figure 3.7 shows the expected proportions over time for the ‘CF Policies’ and ‘Participation’ topics, whose presence has declined the most.

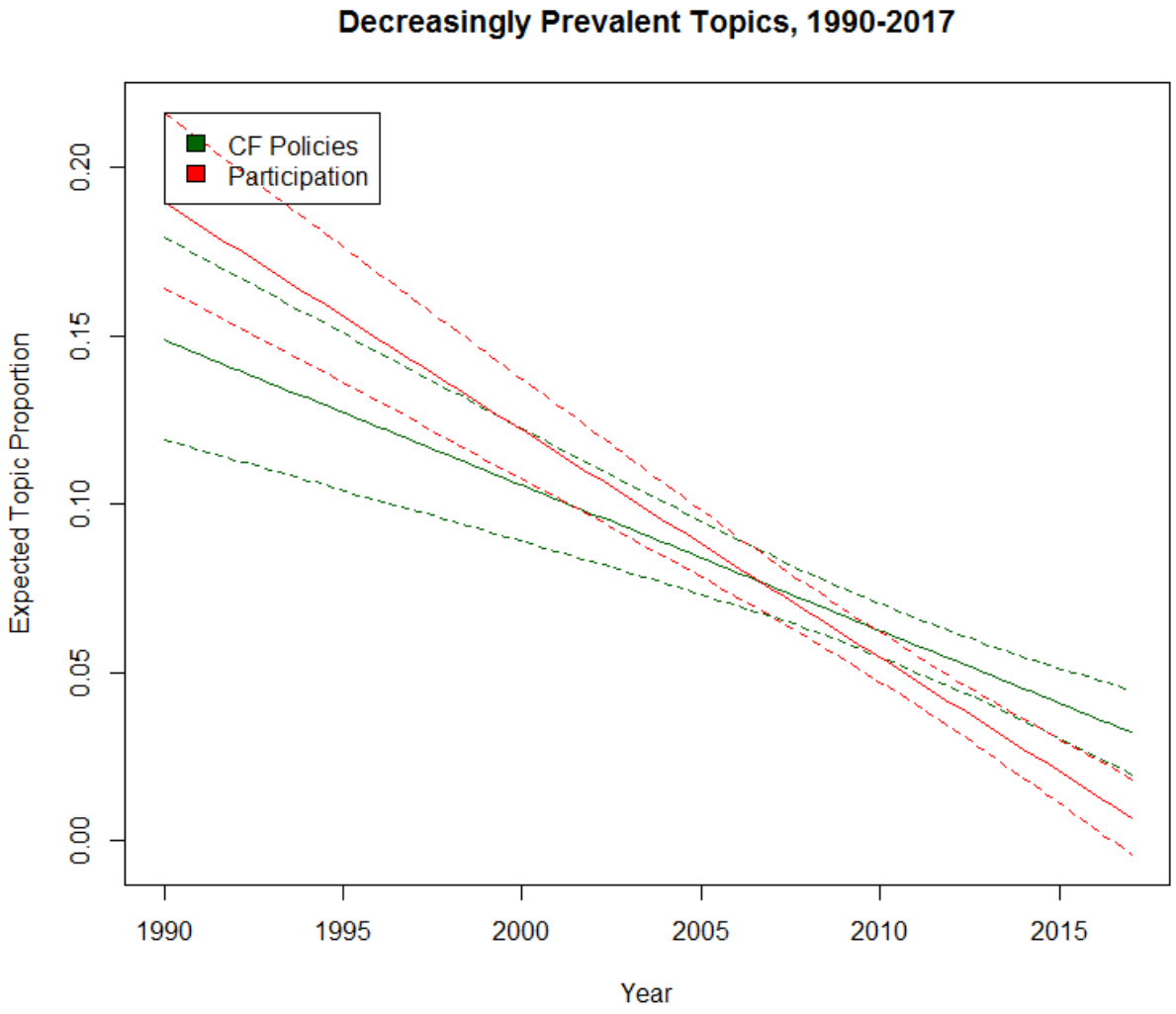

Figure 3.7: Expected topic proportion trends for 'CF Policies' and 'Participation' topics, 90% confidence intervals

The language associated with these topics generally references policies and policy processes. The stems 'polici' and 'reform' are related frequently and exclusively to 'CF Policies' and 'cooperi' and 'collabor' are related frequently and exclusively to 'Participation.' The decline of these topics in research abstracts, therefore, may reflect movement in the CBF literature from broad, policy-oriented research to research into local outcomes and technical concerns (as seen in the previous section). This would align with Arnold's (2001) call for CBF research to move from "promotion to critical analysis" (p. 113).

However, since these topic trends are measured in terms of their *proportional* representation, it should be noted that, given the large overall increase in the number of CBF articles published

between 1990 and 2017, these topics are not necessarily discussed less often today. Rather, their relative decline could just reflect the introduction of more research topics into the CBF abstracts over time. As can be seen in Figure 3.8, most of the topics do not reflect a clear increase or decrease in relative proportion over time.

3.4. Discussion

3.4.1. Global distribution of CBF research

Together, these results offer several meaningful insights into the evolution of CBF research. First, they give some insight into the geographic distribution of CBF research since 1990. All parts of South and East Asia, Africa, and Latin America are well represented in the literature. Countries in those regions are mentioned in 863 of the studies in the database with a geographic basis (87 percent).

South Asia, in particular, is important in CBF research. 360 of a total 994 studies with a geographic focus, or 36 percent, discussed CBF in South Asian countries. More than a quarter of the abstracts analyzed focus on Nepalese CBF (254 studies). These data corroborate the findings of Mai, Mwangi, and Han (2011), who, in a review of gender analysis in forestry research, found that CBF studies were most often conducted in South Asia. They attribute the geographical concentration of CBF research in South Asia to the region's longer history in forest management devolution. However, our data show the research gap between South Asia and the rest of the world continuing to widen even in more recent years. The gap in output between South Asia and all other regions may raise questions concerning generalizability. CBF outcomes, for example, are influenced by a wide variety of contextual variables (Ostrom and Cox 2010). These include biophysical aspects, community institutions, national legal frameworks, and political factors (Pagdee, Kim, and Daugherty 2006). Policy recommendations well-matched to one set of institutional and biophysical conditions are not guaranteed to succeed when adopted in a different context (Ostrom and Cox 2010). Therefore researchers interested in CBF should continue striving to describe CBF experiences across a diversity of contexts. Many countries in Southeast Asia, Latin America, and Africa now have decades of experience with CBF from which researchers may draw (see e.g. de Jong et al., 2010; Tole, 2010; Poffenberger, 2006).

3.4.2. Shifting focus

As shown in section 3.4., several topics that appear to relate to measuring local outcomes have risen in expected proportion over time. 'Resource Users' has increased significantly and is the second-most prevalent topic across all abstracts. The 'Local Outcomes' topic also shows an increase. This means that language relating to words like "users," "benefits," "income," "livelihoods," and "surveys" has become more common.

This analysis also shows the influence of a growing interest in carbon sequestration, especially REDD+. The REDD and Tenure topic has grown to be one of the most prevalent topics in the corpus in recent years. What is especially interesting about this topic is how the model combines words related to REDD+ and words related to tenure into the same topic. To illustrate, the highest probability words for this topic are "redd," "cfm," "tenure," "local," and "rights." Furthermore, "tenure," "climate," and "emissions" are FREX words for this topic. CBF has often been seen by communities as a vehicle to strengthen tenure claims over their land in addition to an end in itself (Larson et al., 2008). The model's combination of REDD+ and tenure issues into a single topic supports claims made by authors that this process is carrying over into the REDD+ process (e.g. Larson et al., 2013).

3.4.3. Topic models and scientific literature

This research note adds to a growing body of research using topic models to understand trends in scientific fields (see e.g. Griffiths and Steyvers, 2004; Hall et al., 2008; and Bohr and Dunlap, 2017). We are not aware of any previous studies that have extended these techniques to natural resource management (NRM) issues. Considering the ability of topic models to quickly analyze very large sets of textual data and use language to compare and contrast topics across disciplines, it may be helpful to apply them more widely in the NRM literature.

The limitations of the model are also displayed in this paper. First, it requires a degree of previous familiarity with the literature to interpret the significance of the topic proportions and highly-associated words. Second, it is difficult to make judgements about the causes of trends in topic proportions. Topic modelling is most useful as an exploratory technique used to take a "snapshot" of progress in scientific topics, quickly identify prominent topics, and check the results of the model against the researcher's theoretical expectations (Blei, 2012).

3.5. Conclusion

Using abstracts of CBF studies indexed by Scopus and WoS between 1990 and 2017, we have shown a striking growth of CBF research around the globe and especially in Asia, Latin America, and Africa. We then modeled the topics addressed in the text of these abstracts using Roberts et al. (n.d.)'s STM package for R. Increases in language discussing the effects of CBF policies on local users and research about REDD+ and tenure issues are the most remarkable trends shown by the topic modelling data. Overall there is some evidence that CBF research is changing to address new issues like REDD+ and focus more on CBF outcomes. Although strict conclusions are difficult to draw from topic models alone, analysts interested in understanding overall trends in scientific fields stand to benefit from using the impressive information-processing capabilities of these models.

3.6. Acknowledgements

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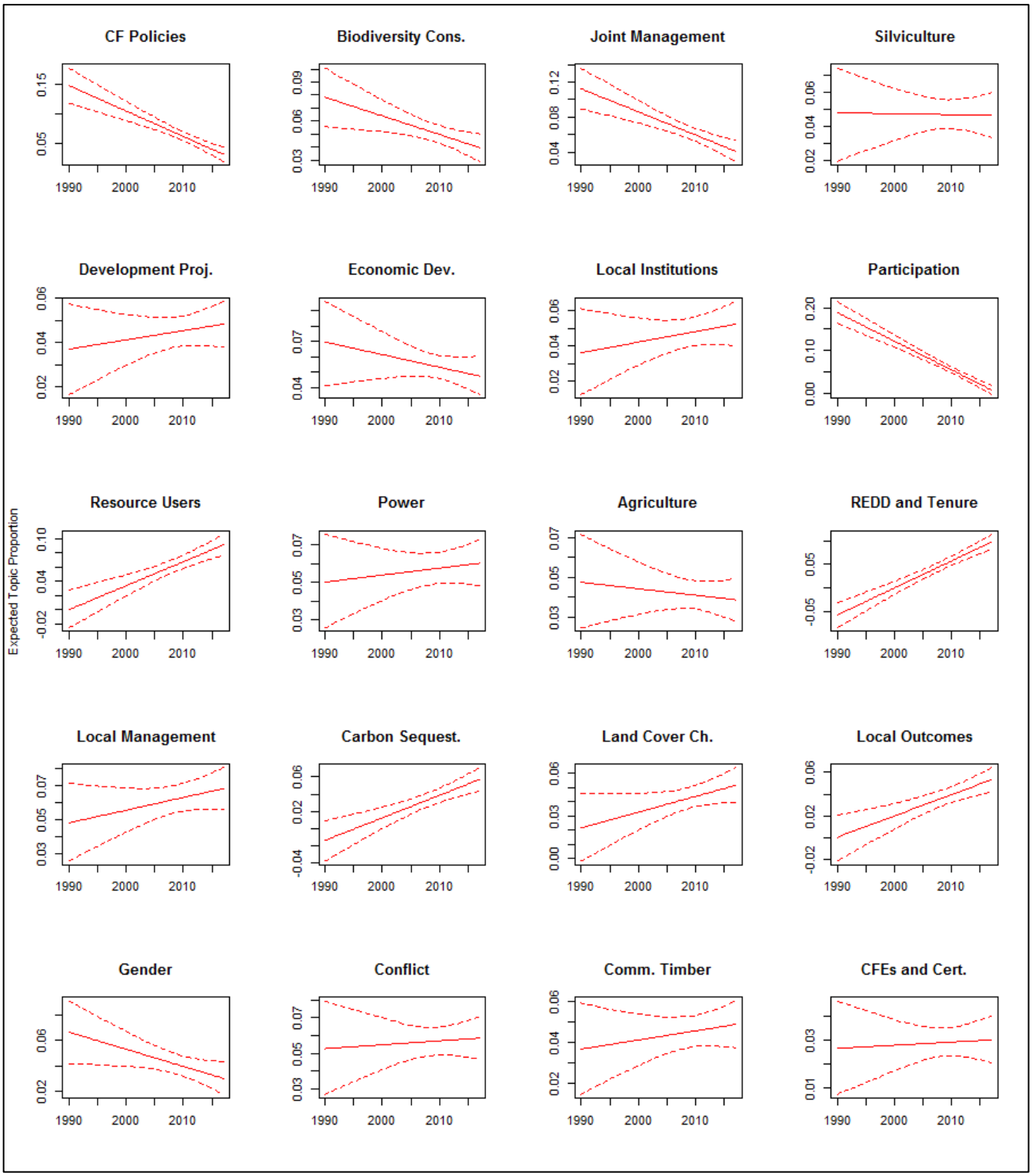
3.8. Additional tables and figures

Table 3.1: All topics, with five highest probability and five FREX words

#	Label	Highest probability terms	Frequent and exclusive (FREX) terms
1	**CF Policies**	forestri, polici, paper, govern, countri	decad, polici, reform, allevi, forestri
2	**Biodiversity Conservation**	local, conserv, area, protect, land	park, protect, zone, biodivers, communal
3	**Joint Management**	manag, resourc, institut, state, local	joint, jfm, india, co-manag, arrang
4	**Silviculture**	speci, tree, manag, regener, plant	speci, regener, seedl, tree, densiti
5	**Development Projects**	project, research, develop, social, model	project, cameroon, methodolog, health, model
6	**Economic Development**	forestri, develop, govern, econom, resourc	partnership, organiz, agrarian, discours, sector
7	**Local Institutions**	collect, institut, group, action, resourc	action, collect, rule, fuelwood, contract
8	**Participation**	develop, manag, sustain, participatori, system	cooper, collabor, participatori, develop, agenc
9	**Resource Users**	household, user, group, benefit, incom	cfug, user, household, incom, poor
10	**Power**	power, govern, actor, local, polit	power, actor, polit, neoliber, decentralis
11	**Agriculture**	agricultur, farmer, land, food, livelihood	farmer, food, farm, agricultur, crop
12	**REDD and Tenure**	redd, cfm, tenur, local, right	cfm, redd, tenur, emiss, climat
13	**Local Management**	manag, local, use, indic, studi	stakehold, criteria, indic, knowledg, monitor
14	**Carbon Sequestration**	carbon, stock, manag, redd, degrad	stock, carbon, payment, sequestr, estim
15	**Land Cover Change**	chang, land, deforest, cover, use	cover, rate, cbf, chang, deforest
16	**Local Outcomes**	household, livelihood, use, survey, data	cbfm, survey, quantit, household, type
17	**Gender**	women, particip, gender, forestri, group	gender, women, men, particip, margin
18	**Conflict**	social, conflict, forestri, environment, manag	conflict, organis, dynam, capit, social
19	**Commercial Timber**	timber, product, manag, market, smallhold	smallhold, timber, commerci, profit, plantat
20	**CFEs and Certification**	certif, cfes, enterpris, log, mexico	cfes, certif, cfe, fsc, oaxaca

Figure 3.8: Expected topic proportion for all topics, 1990 to 2017 (90% confidence intervals)



Chapter 4: General Conclusion and Future Directions

"And when the cherries white with blossoms
Be ready and be brave
And remember what we had here
When there was something left to save"

-John Darnielle, "Magpie" (2005)

4.1. General discussion

Chapter 1 set the scene for this thesis by summarizing the theories that have shaped community-based forestry policies and reviewing how those policies have generally performed so far. Chapter 2 explored how CBF policies may be implemented at the country level, using the challenges and opportunities faced by policy-makers in Panama as a case study. I found that the CBF experience in Panama fits into the general pattern of CBF implementation reported internationally. Chapter 3 explored the global trajectory of CBF research using bibliometric and computational linguistic analyses of CBF research abstracts. The global spread of CBF was documented, prominent research topics were identified, and some observations on how the field may and may not be progressing were made.

4.1.1. The future of community-based forestry

Together, these chapters provide a sense of how CBF science and CBF policy are related, how they are evolving over time, and how they are being interpreted by policy-makers at the country level to shape CBF opportunities for communities and enterprises. It is clear that there are some serious issues to be resolved before CBF can fulfill its potential to achieve social, economic, and environmental goals. Even after forty years of policy experimentation, more than a thousand academic studies, and implementation in countries across all continents where forests are found, CBF performance is still often described as disappointing (Malla, Neupane, and Branney; 2003; Charnley and Poe, 2007; Tole 2010). Some communities have been able to advance their tenure claims and better conserve local forests (Pagdee et al., 2006; Larson et al., 2010). However, rarely have transformative economic benefits been obtained, social development advanced, or forest degradation reversed (Charnley and Poe, 2007). Sustainable CBF enterprises able to

survive and thrive without ongoing technical and financial support from governments and development agencies are also rare (de Jong et al., 2012). These results, documented in the context of Panama in Chapter 2, have been found in many countries around the world (Tole, 2010).

Such problems naturally lead one to wonder whether CBF is still worth pursuing as a mainstream forest management strategy. Around the world, systemic deforestation continues and rural poverty rates remain high. Neither forests nor the people who depend on them for supplies, food, and medicine can wait indefinitely for CBF to fulfill its potential as a holistic sustainable development strategy.

The results of this thesis suggest several reasons to continue trying to make CBF work. First, that local people, and especially Indigenous people, should access, manage, and benefit from forest resources is a moral goal in addition to a wise management strategy. Chapter 2 showed how CBF is often seen as a way to develop Indigenous law and increase the presence of Indigenous people in the forest in addition to develop communities in Panama. Chapter 3 showed that 'REDD and Tenure' is a prominent topic in CBF research; many communities are interested in CBF as much to gain control over local lands as to access benefits. Centralized management strategies have often barred communities from accessing local resources, without controlling resource overexploitation (Phelps et al., 2010; Ostrom and Nagendra, 2006). World forest governance has now moved on from that paradigm (Agrawal et al., 2008), and Ostrom's description of community-organized common pool resource management still shows that there are other ways to manage resources sustainably (Ostrom, 1990).

Second, in certain situations CBF has fulfilled its potential. Communities have developed and forests have become healthier. In Chapter 2, our informants described a few Panamanian communities which had managed to use income from timber sales to fund community development projects while also displacing illegal logging. In Mexico, CBF has been remarkably successful in achieving multiple of its goals (Klooster and Masera, 2000; Ellis and Porter-Bolland, 2008; Cronkleton, Bray, and Medina; 2011). This provides an aspirational example, though not necessarily a blueprint that can be replicated across all contexts.

Third, the results of Chapter 3 showed that CBF research remains dynamic and that research topics such as 'Carbon Sequestration' and 'REDD and Tenure' have grown to become two of the most prominent in the literature. The claim that CBF offers a way to reconcile competing management goals (e.g. forest conservation and timber extraction) has been a source of confusion and conflict in the literature. However such conflict also suggests that CBF unites various stakeholders by incorporating multiple needs and desires.

4.1.2. Complex adaptive systems as a new avenue for CBF research

Complexity is a theme of both CBF research and this thesis. The problems of CBF are complex in the colloquial sense that they are difficult to understand and solve. However these problems are also complex in a technical sense in that CBF management regimes exhibit the properties of complex adaptive systems (CAS). They are hierarchical, spanning global markets, international initiatives, national policies, community institutions, and household livelihoods. Social and natural systems co-evolve, as human actions shape ecological outcomes which constrain social and economic options for communities. Different time scales conflict as policy concerns change over the course of months or years while natural resource management decisions should consider changes on the scale of decades. And people must make decisions while holding incomplete information and facing uncertain futures.

Such complexity means that, while CBF may be a worthwhile venture, simply assuming that more research will lead to better policy outcomes is insufficient (Funtowicz and Ravetz, 1999; Allison and Hobbs, 2006). Instead, new approaches are needed. CBF policy-making approaches informed by CAS theory have the potential to offer new insights and opportunities to policy actors. Some of these are further explored in Section 4.2.

4.2. Future research directions

In several other resource management contexts, researchers have used CAS analysis to generate new policy insights. These include agricultural systems (Chapman et al, 2017), fisheries (Mahon, McConney, and Roy, 2008), conservation planning (Ban et al, 2011), tropical silviculture (Putz, 2013), and plantation forest management (Paquette and Messier, 2013). A complex adaptive system analysis focuses the analyst's attention on the need for adaptability and

long-term planning. These are known to be key characteristics of successful CBF programs (Sabogal et al., 2014).

One direction for future research building on CAS theory is an increased consideration of a CBF system's *adaptability* and *resilience*. Adaptability is a measure of a system's ability to change and maintain its functions in response to external forces (Puettman, Messier, and Coates, 2013). Resilience measures a system's ability to 'absorb' disturbances and return to its original state (Puettman et al., 2013). Chapter 2 of this thesis identified how CBF policies in Panama have been highly vulnerable to economic and political shocks. Such shocks have included loss of financial and technical supports from development organizations and volatility in the market prices of timber. Yet, because CBF programs operate in an uncertain and volatile world, to be sustainable they must be made resilient to such disturbances. Therefore an important future direction for CBF research could be to better understand: (1) what technical capacities and institutional arrangements can increase the adaptability and/or resilience of communities; and (2) how governments and development organizations can best foster those capacities and institutions to allow communities to practice CBF without relying on continuous external support.

The openness and multi-scalarity of these systems also warrant further consideration. In Chapter 2 the effect of distant factors, such as competition from companies in North America or Asia, on CBF's potential to succeed in Panama was noted. The concept of 'teleconnections' was referenced to help identify and address distant drivers of local changes. Though it may not be possible to shield CBF programs from these effects, further research into how environmental change, globalized markets, and international policy initiatives support or threaten CBF at local levels would be valuable.

Finally, a better understanding of the relationship between CBF science and CBF policy is needed. A CAS lens directs the analyst to consider researchers and policy-makers as part of the CBF system. Policies are developed by government actors who have their own incentive structures and resource constraints. As suggested by Chapter 3, there is a great deal of CBF research that continues to be generated every year. How it may become more effectively sorted, summarized, and synthesized to inform public policy options remains an important challenge.

4.3. Moving forward

In 1990, Elinor Ostrom challenged policy scientists to "develop theories of human organization based on realistic assessment of human capabilities and limitations in dealing with a variety of situations that initially share some or all aspects of a tragedy of the commons" (p. 23). Researchers responded enthusiastically, and today CBF is just one of several fields related to common pool resource dilemmas in which a rich scholarly literature has developed. Yet more science has not always translated efficiently or appropriately into better public policies, and better public policies have not always enabled communities to attain better economic and environmental outcomes.

Nevertheless, researchers, governments, NGOs and communities still pursue the elusive goal of "sustainability." In this thesis I have sought to accelerate this pursuit by conducting a new, empirically informed case study on CBF in Panama, and employing an advanced computational linguistic analysis to help highlight the development of CBF research over time. Drawing on my findings, I have suggested practical recommendations for both Panamanian policy actors and CBF researchers internationally. One of CBF's great strengths is that it unites diverse actors across the policy system around the shared goals of social prosperity and environmental sustainability. It is because these goals are so valuable that they are so difficult to obtain and sustain, and our pursuit of them so determined.

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Appendices

Appendix 1. Participant consent form (Spanish)

Fecha:
Ubicación:

Análisis del sistema de la silvicultura comunitaria en Panamá

Formulario de consentimiento del participante

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Maricarmen Ruiz-Jaen
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Panamá

Título del proyecto: *Análisis del sistema de la silvicultura comunitaria en Panamá*

Propósito del estudio:
El propósito del estudio es para mejorar los proyectos de la silvicultura comunitaria en Panamá. Está siendo desarrollado en asociación con la Organización de las Naciones Unidas para la Alimentación y la Agricultura (FAO) y el Fondo Mundial para la Naturaleza (WWF). Por este proyecto estoy colectando los datos sobre las leyes, las políticas, y las programas en Panamá que afectan los organizaciones y comunidades que trabajan en la silvicultura comunitaria. Los gobiernos, las organizaciones, y las comunidades pueden usar esta información para mejorar la silvicultura comunitaria en el futuro.

Procedimientos de estudio*:*
Esta entrevista es espera que dure alrededor de una hora. Le haré preguntas sobre su papel en el desarrollo y la implementación de la silvicultura comunitaria en Panamá. Usted puede pedirme aclaraciones o más información en cualquier momento. Después de sus respuestas puedo pedir más detalles antes de hacer otra pregunta. Sus respuestas serán grabadas y luego transcritas.

Participación voluntaria*:*
Su participación en esta investigación es voluntaria. Usted puede negarse a participar en partes del estudio, declinar responder cualquier pregunta, y retirarse del estudio en cualquier momento, por cualquier razón. Si usted decide retirarse del estudio, incluso después de completar esta entrevista, la

grabación y las transcripciones serán borradas. Puede retirar sus datos hasta el momento en que sus datos ya no están conectados a su nombre.

Riesgos potenciales:
No hay riesgos anticipados para usted de participar en esta investigación. Los datos de esta entrevista que se incluyen en cualquier publicación o presentación resultante no serán atribuibles a usted, a menos que desee que sean.

Beneficios potenciales:

Participar en esta entrevista no puede benefíciale directamente. Pero los resultados de este estudio serán presentados a la FAO y el WWF que pueden usarlos para mejorar los proyectos de la silvicultura comunitaria en Panamá.

Confidencialidad:

La grabación de esta entrevista y las transcripciones que hacemos estarán protegidas por una contraseña y almacenadas de forma segura en una computadora. A menos que quiere ser identificado en publicaciones o informes que usan datos de esta entrevista, los datos que proporcione aquí no le serán atribuidos a usted. Sólo yo y, si es necesario, un traductor tendré acceso a la grabación de audio en la que puede ser identificado.

¿Le gustaría ser identificado en cualquier informe o documento que utilice sus datos?

- ☐ *Si, me gustaría ser identificado*
- ☐ *No, quiero que los datos permanecen anónimos*

Preguntas*:*
Si tiene alguna pregunta sobre la entrevista o su participación en ella, por favor comuníquese con Stephen Clare. Su correo electrónico es *stephen.clare@mail.mcgill.ca*. También usted puede contactar Prof. Gordon Hickey a *gordon.hickey@mcgill.ca* o al + 1 514 398 7214.

Si tiene preguntas acerca de sus derechos como participante en la investigación o si desea verificar la aprobación ética de este estudio, por favor comuníquese con: McGill Research Ethics Board al 514-398-6831, o por correo electrónico *Lynda.mcneil@mcgill.ca*.

Por favor firme abajo si ha leído o ha leído la información anterior y está de acuerdo en participar en este estudio. Acordar participar en este estudio no renuncia a ninguno de sus derechos o libera a los investigadores de sus responsabilidades. Se le entregará una copia de este formulario de consentimiento y el investigador mantendrá una copia.

Nombre del participante: _____

Firma del participante: _____

Fecha: _____

Appendix 2. Participant consent form (English)

Date:
Location:

Systems analysis of community-based forestry in Panama

Participant Consent Form

Researcher:

Stephen Clare
M.Sc. Renewable Resources candidate
Department of Natural Resource Sciences
McGill University

Supervisors:

Gordon Hickey
Associate Professor
Department of Natural Resource Sciences
McGill University

Maricarmen Ruiz-Jaen
Food and Agriculture Organization of the United Nations
Panama

Title of Project: *Systems analysis of community-based forestry in Panama.*

Purpose of the Study:
The purpose of this study is to help improve community-based forestry (CBF) projects in Panama. It is being developed in partnership with the Food and Agriculture Organization of the United Nations (FAO) and the World Wildlife Fund (WWF). For this project I am collecting data about the laws, policies, regulations, and programs in Panama that affect organizations and communities working in community-based forestry. Governments, organizations, and people can use this information to help make community-based forestry more effective in the future.

Study Procedures*:*
This interview is expected to last about an hour. I will ask you questions about your role in developing and implementing forest policy in Panama. You can ask me for clarification or more information at any time. Following your responses I may ask for more detail or clarification before moving on to another question. Your responses will be recorded and later transcribed.

Voluntary Participation*:*
Your participation in this survey is voluntary. You may refuse to participate in parts of the study, decline to answer any question, and withdraw from the study at any time, for any reason. If you decide to withdraw from the study, even after completing the interview, the recording and any transcripts will be deleted. You have the option to withdraw your data up until the time that your data

is no longer connected to your name.

Potential Risks:

There are no anticipated risks to you from participating in this research. Data from the interview that are included in any resultant publication or presentation will not be attributable to you, unless you would like it to be.

Potential Benefits:

Participating in the survey might not benefit you directly. However the results from this study will be presented to FAO and WWF who may use them to better support community-based forestry projects in Panama.

Confidentiality:

The recording of this interview and transcripts we make from it will be protected by a password and safely stored on a computer, backed up on a password protected sever/ hard drive. Unless you request to be identified in publications or reports that use data from this interview, any data you provide here will not be attributed to you. Only I and, if required, a translator will have access to the audio recording on which you may be identified.

Would you like to be identified in any reports or papers that use your data?

☐ *Yes, I would like to be identified*

☐ *No, I want my data to remain anonymous*

Questions*:*

If you have any questions about the survey or your participation in it, please contact Stephen Clare by emailing him at *stephen.clare@mail.mcgill.ca* or calling at 6525-0190 or Gordon Hickey at gordon.hickey@mcgill.ca or +1 514 398 7214.

If you have questions about your rights as a research participant, or if you would like to verify the ethical approval of this study, please feel free to contact: McGill Research Ethics Board at 514-398-6831, or by e-mail Lynda.mcneil@mcgill.ca.

Please sign below if you have read or have been read the above information and consent to participate in this study. Agreeing to participate in this study does not waive any of your rights or release the researchers from their responsibilities. A copy of this consent form will be given to you and the researcher will keep a copy.

Participant's Name: (please print) _____

Participant's Signature: _____

Date: _____

Appendix 3. Semi-structured interview guide

Guide for semi-structured interviews with forest policy officials in Panama

Researcher:
Stephen Clare (stephen.clare@mail.mcgill.ca; 6525-0190)

Instructions: *First read introductory paragraph to participant and ensure free, prior, and informed consent. If participant agrees to participate, move on to questions. Follow the subjects in order listed. Ask questions to initiate conversation but ask participant to elaborate on unexpected or interesting answers as required. Prompts are provided to guide follow-up questions.*

Introduction: "Thank you for agreeing to an interview with me. I am a graduate student in the Department of Natural Resource Sciences at McGill University in Montreal, Canada. This interview is part of the data collection for my Masters thesis research. I am interested in community-based forestry in Panama and am currently researching the extent of policies, programs, and projects related to its development. In doing this research, understanding your perspective on community-based forestry as a [government official / NGO representative / etc.] is very valuable. Before we begin I'd like to review your rights as a participant in this research. [Read consent form and obtain signature]."

Question Guide		
Subject	**Questions and Prompts**	**Purpose**

Participant information, role, and interests	• Tell me about your professional background and experiences.
	  ○ *Prompts:*
	  -education,
	  -years of experience
	  -previous jobs
	  -current title
	  -current responsibilities
	• Which policies and programs do you currently work on?
	  • *Prompts:*
	  -how long they've been working on these programs,
	  -what level of system they work at
	  -specific CBF programs
	  -collaborations
	• How do you contribute to those policies and programs?
	  ○ *Prompts:*
	  -Specific CBF contributions
		Background
		System network
		Regulatory structure

	• Tell me about the challenges you face in your work and how you solve them.	

Institutional opportunities and constraints for CBF	• How does your organization support community-based forestry in Panama?
	  • *Prompts:*
	  -resources provided
	  -legislation enacted
	  -people consulted
	• Who does your organization collaborate with on community forestry projects? How are rights and responsibilities shared between these different organizations?
	  • *Prompts:*
	  -funding,
	  -regional division of responsibilities
	• How does your organization interact with indigenous governance in the comarcas?
	  ○ *Prompts:*
	  -collaboration
	  -challenges
	  -history
		Resources
		Incentives
		Constraints

Norms and *de facto* rules	• How are policy priorities set within your department?
	• Tell me about accountability in your organization.
	  ○ *Prompts:*
	  -Chain of command
	• How are resources distributed in your organization?
	• How are partnerships with other organizations established? Tell me about the rules regarding collaborations.
	• How does your organization consult with the people, groups, and communities affected by decisions?
	• Has your organization's approach to policy-making changed over
		Power
		Rewards

	time?	
Further research	• How do you think community-based forestry will develop in Panama? • What do you think are the big challenges to sustainable forest management in Panama? • What important documents, policies, and regulations would you recommend I read? • Who else do you think it is important I talk to in order to better understand forest policy in Panama?	Networks Snowball research

Concluding script: "Thank you for participating in this research. Do you have any questions for me? Is there anything else that you think is relevant to my research that we haven't covered? Would you like me to send you a copy of any reports or papers arising from this work?"