Community-based management of tropical forests: lessons learned and implications for sustainable forest management

Liz Ota, Sharif A. Mukul, Nestor Gregorio and John Herbohn, Tropical Forests and People Research Centre – University of the Sunshine Coast, Australia

1 Introduction
2 The evolution of community-based forest management (CBFM)
3 How does CBFM work?
4 Community forestry and livelihoods
5 Factors affecting the success or failure of CBFM
6 Designing and implementing CBFM
7 How CBFM can be integrated into international forest policy
8 Conclusion
9 Where to look for further information
10 References

1 Introduction

Globally, forests cover approximately 30% of the world's land surface and are vital for meeting human needs for food, fuelwood, timber, fodder and medicines (FAO 2016; Landell-Mills and Porras 2002). Forests are also critical in providing a wide range of environmental services, including biodiversity conservation, climate regulation, watershed protection and soil amelioration (Mukul et al. 2017; Landell-Mills and Porras 2002). Despite the enormous importance of forests for people's lives and livelihoods, deforestation and forest degradation have increased globally, and at vastly higher rates than ever before (Giam 2017; Kaimowitz and Angelsen 1998). One of the major reasons for the failure of most forestry programmes in tropical developing countries is the exclusion of local people in forest management and poor recognition of local peoples' customary rights and dependency on forests (Mukul et al. 2012; Poffenberger 2000).

http://dx.doi.org/10.19103/AS.2020.0074.24
© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

Community-based forest management (CBFM), also known as community forestry, social forestry, joint forest management or participatory forestry, has emerged in response to the concern that centralised forest ownership in most developing countries has failed to promote sustainable forest management (SFM) (see Schusser 2013; Maryudi et al. 2012; Sunderlin 2006). The CBFM model has been acknowledged for its ability to improve social cohesion and rural incomes (see Chhetri et al. 2013; Antinori and Rausser 2008; Charnley and Poe 2007), and it is an increasingly important form of forest management in the world's tropical regions (Gilmour 2016). Over half a billion people in the tropics are in some way dependent on forests managed by local and indigenous communities (Baynes et al. 2015; Agrawal 2007).

Social, economic and environmental well-being are at the core of the SFM concept and principles (Sands 2005; FAO 2020). Despite the significant progress towards SFM over the last few decades, its implementation is highly variable in the tropics where the capacity to utilise or enforce SFM policies, laws and regulations remains uneven (FAO 2016). In the tropics, CBFM is widely recognised for its capacity to improve the social and economic conditions of forest-dependent people, influencing both forest management and governance (Baynes et al. 2015; Mukul et al. 2012, 2014). The CBFM model is, therefore, also critical in achieving SFM goals throughout the tropics.

This chapter provides an overview of CBFM in the tropics. We first discuss the origins and evolution of CBFM, followed by governance issues relating to CBFM, the factors affecting the success (and failure) of CBFM, the design and implementation of CBFM, and CBFM in international forest policy and management.

2 The evolution of community-based forest management (CBFM)

Like many developing countries today, in pre-industrial Europe, rural dwellers depended on their adjacent forest commons for livelihood support and governed how these common forests were used (Gilmour 2016). This type of forest management system is currently considered as community-based forestry (Wiersum et al. 2004; Jeanrenaud 2001). However, with the rise of industrialization and modernization, this forest management system was abolished as common lands were enclosed and customary rights extinguished. This prevented poor farmers access to these common forests to support their livelihoods.

From the sixteenth century onwards, many countries in the global South and the New World were under colonial rules. Prior to the colonial annexation of forests, most of these forests were managed by indigenous peoples using traditional or customary practices (Borrini-Feyerabend et al. 2004). These

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

pre-modern forest management practices, which include those within tribal and post-feudal societies, were not only highly variable but also dynamic, as discussed by various researchers (e.g. Couillard et al. 2009; Odera 2004; Poffenberger 2000).

Forest management in most colonised countries applied a 'scientific forestry' (Odera 2004) management approach where a central government controlled the access and management of forests. This management sought to maximise timber production for the benefit of the colonising power and/or the State. Due to colonial scientific forest management policies, local communities were alienated from lands and resources that had previously been part of their traditional estates (Gilmour 2016). However, they were often permitted to continue to obtain subsistence goods from the forests.

Many postcolonial governments adopted colonial forest management approaches, laws and policies until the 1970s. During the 1970s and 1980s, social and community-based forestry emerged due to the perceived failure of the forest industry development model to promote sustainable management (Schusser 2013; Maryudi et al. 2012; Casse and Milhøj 2011). Community-led forest enterprises were found more likely to be invested in the local economy and more likely to adopt a longer-term horizon for resource management than larger-scale companies, thus promoting more sustainable management (Molnar et al. 2010; RRI 2018).

More recently, the social forestry model has become a global trend to combat forest degradation by shifting forest ownership from governments to local communities (Bixler 2014). Figure 1 shows the evolution of people-centred forestry approaches. These range from participation and joint management with governments through to differing levels of devolution and on to full ownership, depending on the increasing strength of rights (Gilmour 2016). The underlying assumption is that local communities are in the best position to manage and protect forest resources, provided they see that it is in their best interests to do so (Maryudi et al. 2012; Shrestha and McManus 2007).

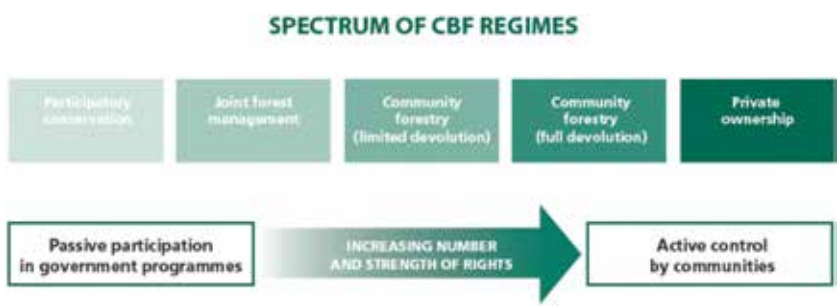

Figure 1 The evolution of people-oriented forestry. Source: Gilmour (2016).

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

3 How does CBFM work?

In the natural resource management literature, governance refers to stakeholders, decision-making actions and the tools that enable these stakeholders to make informed decisions (Mansourian 2017). Traditionally, in the Western world, governments held the decision-making power over the use and management of forest lands (White and Martin 2002). This model was transported to colonies and formed the basis of contemporary pathways to deforestation. In some countries, deforestation stemmed from government land-use policies that promoted colonisation with the provision of credit, low taxation, agricultural incentives and land titles (Lambin and Geist 2003). Industrialization, and the market demands that it generated, has led to further depletion of natural resources (e.g. in China, Lowe 2005).

Once acknowledged that governments and market structures alone had failed to promote sustainable and equitable management of natural resources in developing countries, a pursuit of alternative governance systems began (Duguma et al. 2018; Li 2002; Arnold 2001). Because secure ownership results in higher efficiency and efficacy in forest management and conservation (ITTO and Rights and Resources Initiative 2011), devolution of natural resource management to communities was identified as a potential alternative.

Between 1990 and 2010, the global forest area under public ownership decreased by about 120 million ha, whereas the area under community use rights increased by about 7% (FAO 2016). This forest tenure transition has been observed throughout the tropics (White and Martin 2002), and it is expected that decentralisation of forests from national to subnational levels will continue in many regions of the world (FAO 2016). In Africa, for instance, both colonial and post-independence governments took ownership of natural forests that used to be managed by local communities (FAO 2012). This centralised management of forests was unsustainable and new policies have emerged over the past two decades to devolve management and administrative authority to local populations (FAO 2012).

CBFM, under all its different names, is a commonly used mechanism to enable local communities to exercise their rights to participate in making decisions about forests, developing forest management plans, managing the forests and benefitting from their management (FAO 2012). The CBFM model provides a platform for the participation of all forest users and interested groups, including women, children and the elderly (FAO 2012). In a CBFM process, issues related to inequity and inequality, social exclusion, asymmetric power relations and elite capture are addressed (Gilmour 2016). Social arrangements in community forestry must promote democracy, equity and social justice that are adapted to local customs and practices without impacting on the economic viability of the activity (Jong et al. 2010).

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

For communities, CBFM can be a means of achieving legitimacy to their tenure rights (ITTO and Rights and Resources Initiative 2011). Often, CBFM provides statutory rights to forest areas traditionally managed under customary tenure. However, in many cases, in areas devolved by the government to CBFM, rights are strictly curtailed or come with a range of responsibilities, thereby limiting the benefits communities can attain (Gilmour 2016; ITTO and Rights and Resources Initiative 2011). This shift in responsibilities has helped governments offset the reduction in budgets of forest departments (Arnold 2001).

Community forestry can take many forms. Arnold (2001) proposed four broad categories of the relationship between users and resources in community forestry. In the first category, forests are common property, managed and controlled collectively. In the second category, management and control of resources is based on joint management by stakeholders under different user classes and interests. The third category comprises arrangements in which forest products are obtained mostly from agroforestry or other farm management systems rather than natural forests. In the fourth category, users are involved in processing and trading forest products rather than in direct forest management, thereby allowing landless people to be involved in community forestry. Subsequent debate has focussed more on issues such as strength of rights as a way of categorising differing types of community forestry. On this basis, Gilmour (2016) has suggested a spectrum of community forestry regimes. At one end of the spectrum sits passive participation in government programmes, such as participatory conservation, with a limited number and strength of rights to community forestry. In the middle are joint forest management and community forestry with limited devolution. At the other end of the spectrum is community forestry with active control by communities and full devolution of rights.

The term 'community' suggests collective arrangements for forestry activities. However, in some contexts, societies described as communities are not communal collectivists (Jong et al. 2010). Amerindian populations in Amazonia, for example, hold communal land ownership but manage resources based on individual households and networks of families (Jong et al. 2010). When the benefits to individual households are set aside for the sake of community benefits, interest in CBFM by community members tends to quickly reduce (FAO 2012). Therefore, in some instances a family-based approach to community forestry may be preferred (Baynes et al. 2017).

4 Community forestry and livelihoods

Many people in developing countries depend on the natural environment for their livelihoods. The success of community forestry in developing countries is therefore dependent on its provisioning of ample livelihood opportunities.

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

This has been embedded in community forestry since its early years, when community forestry was seen to comprise three main elements – the provision of 'fuel and other goods essential in meeting basic needs at the rural household and community levels', the provision of 'food and the environmental stability necessary for continued food production' and the generation of 'income and employment in the rural community' (Malla 2000; FAO 1978).

Besides food, fuelwood and broad environmental services, communities can benefit from forests in several other ways. Timber is often the most valuable commodity in forests, and community forestry groups tend to have stricter harvesting regulations for timber than for non-timber forest products (Mukul et al. 2014). Examples of community timber harvesting management practices include Papua New Guinea (Keenan et al. 2011), Guatemala (Stoin et al. 2018) and Nepal (Baral and Vacik 2018). Other non-timber forest products include medicinal plants, foods such as fruits and seeds, materials for making charcoal, materials for cultural and religious uses, essential oils, fodder and fibres. A combination of these material uses and environmental services from forests may also motivate community forestry.

Community forestry livelihood choices differ depending on the local context, including gender issues, household socio-economic status and market access. It has been widely observed that whereas women are mostly engaged in the collection of forest and agricultural products related to the household's daily needs, such as fuelwood, food and medicinal plants, men are more focussed on marketable forest products (Pokharel et al. 2007; Sunderlin et al. 2005). Similarly, poorer households and communities may prioritise more immediate needs, whereas wealthier households are able to manage forests for longer-term benefits, including ecosystem services. Access to markets affects the types of products that have potential for income generation, and when marketable products are being cultivated, management should reflect market requirements.

Forestry can also support non-forest-based livelihood activities. Under a landscape approach, forest activities can be coupled with other land uses that will help communities cope with the long maturity period of trees and their products, which in turn benefit other land uses with ecosystem services, such as erosion protection and increased soil fertility. In Nepal, as in many other countries, forests support agriculture through grazing and fodder collection, acting as windbreaks, and supporting livestock that provide manure for agriculture and animal food products for people (Thoms 2008).

Community-managed forests can also improve livelihoods by increasing community resilience and reducing community vulnerability to climate-induced shocks. Forest resources often serve as safety nets for occasional needs (Baynes et al. 2015; Lambin and Meyfroidt 2010). They can also be used as collateral for loans, broadening access to financial capital and livelihood options. Land-use

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

rights can be strengthened with sustainable management of the land (e.g. Elliott et al. 2019). Community forestry can also improve human and social capitals (Gautam 2009; Pokharel et al. 2007; Dev et al. 2003), which lead to livelihood benefits beyond forestry.

Despite community forestry's great potential to support livelihoods, outcomes are often below expectations due to factors including a limited capacity, weak institutions, elite capture and cumbersome bureaucracy (Sunderlin et al. 2005). At the community level, capacity building can address some of these issues for greater livelihood gains from forestry. Capacity building needs to go beyond technical training. It also needs to focus on social organisation, business skills, financial literacy, and policies and regulations to which communities are subjected. Addressing underlying human and social capital limitations and institutional impediments can lead to increased benefits for local people (e.g. Beauchamp and Ingram 2011).

5 Factors affecting the success or failure of CBFM

There are many factors that affect the success of community forestry, including various socio-economic, biophysical and policy settings. There have been numerous studies that have investigated specific elements that impact on community forestry's success such as local- and national-level policies, land tenure arrangements and site-species matching (see Baynes et al. 2015). There have been few comprehensive studies in the tropics (Le et al. 2012), with possibly the most comprehensive being by Le et al. (2014). There have been attempts to synthesise the literature and draw out key factors affecting community forestry's success (Gilmour 2016; Baynes et al. 2015; Le et al. 2012). As suggested by these synthesis studies, many of these factors are interrelated (Baynes et al. 2015). The causal diagram prepared by Baynes et al. (2015), reproduced as Fig. 2 below, provides a useful framework to discuss the key factors.

Five key factors affecting the success of community forestry emerge from the literature: the importance of effective governance, secure property rights, social equity, government support and tangible benefits (e.g. Baynes et al. 2015; Gregorio et al. 2015; Macqueen 2013; Larson and Dahal 2012; Larson et al. 2010; Van Laerhoven 2010). The causal diagram by Baynes et al. (2015) also emphasises the complexity and the interactions of the various factors as part of a system. In the diagram, arrows labelled with a '+' symbol move up and down in the same direction, for example, if community forestry group (CFG) cohesion increases, then intra-CFG governance improves. If CFG cohesion decreases, then the motivation of CFG members to participate also decreases. Arrows labelled with a '–' symbol move up and down in opposite directions, for example, if social stratification increases, then cohesion decreases. The

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

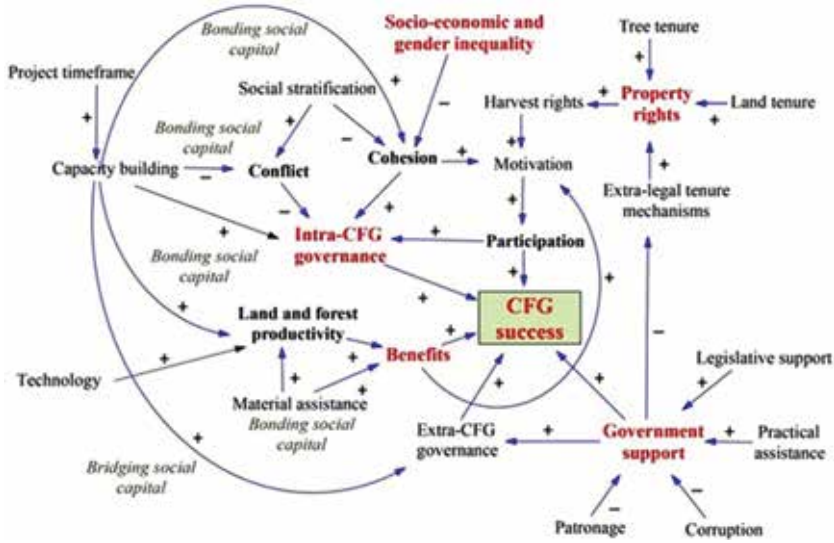

Figure 2 Casual diagram of the relationship between the factors influencing the success or failure of Community Forestry Group success (CFG success). Source: Baynes et al. (2015).

effect of increasing CFG bonding or bridging social capital is depicted as an ameliorating influence. For example, increasing bridging social capital through capacity building assists extra-CFG governance, that is, the ability of the organisation to deal with external agencies.

Within the many factors influencing the success of CFGs, four overriding themes emerge (Baynes et al. 2015), namely:

1 *Power is seldom shared voluntarily*. Corruption and inequality have led to the failure of many CFGs (e.g. Estoria et al. 2004).
2 *Community forestry typically requires long-term capacity building*. This has not been the case in most community forestry programmes (Gregorio et al. 2015).
3 *There is a need for both short-term cash income and longer-term material benefits*. The need for incorporation of livelihood components into reforestation is widely recognised but seldom achieved (Baynes et al. 2015).
4 *Land and tree tenure are probably the most complex issues determining community forestry success*. In the Philippines, land and tree tenure are critical issues. In this context, CBFM agreements theoretically provide tenure security to communities, but in the past the government's willingness to revoke community forestry agreements has seriously weakened CFGs (Calderon and Nawir 2006; Chokkalingam et al. 2006).

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

In addition, restrictions placed on the harvest of native species, even when established as woodlots, have had negative impacts on the willingness of CFGs to plant native trees.

6 Designing and implementing CBFM

In some circumstances, CBFM is a customary practice and little or no external assistance is needed for its smooth implementation. However, in many cases, devolution of land rights is a recent phenomenon, and local institutions to manage forest resources are not strong enough to ensure the sustainability of the activity. Community-based forestry needs to be sustainable not only from a timber yield perspective, but also in terms of institutional arrangements, financial performance and provisions of benefits. Table 1 lists a variety of tools that provide guidance to the process of CBFM design and implementation, considering the complexity of CBFM regimes.

The tools presented in Table 1 have various formats and are aimed at different stages of the CBFM design and implementation process. FAO (2012) defines some essential steps, presented in Fig. 3, and lists the following enabling conditions for the institutionalisation of CBFM in sub-Saharan Africa: clarity on community membership, local institutions, resource property rights,

Table 1 Examples of tools to design and implement CBFM

Source	Description
FAO (2012)	Provides recommendations for improved institutionalisation and implementation of CBFM in sub-Saharan Africa.
FAO (2019b)	Provides criteria and indicators and guidelines on how to conduct assessment of the effectiveness of community-based forestry.
Baynes et al. (2015)	Provides a conceptual model of drivers of success of Community Forestry Groups (CFGs) in developing countries.
Vickers et al. (2012)	Provides guidelines on the decision to engage with voluntary carbon markets, and how to design and implement projects.
ITTO and Rights and Resources Initiative (2011)	Provides methods and guidelines for compiling data on statutory forest tenure change in the tropics.
FAO (2019a)	Provides guidelines for countries to evaluate their forest tenure systems, and help in the identification of areas for improvement of tenure governance.
Cowling et al. (2014)	Provides guidelines for collecting, analysing and using data to assess forest governance.
Mayers et al. (2013)	Provides practical tools to improve governance of forest tenure.
Bruyn and Veer (2014)	Provides facilitators of forest tenure development processes, guidelines to identify the need for improvements in forest tenure systems, and governance and strategies to address it.

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

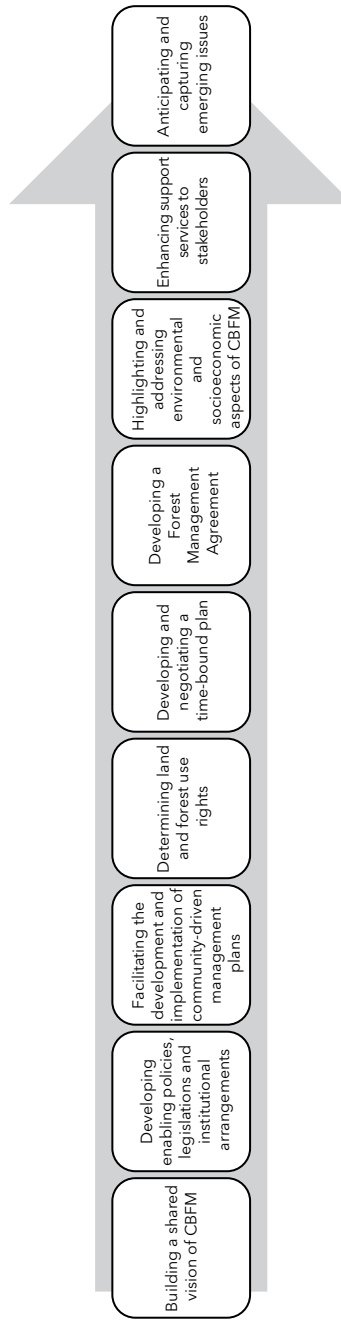

Figure 3 A set of essential steps for CBFM in sub-Saharan Africa, proposed by FAO (2012).

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

and cost and benefit sharing; negotiated land-use planning that includes adaptive management; participation and collective decision-making for long-term commitment; adequate policies, legal frameworks and political support; access to markets and finance; improved knowledge base, capacity building and collaborative learning and monitoring; and an information management and communication strategy.

ITTO and Rights and Resources Initiative (2011) proposed five steps for better progress in forest tenure and governance in the tropics. The first step is focussed on creating a vision, sharing knowledge and improving understanding of local institutions. In many cases, cumbersome regulatory frameworks in the form of legal barriers and high transaction costs impose institutional limitations to community forestry (Jong et al. 2010). In Ecuador, for instance, there are simplified forestry norms for communities and smallholders (Jong et al. 2010). Therefore, the second and third steps comprise creating an enabling policy environment, and investing to accelerate reforms, respectively. The fourth step is centred on defining, clarifying and strengthening property rights to ecosystem services, and the last step is focussed on strengthening knowledge and information about forest tenure. These steps are very similar to the six main issues Gilmour (2016) identified to realise the full potential of CBFM: secure tenure, an enabling regulatory framework, strong governance, viable technology, adequate marketing knowledge and a supportive bureaucracy.

Important aspects for consideration in the devolution of rights to communities are: strengthening trust relationships between stakeholders, ensuring genuine participation and social inclusion, and building community self-confidence and a sense of ownership of the forests (Gilmour 2016). In addition, skill development may be required to ensure the community is capable of organising itself and managing the resources sustainably (FAO 2012). Devolution is more successful when resource users are better organised, when there are good social networks in place, and when stakeholders are aware of their rights and have secure land rights (Shackleton et al. 2002). Governance and ownership issues are addressed by several of the tools listed in Table 1, including those outlined by Mayers et al. (2013) and Bruyn and Veer (2014).

Tools with a more specific geographic scope have resulted from demands posed by policy and societal changes. For example, the guidelines for CBFM for Dak Lak Province, Vietnam, were developed following a forest land allocation policy (Dak Lak Department of Agriculture and Rural Development 2005). The guidelines focus on relevant policies and regulations and the participation of interested stakeholders. In Namibia, guidelines were proposed to ensure a consistent and streamlined approach to community forestry, which had become an integral part of the community-based natural resources management programme of the country's Ministry of Agriculture, Water and Forestry (Ministry of Agriculture Water and Forestry 2005).

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

Despite the availability of knowledge and tools to ensure an adequate implementation of CBFM, some narrow-focused, and poorly designed and implemented efforts have proven to be ineffective. In land devolution, authority must be transferred to communities under a clear, negotiated and consented agreement (FAO 2012). Weak local social institutions and limited enforcement of laws and forest management agreements can lead to increased deforestation and encroachment of forested areas (FAO 2012). Exclusion of some people or sections of communities can result in social conflicts (FAO 2012). Also, unclear definitions of cost and benefit sharing arrangements can result in tensions within communities, and between communities and external organisations (FAO 2012).

Besides negative social outcomes, CBFM often fails in supporting livelihoods, which has a great impact on the lives (including health) of forest-dependent people. Livelihood provision can be limited by the use of species and technologies that are unsuited to the local context, by limited local capacity to carry out the activity, and by market constraints. Under community forestry, local forest users may have to engage in marketing transactions they are unfamiliar with and have low influence and bargaining power over (Jong et al. 2010). Further gains in the commercialisation of products from CBFM are limited by smallholder farmers' common position at the very bottom of a value chain, with products having to pass through several intermediaries and processing phases before reaching the final customer. Insertion of community-based forest products further along the value chain requires not only value-adding skills, but also abilities to negotiate with external actors to achieve agreements with fair risk and benefit-sharing arrangements (Jong et al. 2010).

Negative outcomes of CBFM can be reduced through complementary approaches dedicated to understanding livelihood strategies and opportunities for sustainable livelihoods (Arnold 2001). One such approach is the sustainable livelihoods framework, proposed by the British Department for International Development (DFID 1999). This framework comprises the vulnerabilities, the surrounding institutional and policy environment, and the strategies, opportunities and existing assets in a household or community. The assets are divided into five categories: physical, human, natural, social and financial capitals.

The level of capital assets a household or community holds, along with the socio-economic conditions, has great impacts on the type of community forestry that should be implemented and the level of support that will be required. Monitoring frameworks are commonly focussed on observations of results using lagging indicators. But leading indicators, being those that represent current conditions that point to the likelihood of a certain output in the future, are seldom used. The use of leading indicators in monitoring the design, implementation and administration of CBFM projects can assist in the

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

identification of the level of capacity of the community, the potential obstacles posed by the surrounding conditions and the means to address these weaknesses early enough to increase the chances of success.

Lagging indicators in CBFM are often related to the amount of area being managed, the vegetation structure, soil properties, the amount of carbon stored, and the amounts and values of products obtained. Leading indicators in CBFM can be related to the level of tenure security, the presence or absence of threats, the availability of infrastructure and the existing local knowledge. A monitoring system with leading and lagging indicators can be used by governments, implementing agencies or the communities themselves. However, for the communities to participate in monitoring, especially after the withdrawal of a donor agency, genuine devolution of management power must be achieved, otherwise monitoring is likely to fail (Garcia and Lescuyer 2008).

7 How CBFM can be integrated into international forest policy

In recent decades, the favouring of economic development over biodiversity conservation and the well-being of local peoples has resulted in several developing countries providing access to forest areas to industries, particularly mining, agriculture and logging. More recently, reducing degradation, improving forest management and implementing forest restoration have become policy priorities to achieve sustainability commitments in many parts of the world (ITTO and Rights and Resources Initiative 2011). In this context, forest management and use by rural people has been argued to be an environmentally and socially sound land-use (Arnold 2001).

While community forestry is implemented locally, it can have global impacts. Strengthening forest governance by communities and Indigenous peoples helps to address issues related to poverty, conflicts, degradation of ecosystems and loss of local cultures (ITTO and Rights and Resources Initiative 2011; Arnold 2001). Hence, CBFM can assist the global community advance towards ambitious goals established by global policy initiatives, such as the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) (Gilmour 2016).

Building on the Millennium Development Goals in 2015, 17 SDGs underlying 169 targets were proposed as part of the 2030 Agenda for Sustainable Development. The SDGs provide a blueprint to address major global challenges, with goals and targets to be met by 2030 (https://sustainabledevelopment.un.org). Successful community forestry has been identified to help address SDG 13 and target 31 (De Jong et al. 2018). The strongest link between community forestry and the SDGs is found in SDG 15. This goal has targets related to biodiversity conservation, reducing forest degradation,

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

restoring degraded ecosystems, promoting sustainable land uses and combating desertification. Community forestry can also contribute to SDGs related to ending hunger, promoting healthy lives and well-being, water sanitation, cities, sustainable consumption and production, and climate change (De Jong et al. 2018).

Payments for environmental services (PES) have been promoted for the last few decades, recognising the contributions made by local communities in retaining in-tact forests that can provide environmental services locally and beyond (Gilmour 2016). In PES schemes, service providers receive payments, monetary or otherwise, from a buyer for a well-defined measurable action or land use that likely helps provide an environmental service (Wunder 2005). This can benefit sellers who obtain an alternative source of income, and the buyers who are seeking a reliable supply of environmental services.

Despite the great appeal of PES, major constraints still exist for its adoption at scale. A low demand for services and service users being unwilling to pay for services they always enjoyed for free, in addition to poor knowledge of the supply dynamics of environmental services, are barriers for PES implementation (Wunder 2005). Further, the involvement of the poor and smallholders is limited by additional conditions. The poor have a limited ability, competitiveness and secured tenure to access PES schemes, and there is a high transaction cost for buyers to work with many smallholders instead of fewer larger suppliers (Wunder 2008).

A well-known form of PES is reducing emissions from deforestation and forest degradation (REDD+). This scheme is based on paying people to not remove trees or damage forest quality, while also promoting sustainable management and enhancement of forest carbon stocks (Gilmour 2016). Community forestry regimes have an important role in operationalising REDD+ (Gilmour 2016). The REDD+ scheme has much potential to contribute to local well-being while also providing broader societal benefits. Nevertheless, to date, any beneficial outcomes for engaged communities have been limited.

Similar to other PES schemes, REDD+ can impose prohibitive costs for small-scale initiatives, related to requirements for detailed management plans and data (Cacho et al. 2005). Additionally, if carbon storage becomes the predominant goal in a community forestry initiative, REDD+ can have negative impacts on local livelihoods and other social goals (Gilmour 2016). To ensure participation and benefits for communities, improvements in the enabling environment, including tenure, law enforcement and appropriate forest regulations, are needed (Tomaselli and Hajjar 2011). An environment that encourages and enables local small-scale and medium-scale forestry enterprises enhances the benefits to smallholders and communities (Tomaselli and Hajjar 2011). A meta-analysis of a range of case studies of community forest management within REDD+ by Pelletier et al. (2016) suggests that REDD+ can

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

be beneficial in providing access to new sources of income, providing the right conditions are in place such as support for capacity building and mechanisms for sharing benefits equitably.

Other global-scale movements that may involve CBFM have gained momentum in the last decade. For example, the Bonn Challenge was launched in 2011 with the aim of restoring 150 M ha by 2020, and the subsequent New York Declaration on Forests of the 2014 UN Climate Summit increased the target to 350 M ha by 2030 (Bonn Challenge 2019). The restoration target is based on a forest and landscape restoration (FLR) approach. The FLR approach consists of participatory decision-making involving stakeholders of all affected land-use sectors for land use management at a landscape scale rather than individual sites (Sabogal et al. 2015). The approach is also closely aligned with community-based natural resource management. The Bonn Challenge has support from local initiatives such as AFR100 (the African Forest Landscape Restoration Initiative) and Initiative 20×20 (in Latin America and the Caribbean), and the FLR approach is now being applied in over 60 countries. As of August 2019, these countries have pledged to restore over 170 M ha of forest.

In March 2019, the UN Decade on Ecosystem Restoration was declared. The initiative will assemble political support, science and financial investment to boost restoration efforts and accelerate the existing global restoration goals (UN Environment 2019). The combination of all these policies and goals at the global scale should benefit and motivate CBFM. However, true devolution depends on national and regional governments and there is often disagreement between local people and government officials about what devolution is supposed to achieve and how it can be achieved (Shackleton et al. 2002).

8 Conclusion

CBFM is an important mechanism through which forests can be managed for the benefit of forest-dependent peoples and the wider community. There is a broad spectrum of community participation in forest management, ranging from passive participation in government programmes through to active control of forests by communities. Recognition and incorporation of livelihoods is a fundamental component of successful community forestry. Forests provide many different livelihood opportunities and the most appropriate choices differ depending on the local context, including gender issues, household socio-economic status and market access. Despite CBFM's great potential to support livelihoods, outcomes are often below expectations due to factors including a limited capacity, weak institutions, elite capture and cumbersome bureaucracy. There are many factors that affect the success or failure of CBFM, with the five most important being effective governance,

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

secure property rights, social equity, government support and tangible benefits. The design and implementation of CBFM is a complex process and must be sustainable, not only from a timber yield perspective, but also in terms of institutional arrangements, financial performance and provisions of benefits. Unfortunately, many CBFM programmes are poorly designed or implemented. This is despite the literature related to CBFM providing a reasonable understanding of the key factors that need to be considered. Importantly, many programmes do not adequately consider the differences between communities, particularly in terms of their capacity to implement CBFM. Many programmes also do not adequately consider the need to develop sustainable livelihoods. In monitoring the outcomes (successes or failures) of CBFM reforestation projects, there is an almost exclusive focus on two short-term lagging indicators (number of trees planted, area reforested). It would instead be far more beneficial to focus on leading indicators of success such as tenure security. In conclusion, CBFM clearly offers great potential to benefit communities and the environment, but its successful design and implementation still faces many challenges.

9 Where to look for further information

Table 1 brings a list of useful material to design and implement CBFM. Further information can be found in the websites of major agricultural and forestry organisations and centres of expertise such as:

- The Regional Community Forestry Training Center for Asia and the Pacific (RECOFTC) uses community forestry as a means to sustainable development and climate change solutions in seven countries of the Asia Pacific region (https://www.recoftc.org/).
- Center for International Forestry Research (CIFOR), now merged with World Agroforestry (ICRAF), is a scientific institution that works, along with many other forestry topics, with communities across the tropics to build knowledge related to governance and use and devolution of natural resources (https://www.cifor.org/topic/community-forestry/).
- The International Union of Forest Research Organizations (IUFRO) has a unit focussed on community forestry (Unit 9.05.06) under the subsection of forest policy and governance (https://www.iufro.org/science/divisions/division-9/).
- FAO has a section of their website dedicated to CBFM, but the topic cuts across several other in which FAO is involved (http://www.fao.org/forestry/participatory/90729/en/).
- Despite not having a section explicitly on CBFM, the International Tropical Timber Organization (ITTO) has rich material on Tropical Forest

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

Management, which comprises community management (https://www.itto.int/sfm/).

Country- and region-specific syntheses of CBFM have been published. Examples are provided below.

- Nath, T. K., Jashimuddin, M., and Inoue, M. (2016). Community-based forest management (CBFM) in Bangladesh (Vol. 22). Switzerland: Springer.
- Pulhin, J. M., Inoue, M., & Enters, T. (2007). Three decades of community-based forest management in the Philippines: emerging lessons for sustainable and equitable forest management. The International Forestry Review, 9(4), 865–883.
- Odera, J. (2004). Lessons learnt on community forest management in Africa. A report prepared for the project 'Lessons Learnt on Sustainable Forest Management in Africa'. Royal Swedish Academy of Agriculture and Forestry (KSLA), African Forest Research Network (AFORNET) and Food and Agriculture Organization of the United Nations (FAO).

10 References

Agrawal, A. 2007. Forests, governance, and sustainability: common property theory and its contributions. *International Journal of the Commons* 1(1): 111–136.

Antinori, C. and Rausser, G. C. 2008. Ownership and control in Mexico's community forestry sector. *Economic Development and Cultural Change* 57(1): 101–136.

Arnold, J. E. M. 2001. *Forests and People: 25 Years of Community Forestry*. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

Baral, S. and Vacik, H. 2018. What governs tree harvesting in community forestry? *Forests* 9(10): 649–665.

Baynes, J., Herbohn, J., Smith, C., Fisher, R. and Bray, D. 2015. Key factors which influence the success of community forestry in developing countries. *Global Environmental Change* 35: 226–238.

Baynes, J., Herbohn, J. and Unsworth, W. 2017. Reforesting the grasslands of Papua New Guinea: the importance of a family-based approach. *Journal of Rural Studies* 56: 124–131. doi:10.1016/j.jrurstud.2017.09.012.

Beauchamp, E. and Ingram, V. J. I. F. R. 2011. Impacts of community forests on livelihoods in Cameroon: lessons from two case studies. *International Forestry Review* 13(4): 389–403.

Bixler, R. P. 2014. From community forest management to polycentric governance: assessing evidence from the bottom up. *Society and Natural Resources* 27(2): 155–169.

Bonn Challenge 2019. *The Challenge: A Global Effort*. IUCN, Gland, Switzerland.

Borrini-Feyerabend, G., Pimbert, M., Farvar, T., Kothari, A. and Renard, Y. 2004. *Sharing Power: Learning-by-Doing in Co-Management of Natural Resources throughout the World*. IIED, London and IUCN, Cambridge, UK.

Brazil Forest Service 2016. Programa Federal de Manejo Florestal Comunitário e Familiar. In: Ministry of Agriculture, L.a.S. (Ed.), Desenvolvimento Florestal.

AQ: Please provide an in-text citation for reference "Brazil Forest Service (2016)".

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

Bruyn, T. d. and Veer, C. 2014. *Strengthening Forest Tenure Systems and Governance: Training Module for Facilitators*. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

Cacho, O. J., Marshall, G. R. Milne, M. J. E. and Economics, D. 2005. Transaction and abatement costs of carbon-sink projects in developing countries. *Environment and Development Economics* 10(5): 597–614.

Calderon, M. M. and Nawir, A. A. 2006. An evaluation of the feasibility and benefits of forest partnerships to develop tree plantations: case studies in the Philippines. CIFOR Working Paper No. 27. Centre for International Forestry Research, Bogor, Indonesia.

Casse, T. and Milhøj, A. 2011. Community forestry and forest conservation: friends or strangers? *Environmental Policy and Governance* 21(2): 83–98.

Charnley, S. and Poe, M. R. 2007. Community forestry in theory and practice: where are we now? *Annual Review of Anthropology* 36(1): 301–336.

Chhetri, B. B. K., Johnsen, F. H., Konoshima, M. and Yoshimoto, A. 2013. Community forestry in the hills of Nepal: determinants of user participation in forest management. *Forest Policy and Economics* 30: 6–13.

Chokkalingam, U., Carandang, A. P., Pulhin, J. M., Lasco, R. D., Peras, R. J. J. and Toma, T. (Eds). 2006. *One Century of Forest Rehabilitation in the Philippines: Approaches, Outcomes and Lessons*. Centre for International Forestry Research (CIFOR), Bogor, Indonesia.

Couillard, V., Gilbert, J., Kenrick, J. and Kidd, C. 2009. Land rights and the forest peoples of Africa-historical, legal and anthropological perspectives, Vol. 0, Overview: analysis and context. Forest Peoples Programme, Moreton-in-Marsh, UK Available at: www.rightsandresources.org/documents/files/doc_1200.pdf.

Cowling, P., DeValue, K. and Rosenbaum, K. 2014. *Assessing Forest Governance: A Practical Guide to Data Collection, Analysis and Use*. PROFOR and FAO Washington, DC.

Dak Lak Department of Agriculture and Rural Development 2005. *Guidelines for Community-Based Forest Management*. Dak Lak, Vietnam.

De Jong, W., Pokorny, B., Katila, P., Galloway, G. and Pacheco, P. 2018. Community forestry and the sustainable development goals: a two way street. *Forests* 9(6): 331.

Dev, O. P., Yadav, N. P., Springate-Baginski, O. and Soussan, J. 2003. Impacts of community forestry on livelihoods in the middle hills of Nepal. *Journal of Forest and Livelihood* 3: 64–77.

DFID 1999. *Sustainable Livelihoods Guidance Sheets*. DFID, London, UK.

Duguma, L. A., Atela, J., Ayana, A. N., Alemagi, D., Mpanda, M., Nyago, M., Minang, P. A., Nzyoka, J. M., Foundjem-Tita, D. and Ngo Ntamag-Ndjebet, C. 2018 Community forestry frameworks in sub-Saharan Africa and the impact on sustainable development. *Ecology and Society* 23(4): 21.

Elliott, S., Chairuangsri, S., Kuaraksa, C., Sangkum, S., Sinhaseni, K., Shannon, D., Nippanon, P. and Manohan, B. 2019. Collaboration and conflict–developing forest restoration techniques for northern Thailand's upper watersheds whilst meeting the needs of science and communities. *Forests* 10(9): 732.

Estoria, E., Herbohn, J. and Harrison, S. 2004. The performance of community organisers in promotion of community forestry in Leyte Province, Philippines. *Small-Scale Forest Economics, Management and Policy* 3(3): 363–384.

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

FAO. 1978. Forestry for local community development. Forestry Paper 7. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO 2012. *Guidelines for Institutionalizing and Implementing Community-Based Forestry Management in Sub-Saharan Africa*. Food and Agriculture Organization of the United Nations, Regional Office for Africa, Accra.

FAO 2016. *Global Forest Resources Assessment 2015: How Are the World's Forests Changing?* Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO 2019a. *Assessing the Governance of Tenure for Improving Forests and Livelihoods – A Tool to Support the Implementation of the Voluntary Guidelines on the Responsible Governance of Tenure*. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO 2019b. *A Framework to Assess the Extent and Effectiveness of Community-Based Forestry*. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO 2020. Sustainable forest management. Available at: http://www.fao.org/forestry/sfm/en/ (accessed 24/2/2020).

Garcia, C. A. and Lescuyer, G. J. B. 2008. Monitoring, indicators and community based forest management in the tropics: pretexts or red herrings? *Biodiversity and Conservation* 17(6): 1303–1317.

Gautam, A. P. 2009. Equity and livelihoods in Nepal's community forestry. *International Journal of Social Forestry* 2: 101–122.

Giam, X. 2017. Global biodiversity loss from tropical deforestation. *Proceedings of the National Academy of Sciences of the United States of America* 114(23): 5775–5777.

Gilmour, D. 2016. *Forty Years of Community-Based Forestry: A Review of Its Extent and Effectiveness*. Food and Agriculture Organization of the United Nations, Rome, Italy.

Gregorio, N. O., Herbohn, J. L., Harrison, S. R., Pasa, A., Fernandez, J., Tripoli, R. and Polinar, B. 2015. Evidence-based best practice community-based forest restoration in Biliran: integrating food security and livelihood improvements into watershed rehabilitation in the Philippines. In: IUCN (Ed.), *Enhancing Food Security through Forest Landscape Restoration: Lessons from Burkina Faso, Brazil, Guatemala, Viet Nam, Ghana, Ethiopia and Philippines*. International Union for Conservation of Nature (IUCN), Gland, Switzerand, pp. 177–217.

ITTO and Rights and Resources Initiative 2011. Tropical forest tenure assessment. In: Hatcher, J. and Bailey, L. (Eds), *Trends, Challenges and Opportunities*. Rights and Resources Initiative, Washington DC, USA and ITTO, Yokohama, Japan.

Jeanrenaud, S. 2001. *Communities and Forest Management in Western Europe. A Regional Profile of the Working Group on Community Involvement in Forest Management*. IUCN, Gland, Switzerland.

Jong, W. d., Cornejo, C., Pacheco, P., Pokorny, B., Stoian, D., Sabogal, C. and Louman, B. 2010. *Opportunities and Challenges for Community Forestry: Lessons from Tropical America*. International Union of Forestry Research Organizations (IUFRO), Vienna, Austria.

Kaimowitz, D. and Angelsen, A. 1998. *Economic Model for Tropical Deforestation*. Center for International Forestry Research, Bogor.

Keenan, R., Brack, C. L., Golman, M. and Vanclay, J. K. (2011). A simple planning system for sustainable timber harvesting in Papua New Guinea. In: Fox, J. C., Keenan, R., Brack, C. L. and Saulei, S. (Eds), *Native Forest Management in Papua New Guinea*. ACIAR Proceedings, 135, Canberra, Australia.

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

Lambin, E. F. and Geist, H. J. 2003. Regional differences in tropical deforestation. *Environment: Science and Policy for Sustainable Development* 45(6): 22–36.

Lambin, E. F. and Meyfroidt, P. 2010. Land use transitions: socio-ecological feedback versus socio-economic change. *Land Use Policy* 27(2): 108–118.

Landell-Mills, N. and Porras, T. I. 2002. Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor. *Instruments for Sustainable Private Sector Forestry Series*. International Institute for Environment and Development (IIED), London.

Larson, A. M., Barry, D., Dahal, G. R. and Colfer, C. J. P. 2010. Tenure change in the global south. In: Larson, A.M., Barry, D., Dahal, G.R., Colfer, C.J.P. (eds.), *Forests for People: Community Rights and Forest Tenure Reform*. Earthscan Publications, London, pp. 3–18.

Larson, A. M. and Dahal, G. R. 2012. Forest tenure reform: new resource rights for forest-based communities? *Conservation and Society* 10(2): 77–90.

Le, H. D., Smith, C. and Herbohn, J. 2014. What drives the success of reforestation projects in tropical developing countries? The case of the Philippines. *Global Environmental Change* 24: 334–348. doi:10.1016/j.gloenvcha.2013.09.010.

Le, H. D., Smith, C., Herbohn, J. and Harrison, S. 2012. More than just trees: assessing reforestation success in tropical developing countries. *Journal of Rural Studies* 28: 5–19. doi:10.1016/j.jrurstud.2011.07.006.

Li, T. M. 2002. Engaging simplifications: community-based resource management, market processes and state agendas in upland Southeast Asia. *World Development* 30(2): 265–283.

Lowe, E. 2005. Economic solutions. In: Agardy, F. J. and Nemerow, N. L. (Eds), *Environmental Solutions*. Burlington: Academic Press.

Macqueen, D. 2013. Enabling conditions for successful community forest enterprises. *Small-Scale Forestry* 12(1): 145–163.

Malla, Y. B. 2000. Impact of community forestry on rural livelihoods and food security. *Unasylva* 202: 37–45.

Mansourian, S. 2017. Governance and forest landscape restoration: a framework to support decision-making. *Journal for Nature Conservation* 37: 21–30.

Maryudi, A., Devkota, R. R., Schusser, C., Yufanyi, C., Salla, M., Aurenhammer, H., Rotchanaphatharawit, R. and Krott, M. 2012. Back to basics: considerations in evaluating the outcomes of community forestry. *Forest Policy and Economics* 14(1): 1–5.

Mayers, J., Morrison, E., Rolington, L., Studd, K. and Turrall, S. 2013. *Improving Governance of Forest Tenure: A Practical Guide*. International Institute for Environment and Development, Food and Agriculture Organization of the United Nations, Rome, Italy.

Ministry of Agriculture Water and Forestry 2005. *Community Forestry Guidelines*. Directorate of Forestry, Windhoek.

Molnar, A., et al. 2010. Community-led forest enterprises in tropical forest countries: status and potential. ITTO/RRI/Forest Trust. Available at: https://rightsandresources.org/wp-content/exported-pdf/cfescopingitto62207final.pdf.

Mukul, S. A., Herbohn, J., Rashid, A. Z. M. M. and Uddin, M. B. 2014. Comparing the effectiveness of forest law enforcement and economic incentive to prevent illegal logging in Bangladesh. *International Forestry Review* 16(3): 363–375.

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

Mukul, S. A., Rashid, A. Z. M. M., Quazi, S. A., Uddin, M. B. and Fox, J. 2012. Local peoples' response to co-management in protected areas: a case study from Satchari National Park, Bangladesh. *Forests, Trees and Livelihoods* 21(1): 16–29.

Mukul, S. A., Sohel, M. S. I., Herbohn, J., Inostroza, L. and König, H. 2017. Integrating ecosystem services supply potential from future land-use in protected area management: a Bangladesh case study. *Ecosystem Services* 26: 355–364.

Odera, J. 2004. Lessons learnt on community forest management in Africa. Report prepared for the project Lessons Learnt on Sustainable Forest Management in Africa. Royal Swedish Academy of Agriculture and Forestry (KSLA), African Forest Research Network (AFORNET) and FAO, Nairobi, Kenya.

Pelletier, J., Gélinas, N. and Skutsch, M. 2016. The place of Community Forest Management in the REDD+ landscape. *Forests* 7(12): 170–194.

Poffenberger, M. (Ed.). 2000. *Communities and Forest Management in South Asia*. IUCN, DFID, and Asia Forest Network, Bohol, Philippines.

Pokharel, B. K., Branney, P., Nurse, M. and Malla, Y. B. J. 2007. Community forestry: conserving forests, sustaining livelihoods and strengthening democracy. *Journal of Forest and Livelihood* 6: 8–19.

RRI, 2018. Scaling Up Locally-Controlled Forest Enterprises: Final Report. Rights and Resources Initiative (RRI)/INDUFOR Report: 30068. Available at: https://rightsandresources.org/wp-content/uploads/2019/12/Workshop-Brief_Scaling-Up-LCFEs_Indufor-3.pdf.

Sabogal, C., Besacier, C. and McGuire, D. J. U. 2015. Forest and landscape restoration: concepts, approaches and challenges for implementation. *Unasylva* 245(66): 3–10.

Sands, R. 2005. *Forestry in a Global Context*. CABI, Oxfordshire, UK.

Schusser, C. 2013. Who determines biodiversity? An analysis of actors' power and interests in community forestry in Namibia. *Forest Policy and Economics* 36: 42–51.

Shackleton, S., Campbell, B., Wollenberg, E. and Edmunds, D. J. 2002. Devolution and community-based natural resource management: creating space for local people to participate and benefit. *Natural Resource Perspectives* 76: 1–6.

Shrestha, K. K. and McManus, P. 2007. The embeddedness of collective action in Nepalese community forestry. *Small-Scale Forestry* 6(3): 273–290.

Stoin, D., et al. 2018. Forest concessions in Petén, Guatemala – a systematic review of the socioeconomic performance of community enetrprises in the Maya Biosphere Reserve. CIFOR. Available at: http://www.cifor.org/publications/pdf_files/brief/7163-brief.pdf.

Sunderlin, W. D. 2006. Poverty alleviation through community forestry in Cambodia, Laos, and Vietnam: an assessment of the potential. *Forest Policy and Economics* 8: 386–396. doi:10.1016/j.forpol.2005.08.008.

Sunderlin, W. D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L. and Wunder, S. 2005. Livelihoods, forests, and conservation in developing countries: an overview. *World Development* 33(9): 1383–1402.

Thoms, C. A. 2008. Community control of resources and the challenge of improving local livelihoods: a critical examination of community forestry in Nepal. *Geoforum* 39(3): 1452–1465.

Tomaselli, M. F. and Hajjar, R. 2011. Promoting Community Forestry Enterprises in national REDD+ strategies: a business approach. *Forests* 2(1): 283–300.

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.

UN Environment 2019. New UN Decade on Ecosystem Restoration offers unparalleled opportunity for job creation, food security and addressing climate change. In: *News and Stories – Press Release*. United Nations Environmental Program.

Van Laerhoven, F. 2010. Governing community forests and the challenge of solving two-level collective action dilemmas—a large-N perspective. *Global Environmental Change* 20(3): 539–546.

Vickers, B., Trines, E. and Pohnan, E. 2012. *Community Guidelines for Accessing Forestry Voluntary Carbon Markets*. Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok.

White, A. and Martin, A. 2002. *Who Owns the World's Forests? Forest Tenure and Public Forests in Transition*. Forest Trends, Washington, DC.

Wiersum, K. F., Singhal, R. and Benneker, C. 2004. Common property and collaborative forest management: rural dynamics and evolution in community forestry regimes. *Forests, Trees and Livelihoods* 14(2–4): 281–293.

Wunder, S. 2005. Payments for environmental services: some nuts and bolts. *CIFOR Occasional Paper No. 42*. CIFOR, Bogor, Indonesia.

Wunder, S. 2008. Payments for environmental services and the poor: concepts and preliminary evidence. *Environment and Development Economics* 13(3): 279–297.

© Burleigh Dodds Science Publishing Limited, 2020. All rights reserved.