Prioritising support for locally controlled forest enterprises

Duncan Macqueen (ed.), Emmanuelle Andaya, Samuêl Begaa, Mario Bringas, Martin Greijmans, Tony Hill, Shoana Humphries, Barthelemy Kabore, Thibault Ledecq, Tabin Lissendja, Alphonse Maindo, Amalia Maling, David McGrath, Simon Milledge, Femy Pinto, Nguyen Quang Tan, Elvis Tangem, Stella Schons and Bhishma Subedi

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Forest Connect

FOREST AND FARM FACILITY

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Contents

Acronyms

ADIKIS	Action for the Integral Development of Kisangani and the Congolese Central Basin (DRC)
AMECAFE	Mexican Association of Coffee Production
ANSAB	Asia Network for Sustainable Agriculture and Bioresources (Nepal)
APILAF	Association for the Promotion of Local Initiatives in the Forested Areas of Africa
ASPIRO	Association of Pirogue Fishermen (DRC)
CBHE	Cambodian Federation for Bee Conservation and Community-based Honey Enterprises
CFUG	community forest user group (Nepal)
CIFOR	Centre for International Forestry Research
CO_2	carbon dioxide
COREX	Congo Relais pour l'Exploitation et l'Exportation (DRC)
DAP	declaração de aptidão (Brazil)
DFID	Department for International Development (United Kingdom)
DRC	Democratic Republic of the Congo
EAC	East African Community
EPL	eastern plains landscape (Cambodia)
FAO	Food and Agriculture Organization of the United Nations
FLEGT	Forest Law Enforcement Governance and Trade
GDP	gross domestic product
G3	The three rights-holders groups of family, community and indigenous farm-foresters
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IBAMA	Instituto Brasileiro do Meio Ambiente E Dos Recursos Naturais Renováveis (Brazil)
IBGE	Instituto Brasileiro de Geografia e Estatistica (Brazil)
IEA	International Energy Agency
IFA	Institut Facultaire des Sciences Agronomique de Yangambi (DRC)
IIED	International Institute for Environment and Development
INCRA	Instituto Nacional de Colonização e Reforma Agrária (Brazil)
INERA	Institut National d'Etudes et Recherche Agronomique (DRC)
IPAM	Instituto de Pesquisas Ambientais da Amazônia (Brazil)
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
MARD	Ministry of Agriculture and Rural Development (Vietnam)
MEDD	Ministère de l'Environnement et du Developpement Durable (Burkina Faso)
MPF	Mondulkiri Protected Forest (Cambodia)
NGO	non-governmental organisation
NTFP	non-timber forest product
NTFP-EP	NTFP Exchange Programme for South and Southeast Asia
OCEAN	Organisation Concertée des Ecologistes et Amis de la Nature (DRC)
OECD	Organisation for Economic Co-operation and Development
PAA	Programa de Aquisição de Alimentos (Brazil)
PAIDECO	Projet d'Appui aux Initiatives de Développement Communautaire dans la Tshopo (DRC)
PFM	participatory forest management
PNAE	Programa Nacional de Alimentação Escolar (Brazil)

PPGM	minimum price policy (Brazil)
PROCACAU	National Programme for the Expansion of Cocoa Cultivation (Brazil)
RECOFTC	Center for People and Forests
REDD+	reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries
RRI	Rights and Resources Initiative
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
SFB	Serviço Florestal Brasileiro (Brazil)
SMFE	small and medium forest enterprise
SOTEXKI	Société Textile de Kisangani (DRC)
TFD	The Forests Dialogue
UN	United Nations
UNIKIS	University of Kisangani (DRC)
US$	United States dollar
VND	Vietnamese dong
WWF	World Wide Fund for Nature

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Executive summary

In a finite biosphere there is a limit to what a growing human population can do and still survive – what may be termed a safe operating space. Maintaining a safe operating space requires respect for planetary boundaries, but such boundaries have already been breached on at least three fronts: climate change, biodiversity loss and atmospheric nitrogen removal. It also requires respect for social foundations to meet the basic needs of all humanity, such as income generation, food security, energy security and access to clean water. How to achieve a safe operating space is increasingly the focus of those designing post-2015 development frameworks, to which the potential contribution of forests is the topic for this book.

How forests are treated in post-2015 development frameworks is important because of the substantial contributions that forests make towards respecting both planetary boundaries and social foundations. At Rio+20, forest actors of all sorts championed a green economy that would move humanity towards this safe operating space. Agroindustries pushed for a bio-economy that would replace the unsustainable use of petrochemicals. Local forest rightsholders pushed for greater entitlement and support to produce food, fuel and fibre products in ways that would improve local livelihoods and resilience in the face of increasing environmental and economic shocks. Both these groups acknowledged that the green economy should be less about 'greening what is economic' and more about 'making economic what is green'. The main contention between them was on the extent to which a green economy would be inclusive and would respect the social foundations of the poor.

Since 2007, an ad hoc international alliance, Forest Connect, has linked institutions that support locally controlled forest enterprises in order to bring about an 'inclusive green economy' that will help humanity move towards a safe operating space – both socially and environmentally. The sheer scale of locally controlled forest enterprises is at once an opportunity and a challenge. On one hand, these (often informal) myriad enterprises constitute the largest forest-based 'private sector' and therefore have the potential to restore forest landscapes and transform communities. On the other hand, providing the support required to unleash this potential – when spread across often remote forest areas – is a formidable challenge. For that reason, the Forest Connect alliance organised an international learning event in Nepal in 2013, the third in a series of similar events, to discuss how best to prioritise scarce resources for the support of locally controlled forest enterprises. Should particular locally controlled forest subsectors receive priority support because of the disproportionately positive social and environmental impacts such subsectors would have? If so, what types of support might best deliver those positive impacts? These were the questions to be discussed.

In preparation for the event, teams were commissioned to prepare background papers that assessed, in eight very different country contexts, which subsectors should be prioritised for support on account of their likely social and environmental impacts. Chapter 1 describes in more detail the rationale and terms of reference of those background papers – chosen to represent a wide spread of forest ecosystems across Africa, Asia and Latin America.

The main body of this book (chapters 2-9) comprises a detailed assessment of the likely impacts of small-enterprise support across different forest subsectors in each of the eight countries (which, in the order of the chapters, are Nepal, Brazil, Burkina Faso, Vietnam, Mexico, Tanzania, Cambodia and the Democratic Republic of the Congo). The teams first assessed the economic prospects of each locally controlled forest subsector and then evaluated the likely impacts against seven impact criteria: (i) income-generating potential; (ii) gender balance in such income generation; (iii) contribution to food security; (iv) contribution to energy security; (v) contribution to climate change mitigation and adaptation; (vi) biodiversity; and (vii) capacity to improve soil fertility without chemical nitrogen inputs. Chapter 10 analyses the divergences and similarities between countries, draws out lessons, and makes policy recommendations.

What is immediately striking in the eight country chapters is that each team rejects a single subsectoral (monotypic) priority. In other words, even the most profitable, socially and environmentally sustainable smallholder production system is judged to be unable, as a 'monotypic mass', to deliver all the desired public goods for local people, let alone for both local and distant populations. Instead, progress against multiple social and environmental criteria requires support for a portfolio or blend of subsectoral enterprises — that is, an approach based on 'multifunctional mosaics'.

In each country context it was possible to identify a multifunctional mosaic blend of subsectors of locally controlled forest enterprisese that would do the job of ensuring local sustainability in a system that also included international public goods, such as climate regulation and biodiversity conservation. For example, the Nepal team prioritised ecosystem-based farming, charcoal briquette production, and timber. The Brazil team prioritised timber production derived from natural forests and agroforestry, as well as the domestication of non-timber forest products (NTFPs) in forest and farm settlements. The Burkina Faso team prioritised tree-crop food enterprises and agroforestry fertiliser trees that support agricultural yields, along with secondary woodlot energy and NTFP enterprises. The Democratic Republic of the Congo team prioritised almost everything – timber, wood energy, cash crops and NTFPs, with all requiring significant governance interventions to promote a formal and sustainable supply. The Mexican team prioritised tree-based cash crops, such as coffee and honey, with timber and woodfuel from managed natural forests. The Tanzanian team prioritised woodlots for timber and woodfuel, plus briquetted farm waste for energy, with the development of fertiliser trees and indigenous fruit trees. The Vietnam team prioritised tree-based cash crops, for example rubber, coffee and pepper, with community plantation wood and NTFPs. The Cambodia team opted for blended NTFP options and did not assess other options owing to strong restrictions on local timber businesses.

Many of the country chapters advance recommendations that are sometimes generic and sometimes linked to support for particular subsectors of locally controlled forest enterprises. Two areas of support are particularly prominent. One is support for the brokering of policy deals to improve natural resource governance and tenure. The lack of secure land and forest rights upon which locally controlled forest enterprises can be built remains one of the key stumbling blocks to enterprise support actions that aim to deliver impacts across multiple social and environmental criteria. The second area where support is particularly needed is investment in organisation-building for forest and farm producer organisations. Across a wide range of country contexts, stronger enterprise organisation is critical for developing the scale efficiencies and networks that will bring significant volumes of reliable quality to the market, whether domestic or international.

The recommendations of the country teams recognise a further two priority areas of support for locally controlled forest enterprises: ongoing support for capacity development in business management; and research into, and development of, appropriate mixes of enterprise options within multifunctional mosaics at a landscape scale that also restore the ecosystems upon which future prosperity will be based.

Much practical work can be done to improve support for locally controlled forest enterprises that deliver multiple positive social and environmental impacts. This is often referred to as 'enabling investment' because it falls outside the remit of – but is a necessary precondition to leverage – more conventional 'asset investment'. Four key policy recommendations, to a wide range of government, private-sector and civil-society actors that spring from this work are:

1. Secure commercial land and resource tenure for local people.
2. Simplify the procedures through which enterprise-oriented organisations and ultimately political federations can emerge and provide the space and logistics to catalyse such organisation-building.
3. Invest in practical programmes that strengthen the business capacity of locally controlled forest enterprises.
4. Revitalise the necessary technical extension services to install a mosaic of enterprise options that delivers multiple positive social and environmental impacts.

In the forest sector, current development agendas are focused primarily on two main approaches: (i) using trade conditionality to enforce legality assurances for timber, for example through the Forest Law Enforcement, Governance and Trade (FLEGT) initiative of the European Union and the Lacey Act of the United States; and (ii) using climate finance linked to reducing emissions from deforestation and forest degradation (REDD+) to broker better forest governance and provide financial incentives for the sustainable management of forest and farm landscapes.

Given the very large number of locally controlled forest enterprises and their many positive social and environmental impacts, a critical element of both the trade conditionality and REDD+ programmes must surely be to support the locally controlled forest sector. To do that, such programmes must pay much more explicit attention to the four recommendations given above. For example, how do the latest FLEGT and REDD+ strategies secure commercial land and forest rights for local people? How do they foster associations that can generate scale efficiencies and ensure smallholder representation to further improve the national enabling environment? How do they set out to build the capacity of sustainable locally controlled forest enterprises in multifunctional landscape mosaics? How do they equip those producers with the agronomic and technical knowledge to manage diverse portfolios of enterprise options?

If initiatives can give good answers to these questions, they are likely to be on the right track. If they are unable to answer them adequately, however, they are likely to be fostering large-scale, monotypic approaches that probably won't result in an inclusive green economy or a safe operating space for humanity. This matters because, at present, humanity is crashing through planetary boundaries while still failing to meet the needs of the world's poorest people.

Smallholder agroforester in Myanmar discussing Elephant Foot Yam crop.

1 Developing criteria through which to screen support priorities

Duncan Macqueen

1.1 Introduction

The pursuit of a 'green economy' received a substantial push at Rio+20 and is now centre stage in efforts to design post-2015 development frameworks. But there was divergence at Rio+20 between the hopes of agro-industries for the creation of a bio-economy in which large-scale corporations would increasingly provide agricultural commodities, biofuels, construction materials and the chemical building blocks of a new range of non-petrochemical bio-products; and the hopes of local forest rightsholders for the local provision of food, energy and construction materials to strengthen communities and their resilience in the face of environmental and economic shocks. Central to both approaches was the idea that a green economy should be less about 'greening what is economic' than about 'making economic what is green'. The divergence was over the degree to which such a green economy would be inclusive and fair in the ownership and use of the factors of production.

Since 2007, an ad hoc international alliance, Forest Connect, has linked institutions that support locally controlled forest enterprises in order to bring about an 'inclusive green economy'. Co-managed by the International Institute for Environment and Development (IIED), the Forest and Farm Facility (hosted by the Food and Agriculture Organization of the United Nations – FAO) and the Center for People and Forests (RECOFTC), Forest Connect seeks to tackle the isolation that plagues the attempts of such enterprises to access markets. Forest Connect aims 'to avoid deforestation and reduce poverty by better linking sustainable locally controlled forest enterprises to each other, to markets, to service providers and to policy processes'. Its partners help locally controlled forest enterprises compete, on the basis that such enterprises generally meet local needs, accrue incomes locally, strengthen local social networks, build entrepreneurial capacity, enhance social and environmental accountability, and respect local cultural traditions in ways that agro-industries generally do not, and that these are important for a just and resilient future (Molnar *et al.*, 2007; Chhatre and Agrawal, 2009; Porter-Bolland *et al.*, 2011; Nelson and Chomitz, 2011).

Despite positive reviews of the work of the Forest Connect alliance (Inglis, 2013) that highlighted the economic, social and environmental gains to be had by strengthening locally controlled forest enterprises, few resources have been available to support its work. The general scarcity of support for locally controlled forest enterprises runs in the face of the obvious relationships between such enterprises and, for example, pro-business poverty reduction, efforts to tackle market failure and promote ethical trade, the implementation of (in a lot of cases) existing laws, especially those aimed at securing land tenure and forest rights, the prospects for economic growth and the generation of new tax revenues, and active environmental stewardship, relationships that are all backed by strong metrics. In his review of Forest Connect, Inglis (2013) found the lack of donor support 'baffling', and he

identified a number of possible factors: the (erroneous) belief that such enterprise support is inherently risky; the lack of appreciation for the transaction costs of securing commercial rights, strengthening functional enterprise-oriented organisations, and building business capacity at a scale that rewards asset investors; the potential that an enterprise approach is, on the one hand, too much about markets – albeit fair and ethical ones – for some community development funding streams or, on the other hand, too niche-based to attract larger private-sector funding streams; and a failure to comprehend how cross-cutting such work is with attempts to ensure legal trade, for example, through Voluntary Partnership Agreements within Forest Law Enforcement Governance and Trade (FLEGT) programmes, or forest restoration and management, for example, in strategies for reducing emissions from deforestation and forest degradation (REDD+).

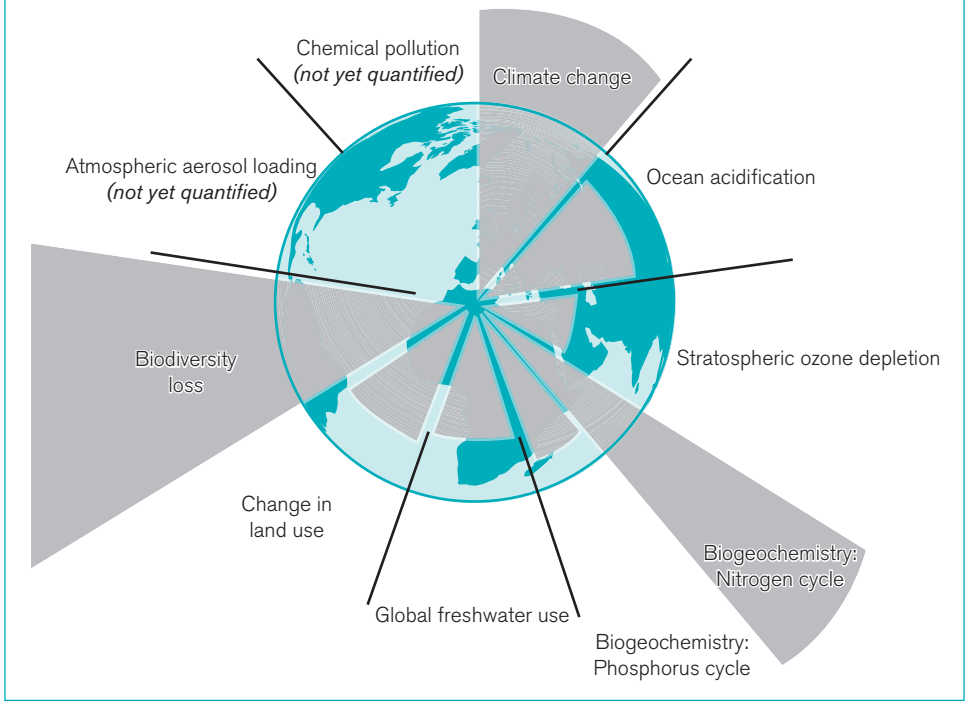
Irrespective of the reason behind the lack of support for locally controlled forest enterprises to date, a proactive approach is to ask how best to use the scarce resources that are available. It was with that intention that Forest Connect partners met in Kathmandu, Nepal, on 12–15 February 2013. Eight country papers were commissioned which sought to assess how such a prioritisation might best be done to optimise both socio-economic and environmental indicators (Macqueen and Rolington, 2013). A background paper attempted to guide the selection of criteria against which such prioritisation exercises could be run. This chapter captures the content of that background paper and the following chapters comprise edited versions of the country papers. The final chapter analyses the conclusions to emerge from the collective body of work.

1.2 A complex socio-economic and environmental problem unpacked

In a finite biosphere there are limits to what growing human populations can do and still survive – a 'safe operating space'. With humans now the dominant driver of change in the earth's system, an era some call the Anthropocene (Crutzen, 2002), new responsibilities to maintain the safe operating space have emerged. Seven of nine key planetary boundaries have been quantified (Rockström *et al.*, 2009), showing that humankind has already overstepped three of these boundaries: climate change (global impacts from extreme weather events); biodiversity loss (local or regional impacts involving unquantified disruptions to ecosystem services); and atmospheric nitrogen removal, resulting in localised acidification of terrestrial systems and regional eutrophication of freshwater and coastal systems (Figure 1).

To these environmental planetary boundaries must be added the fulfilment of basic human needs, which also have a number of dimensions, such as food, energy, water, income and education. For many 'have-nots', these 'social foundations' are just as pressing a concern for survival as environmental planetary boundaries (Raworth, 2012). Raworth (2012) demonstrated that large percentages of humanity are falling below the social foundations: for example, 13 per cent of the global population lack food security, 19 per cent lack electricity, 39 per cent lack clean cooking facilities, 13 per cent lack improved drinking water, 21 per cent live below US$1.25 purchasing power parity income per day, and 10 per cent are not enrolled in primary education.

Figure 1. The nine planetary boundaries and the extent to which they are being overstepped



Source: Rockstrom *et al.*, 2009

The combination of these two concepts of environmental planetary boundaries and social foundations provides what Raworth (2012) called 'living inside the donut' – or the safe and just space for humanity (Figure 2). As Raworth noted, environmental stresses such as climate change can exacerbate attempts to build social foundations, such as food security. Conversely, people without adequate social foundations – if they lack food or energy, for example – can exacerbate environmental stress, such as by deforesting land to grow crops. Similarly, attempts to reduce environmental stress, such as switching to biofuels to reduce climate change, can exacerbate poverty, for example, by displacing subsistence agricultural crops. Conversely, attempts to improve social foundations, such as fertiliser subsidies, can exacerbate environmental stress – for example, excessive chemical nitrogen use adds little to crop yields but leads to acidification and eutrophication.

Thus, humanity faces a major, potentially catastrophic problem – the diminution of its safe operating space. Forests offer a partial solution. Below, six key issues are described – three related to social foundations and three to environmental boundaries – that can be addressed by providing more support for locally controlled forest and farm enterprises in forest landscapes.

Figure 2. The safe and just space for humanity

Source: Raworth, 2012

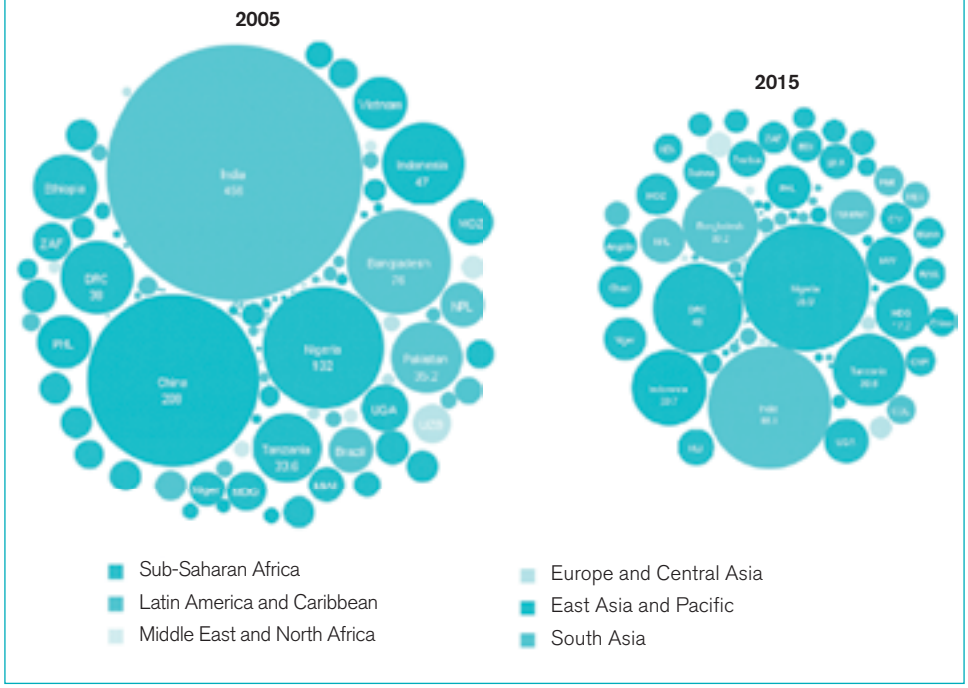
Social foundations

Income. The Millennium Development Goal of halving world poverty by 2015 has already been achieved, and improving incomes for the 1.4 billion people who live on less than US$1.25 per day would require less than 0.2 per cent of global income (Chandy and Gertz, 2011). Poverty has distinct geographical dimensions, both between countries (Figure 3) and between rural and urban populations – with urban poverty increasing due to migration towards towns and cities. Nevertheless, there are still high levels of poverty in many of the world's forest areas, notably in sub-Saharan Africa and South and Southeast Asia and to a lesser extent in Central and South America. Income generation is a particularly important social foundation because it provides the wherewithal for local people to pursue other social foundations, such as jobs, education, health and political voice.

In rural areas, agricultural and forest enterprises remain the two main options for generating income. While there is little evidence of poverty reduction through large-scale industrial forestry (Mayers, 2006), prospects are much brighter for locally controlled forest enterprises where income accrues and is reinvested locally, business capacity is strengthened, social organisations are built and cultural norms are respected (Macqueen, 2007). The challenge is to convince government actors to cede commercial control to local people within an enabling environment that helps build capacity and ensure sustainability.

Food security. This is a critical factor in the diminution of the global safe operating space, but it is hotly contested. On the one hand, some commentators assert the need to produce 70-100 per cent more food by 2050 to meet the demands – including the changing dietary demands – of a probable global population of nine billion people (Godfray *et al*., 2010); already, an estimated 842 million people go hungry (FAO, 2013). On the other hand, some commentators suggest it is not the volume but the distribution of food that is problematic, and that it would take just one per cent of current global food supply to meet the needs of the chronically hungry (Raworth, 2012). Changes in the production and distribution of food are clearly required to better meet the needs of the poor.

Figure 3. Changing geographical nature of poverty (in millions)



Source: Chandy and Gertz, 2011

Substantial improvements in tenure security and socio-economic conditions among the poor are also required to enable those most in need of food to intensify and diversify their production. It is increasingly recognised that the 'green revolution' approach to food security (whereby increases in agricultural production have been achieved through the use of high-yield varieties of grains as well as pesticides and industrial fertilisers) has met demand at the expense of agriculture's natural resource base, in some cases jeopardising future production. To be sustainable, agricultural intensification will have to adopt an ecosystem approach, involving conservation agriculture, good seed of high-yielding varieties, the integration of crops, pastures and trees, and integrated pest and soil-fertility management (FAO, 2011a). In other words, future food-production efforts will need to enhance biocapacity (the capacity of an area to provide resources and absorb wastes) and increase local control over production systems.

Without such improvements, and without major demand-side measures among affluent people to reduce overconsumption (Hurtt *et al*., 2011) and food waste (Parfitt *et al*., 2010; Foley, 2011), it is likely that agriculture will expand into the 0.6 billion hectares of forestland that are highly suitable for agricultural production. Such added deforestation would likely have severe environmental consequences (Fischer *et al*., 2002). Resilient local food-production systems are also needed, given the growing risks of yield damage due to extreme weather episodes and the widespread negative climate change impacts projected to occur after the middle of the century (Fischer, 2009). A planetary solution to food security cannot be reached without a redistribution, from the rich to the poor, of consumption and control over agricultural systems, plus investment in resilient local systems that intensify food production.

Energy security. An estimated 1.3 billion people lacked access to electricity in 2011, but they could all obtain such access with less than a one per cent increase in global carbon dioxide (CO_2) emissions (OECD/IEA, 2011). Yet the International Energy Agency (IEA) noted that, notwithstanding regional variations in the global economic recovery, global primary energy demand rebounded by a remarkable five per cent in 2010, pushing CO_2 emissions to a new high; subsidies that encourage the wasteful consumption of fossil fuels jumped to over US$400 billion; and, despite a drive in many countries to increase energy efficiency, global energy intensity worsened for the second straight year (IEA, 2011). Clearly, those with access to energy continued to use more of it in less-efficient ways.

Simply generating sufficient energy, in the right places, is not enough. It is also essential that sufficient energy is generated in ways that are environmentally secure. In 2010, the IEA introduced a 'new-policies scenario' that would result in a level of greenhouse gas emissions consistent with a long-term average global temperature increase of more than 3.5 °C (~650 parts per million of CO_2 equivalent). Without such new policies, the IEA estimated that the average global temperature would increase by 6 °C or more – which would clearly be catastrophic. The new-policies scenario requires, among other interventions, government support for renewables to increase from US$57 billion in 2009 to US$205 billion (in 2009 dollars) by 2035, and a tripling of renewable energy sources – including sustainable hydro, wind, solar, geothermal, modern biomass and marine power – in global primary energy use between 2008 and 2035.

Environmental planetary boundaries

In addition to the three necessary social foundations of income, food security and energy security, any attempt to build a fair green economy must address the critical environmental overshoots that are already occurring. The three most prominent of these are described below.

Climate change. Driven by greenhouse gas emissions, climate change arises in part because of sub-optimal land use, including deforestation (up to 17 per cent of global greenhouse gas emissions), agricultural practices (14 per cent of such emissions), and elements of energy supply (26 per cent) such as the extent and sustainability of biomass energy production (IPCC, 2007). According to FAO (2011b), the annual net rate of forest cover loss fell from 8.3 million hectares per year between 1990 and 2000 (-0.2 per cent per year) to 5.2 million hectares per year between 2000 and 2010 (-0.1 per cent). This overall reduction masks variations between countries and regions. While some countries are losing forest cover, primarily natural tropical forests, others, notably China, are reforesting – primarily through monocultural plantations, with worrying implications for biodiversity. The most important direct drivers of deforestation are agricultural expansion for food and energy production, followed by infrastructure development and unsustainable wood extraction. But indirect underlying drivers, such as population growth, economic growth and changing patterns of consumption, agricultural production and trade, and energy use are also fundamental and do not have single-factor causation (Rademaekers *et al*., 2010).

The three main sources of agricultural greenhouse gas emissions involve nitrous oxide from fertiliser use and soil organic matter breakdown (38 per cent of agricultural emissions); methane from livestock and rice production (32 per cent); and biomass burning (12 per cent) (Smith *et al*, 2008). Agriculture can contribute to mitigation in three ways: by (i) avoiding forest loss; (ii) increasing the storage of carbon in vegetation and soil; and (iii) reducing emissions from fertiliser use, soil organic matter breakdown, and livestock and rice production (World Bank, 2011).

Biodiversity loss. Quantifying biodiversity loss is a difficult science (for a good review see Barnosky *et al*., 2001). Only a fraction (about 1.9 million) of the world's estimated 5–30 million species have been scientifically named. Estimates of the current rate of extinction, primarily from habitat loss, range from 100 to 10,000 times the historical background rate (e.g. Dirzo and Raven, 2003; Mace *et al*, 2005; IUCN, 2007). The rate of extinction is usually calculated based on species–area curves; the bigger the area you sample, the more species you find, but the rate of discovery tails off in a curve. It is possible to estimate, from known rates of habitat loss, the impact on species numbers – both actual extinctions, and species for which extinction is inevitable because the remaining habitat is too small to support them indefinitely (the 'extinction debt'). He and Hubbel (2012) suggested that this method overestimates the likely extinction rate by up to 160 per cent and that a more realistic estimate of the current extinction rate is 40–400 times the historical background rate. The authors pointed out that any overestimation would not negate the severity of the problem but it would affect the rate at which the problem develops.

Species' extinctions mean the permanent loss of unique life forms, some of which may have been useful to humans or have had commercial potential (although this is often unknown). Extinctions also undermine the adaptive potential of remaining ecosystems, which is a key consideration given likely climate change scenarios. But perhaps more significant than the loss of biodiversity in natural ecosystems has been the deliberate reduction of biodiversity in agricultural and tree crops in search of higher crop yields (and profits) to meet global demand as part of the green revolution. Since the 1900s, some 75 per cent of plant genetic diversity has been lost as farmers worldwide have switched their multiple local varieties and landraces for genetically uniform, high-yielding varieties (FAO, 2004). An estimated 30 per cent of livestock breeds are at risk of extinction – six breeds are lost each month. Three cereals, wheat, rice and corn, provide 60 per cent of human food, a further indication of the loss of agricultural diversity. A central premise of epidemiology is that both the number and incidence of diseases increase in proportion to host abundance, which puts in doubt the stability of a global strategy of food production in which just three species account for so high a proportion of production (Tilman *et al*., 2002).

In the forest sector, a handful of fast-growing eucalypt, pine and acacia species provides most of the world's construction wood, pulp and biomass energy. As in agriculture, monocultures are particularly vulnerable to pest and disease outbreaks, and this is likely to be exacerbated by climate change. For example, Logan et al. (2003) wrote that 'the majority of results assessing individual pest species' response to climate change indicate intensification in all aspects of outbreak behaviour, and this certainly characterises our work with the mountain pine beetle, gypsy moth, spruce beetle, and spruce budworm'. Put simply, continuing reliance on large-scale monocultures rather than biodiverse, integrated smallholdings is likely to be a big mistake.

Soil fertility and nitrogen use. The indiscriminate use of nitrogen in agriculture has had profound effects on the nitrogen cycle (Gruber and Galloway, 2008). The use of mineral fertilisers worldwide increased almost 350 per cent between 1961 and 2002, from 33 million tonnes to 146 million tonnes per year. But in countries like China and the United States, only 26-28 per cent of the nitrogen applied to soils for rice, wheat and maize production is taken up by the target crops. The rest is released into the environment, leading to the acidification of soils and to algal blooms in freshwater and coastal systems that deplete oxygen and kill aquatic life. There is also inequity in the way nitrogen is used in agriculture. The European Union, for example, with just seven per cent of the world's population, uses 33 per cent of the global agricultural nitrogen supply simply to grow and import animal feed (Sutton *et al*., 2011).

Clearly, it is the efficiency with which nitrogen is used that determines whether such use is a boon for crops or a negative for the environment. Maintaining a healthy soil structure and biology is critical, and the use of nitrogen-fixing trees and crops is generally better than the application of mineral fertilisers for maintaining healthy soils. Particularly in nitrogen-deficient soils in African countries, where the excessive use of mineral fertilisers is not possible due to price constraints, the use of nitrogen-fixing species such as *Faidherbia albida, Leucaena leucocephala, Sesbania sesban, Tephrosia vogelii* and *Crotalaria ochroleuca* is a sensible strategy for enhancing crop yields with minimal negative environmental consequences.

1.3 An integrated, intensified and climate-smart solution proposed

The complexity of the problems facing sustainable development (or a 'safe and just space for humanity', to use Raworth's phrase) requires an integrated solution that is tailored to those who most need safety and justice.

Entrepreneurial options that enhance biocapacity. Few agencies, governmental and non-governmental, have the reach to enhance biocapacity at the scale required. Local people, on the other hand, can be transformative in efforts to scale up integrated solutions. What is required is an enabling environment of rights and incentives that channels local entrepreneurial spirit towards solutions, matching intrinsic social and environmental aims with a strong profit motive. Rather than creating a raft of directed 'project-type' initiatives, better results can be delivered more organically if it is in the financial interests of rural people to enhance biocapacity.

Income-generating. The roles that locally controlled enterprises play in generating income for both men and women, while also meeting local demands for food, energy and construction materials are well known. The paucity of evidence that large-scale industrial models are either reducing poverty or distributing food and energy to where they are most needed only strengthens the justification for a focus on locally controlled forest enterprises. Much is now known about how to support such enterprises and how to attract investment into locally controlled forestry (Macqueen *et al.*, 2012a), although there is a lack of detailed impact assessments on, for example, gender outcomes (see below). While there has been much attention on the production of non-timber forest products (NTFPs) for income generation, the approach proposed here is to prioritise locally controlled forest enterprises that support food and energy production or that break into mainstream timber supply chains.

Gender- and age-balanced. Integrated farm-forest systems must be strengthened because these are most likely to provide food and energy and generate income for the poor in all age groups and both genders. Such integrated systems also provide the basis for many of the other social foundations, such as jobs, education, health, political voice and resilience. They must allow women access to natural resources and respect rights to sexual and reproductive health care and family development – because adequate space for family planning, management and education is critical for the long-term sustainability of the social foundations.

Food-securing. Given the likely magnitude of the future food-security crisis, it is reasonable to immediately prioritise support for those farm-forest systems that strengthen the delivery of basic staple foods to local people. In line with the other dimensions of the problem posed by the diminution of humanity's safe operating space, such farm-forest systems should adopt an ecosystem approach involving conservation agriculture, good seed of high-yielding varieties, the integration of crops, pastures and trees, and integrated pest and soil-fertility management.

Energy-enhancing. Integrated farm-forest systems have considerable potential to generate biomass energy to help meet local energy needs. Irrespective of the energy trajectories of countries in South Asia and sub-Saharan Africa, charcoal and firewood are likely to remain the predominant sources of household energy for the foreseeable future.

The emphasis must be to enhance the efficiency and sustainability of such energy sources to maximise the potential for energy delivery from trees on farms and agriculture residues, while also reducing risks to household health. In countries such as India, substantial progress has been made in biomass gasification for electricity at the community and district levels (Macqueen and Korhalliler, 2011). Further exploration of this potential is now an urgent priority.

Climate-smart. It is clear that efforts to ensure that production systems do not overstep environmental planetary boundaries must be climate-smart – that is, they must both help to mitigate climate change and assist people who are most precariously dependent on natural resources to adapt to the shocks that will inevitably come as the frequency and intensity of extreme weather events increase. From a climate change perspective, therefore, support for locally controlled forest enterprises should focus on production systems that maintain or enhance tree cover (thus curbing forest-related greenhouse gas emissions), enrich agricultural soil fertility and organic content naturally (thus curbing agricultural greenhouse gas emissions), and provide a diverse portfolio of income-generating options that create economic resilience even if elements of the system fail due to climatic shocks.

Biodiverse. The links between biodiversity – the move towards diverse integration of crops, pastures and trees – and economic resilience in an uncertain environment are intuitive. Farm-forestry practitioners are often averse to the risks of new untried technologies, and also those associated with putting 'all your eggs in one basket' (Binswanger, 1980; Yesuf and Bluffstone, 2007). The trick is to encourage the development of diversified and therefore resilient production systems in which each of the constituent elements is well understood and for which market demand is strong. Helping to create integrated food, energy and construction-material enterprises across landscapes in which biodiversity and economic resilience are high will do much to foster long-term sustainability.

Nitrogen-efficient. For many areas in which poverty is acute, the excessive use of nitrogen fertilisers is rare. As described earlier, however, such use has proved environmentally damaging in affluent societies such as those of the European Community and the United States, as well as in China. A priority for integrated, intensified and climate-smart land use is to promote the use of organic nitrogen-fixing species that also enhance overall soil composition and the efficient uptake of nutrients by the main crops, thereby reducing nitrogen leakage into the environment. The judicious use of agroforestry systems in which planted trees or rotational cover crops enhance soil fertility over the long term seems to be the way ahead.

Geographically relevant. The fact that poverty is concentrated in specific locations enables a geographical prioritisation of the task at hand. Networks such as Forest Connect that provide support to locally controlled forest enterprises might decide to focus their efforts in, for example, sub-Saharan Africa and South and Southeast Asia.

1.4 A contributory investment framework advanced

The intention to install an entrepreneurial approach to integrated, intensified and climate-smart land use is one thing, but putting it into practice through investment is another (Macqueen, 2013). Four main challenges can be identified. First, natural resource rights in farm-forest landscapes are often confused and the commercial rights over trees are often insecure. This undermines the willingness of local people to put time and effort into establishing enterprises for which the right to use resources is open to question. Second, enterprises face formidable obstacles through their isolation, not only from markets, service providers and decision-makers, but also from one another. The organisation of enterprises within particular subsectors can be a powerful way to gain bargaining power in the market and to advocate for better rights and incentives for enterprise development. Third, business capacity development is essential in the development of investment proposals for upgrading businesses. Fourth, getting fair investment deals in subsectors that are often characterised as high risk can be difficult and often requires the presence of neutral brokers who can link enterprises with prospective investors, balance asymmetries of information, and help oversee fair negotiation processes.

The 'investing in locally controlled forestry' framework responds well to these four challenges. A particular strength of the framework is that it has been developed by rightsholder groups themselves – the International Alliance for Family Forestry, the Global Alliance for Community Forestry, and the International Alliance of Indigenous and Tribal Peoples of the Tropical Forests, who provocatively call themselves the G3 on account of their control of roughly 25 per cent of the world's forests. 'Locally controlled forestry' is an umbrella term for a mutual agenda that has been agreed by these groups, and it encompasses – without seeking to replace – notions of community forest management, family forestry and indigenous people's rights (for more detail see Macqueen *et al*., 2012b).

The framework for investing in locally controlled forestry is based on the notion of rights and responsibilities. Rightsholder groups are pursuing three main sets of rights:

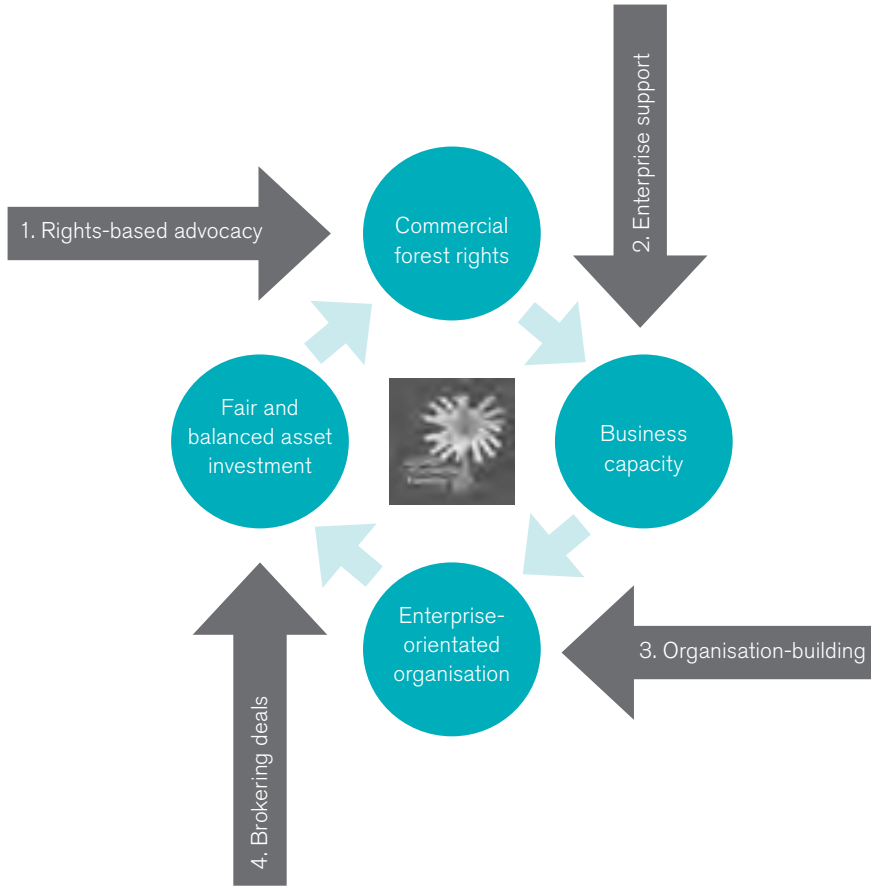
- local decision-making on forest management and broader land use, including freedom of association;
- secure land tenure and commercial forest use rights; and
- access to markets and technology.

But equally important is the commitment by rightsholder groups to assume responsibility for:

- long-term forestry resulting in improved livelihoods and sustainable forest management, including the protection of biodiversity;
- the provision of multiple forest products and services, through local enterprise, to benefit society; and
- respect for communities, families and peoples and their customary use and traditional and local knowledge.

The G3 argues that where rights are afforded, responsibilities follow. There is a substantial body of evidence that backs up this claim (Macqueen, 2011; RRI, 2012). But achieving these rights usually requires investment, including, but not limited to, 'asset investment', or hard financial investment. Such investment also includes four main areas of 'enabling investment'. In a series of 11 international meetings between rightsholder groups, investors, government representatives and civil-society organisations run by The Forest Dialogue (TFD) and including field dialogues in Panama, Macedonia, Nepal, Kenya, Burkina Faso, Indonesia and Sweden, a framework was developed that captures the essence of what is required to implement locally controlled forestry. In brief, the framework posits four main areas of enabling investment that are required, both to enhance locally controlled forestry and to attract fair and balanced asset investment in support of it (see Figure 4).

Figure 4. Positive cycle of investing in locally controlled forestry (arrows signify the four main areas of 'enabling' investment to achieve fair and balanced 'asset' investment)



The framework depicted in Figure 4 suggests a series of practical enabling actions – the priority for which will vary from context to context – for supporting locally controlled forestry. Yet the complexity of the problem faced by humanity and the integrated nature of the solution require a more nuanced type of support. Not just any form of locally controlled forestry is required; what is needed is locally controlled forestry that delivers integrated, intensified and climate-smart land use in very different sociopolitical and environmental contexts. To achieve that, it will be necessary for support institutions (those that provide the enabling investments) to both discern and prioritise support for particular types of forest enterprise that best deliver the outcomes desired. Building the capacity to make such discerning enabling investments is the subject of the final section of this chapter.

1.5 A shared process of prioritisation

Despite the scarce resources, there have been many attempts to promote locally controlled forest enterprises in recent years. As noted above, Forest Connect is an ad hoc alliance created both to provide such support and to serve as a platform for sharing experiences among those who facilitate support to locally controlled forest enterprises. The Forest Connect partners decided that an investigation was needed to determine which subsectors, and what types of enabling investment, in which sociopolitical and environmental contexts, might best deliver integrated, intensified and climate-smart land use. The partners set out to determine the merits and potential tradeoffs of providing support for different subsectors – such as on-farm enterprises where the main product is food; natural-forest or on-farm enterprises where the main product is energy; natural-forest or on-farm enterprises where the main product is construction timber; and natural-forest or on-farm enterprises where the commercial output is one or more ecosystem service (for example, carbon, biodiversity, water or tourism). It was proposed that a structured assessment should be made of such subsectors that answered and scored the following questions:

Introduction

1. Geographical targeting that might optimise pro-poor impact: which particular geographical focus within the country in question might optimise the contribution to poverty reduction and sustainable natural resource management, and why?
2. Subsectoral entrepreneurial options: what main subsectors of forest enterprises exist that require as part of their operations an enhancement of biocapacity?

Assessment of market prospects for each potential subsector

3. Income-generating potential of those options: what is the scale of market demand for products or services derived from enterprises in the subsectors defined above, and which markets have the greatest potential for expansion and income generation given (i) market trends, (ii) issues of competitive advantage, (iii) issues to do with the enabling environment (e.g. product restrictions and bureaucratic hurdles) and (iv) resilience in the face of likely climate change?

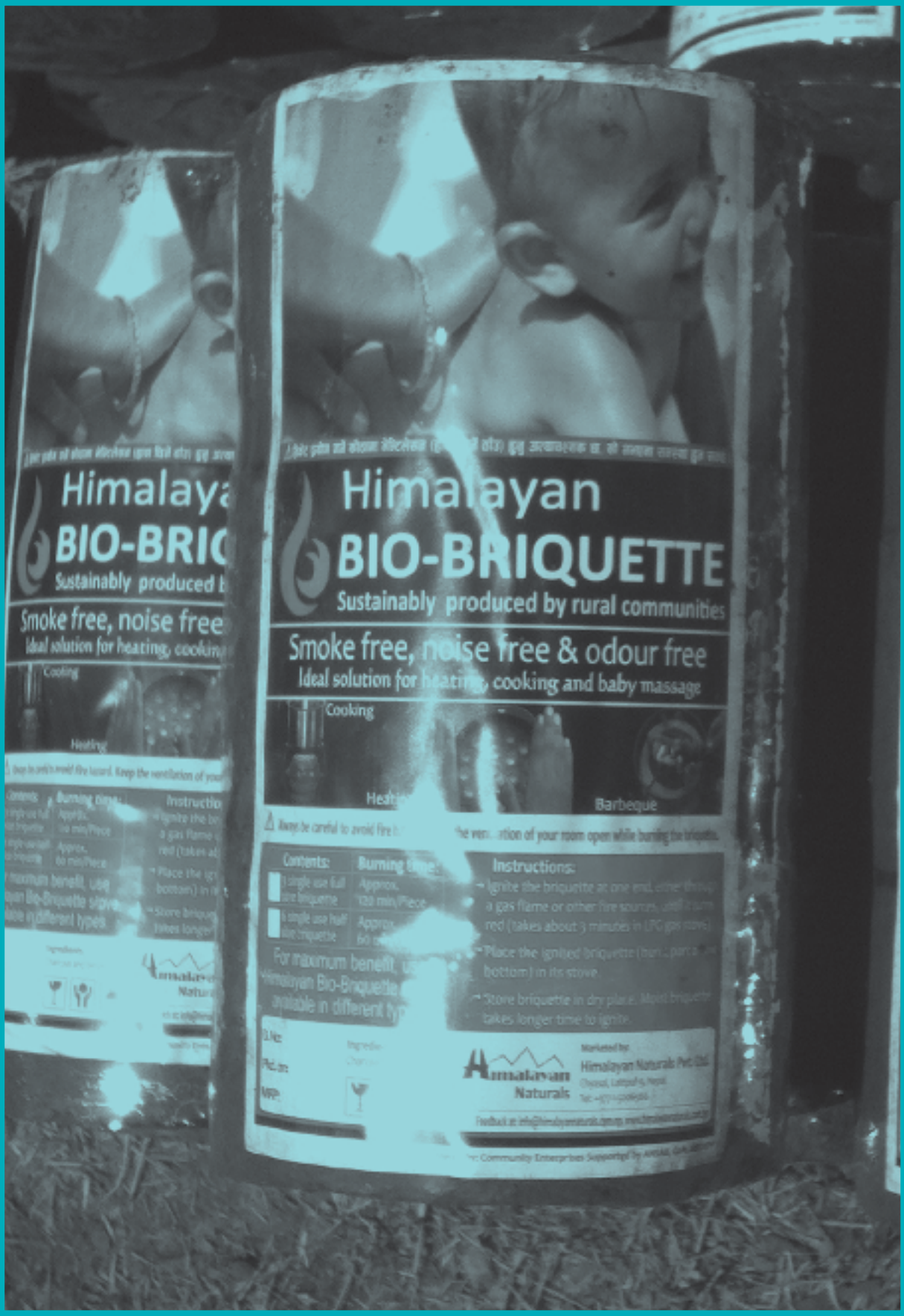
Assessment of integrated impacts for each potential subsector

4. Gender and age analysis of those options: what is the likely contribution of each subsector to income-generating opportunities for women – and thereby the likely impacts on household well-being (including any issues to do with reproductive health)?
5. Impacts on food security of those options: what is the likely contribution of each subsector, either (i) directly to increased food security/better nutrition through the enhanced agricultural production of staple foods and diverse nutritious foods produced locally, or (ii) indirectly through increased diversification/income generation that affords households greater purchasing power for staple foods?
6. Impacts on energy security: what is the likely contribution of each subsector to the provision of household energy, either (i) directly where energy is the main business, or (ii) indirectly where tree or agricultural crop residues can be used to enhance energy security?
7. Quantification of climate change mitigation and adaptation potential: what impact does each subsector have on carbon emissions (including replacement of alternative sources of emissions), and how important is it likely to be in terms of adapting to and building resilience to known future climate change scenarios?
8. Impacts on biodiversity within actual system and on adjacent natural systems: to what extent does the subsector require the maintenance of biodiverse natural ecosystems or enhance the degree of agrobiodiversity through its operations?
9. Impacts on soil fertility and nitrogen inputs: to what extent does the subsector use natural forest management or on-farm soil husbandry techniques that enhance long-term soil fertility without the excessive use of nitrogen fertilisers?

Assessment of support priorities

10. Given the likely variation in impacts in answers to questions 3-8 above, what manageable portfolio of enterprise support activities to, say, 2-3 main subsectors might deliver a balanced set of impacts across the impact areas deemed to be critical by either the global analysis (above) or a national analysis that argues strongly for other impact measures?

Eight papers were commissioned from members of the Forest Connect alliance in line with this assessment structure as a means of ensuring comparability in the findings. By considering this set of 10 questions in a range of country contexts, it was hoped that the Forest Connect alliance would be in a better position to take strategic decisions that enhance the contribution of support for locally controlled forest enterprises to the broader global imperative of integrated, intensified and climate-smart land use (or a fair green economy), while also optimising local livelihood benefits and resilience.


Himalayan
BIO-BRIQUETTE
Sustainably produced by rural communities
Smoke free, noise free & odour free
Ideal solution for heating, cooking and baby massage
Cooking
Barbeque
Contents:
Instructions:
Ignite the briquette at one end, either through a gas flame or other fire sources, until it turns red (takes about 3 minutes in LPG gas stove)
Place the ignited briquette (burnt part at bottom) in its stove
Store briquette in dry place. Moist briquette takes longer time to ignite
Amalavan Naturals
Himalayan Naturals Pvt. Ltd.

Charcoal briquette product from Nepal.

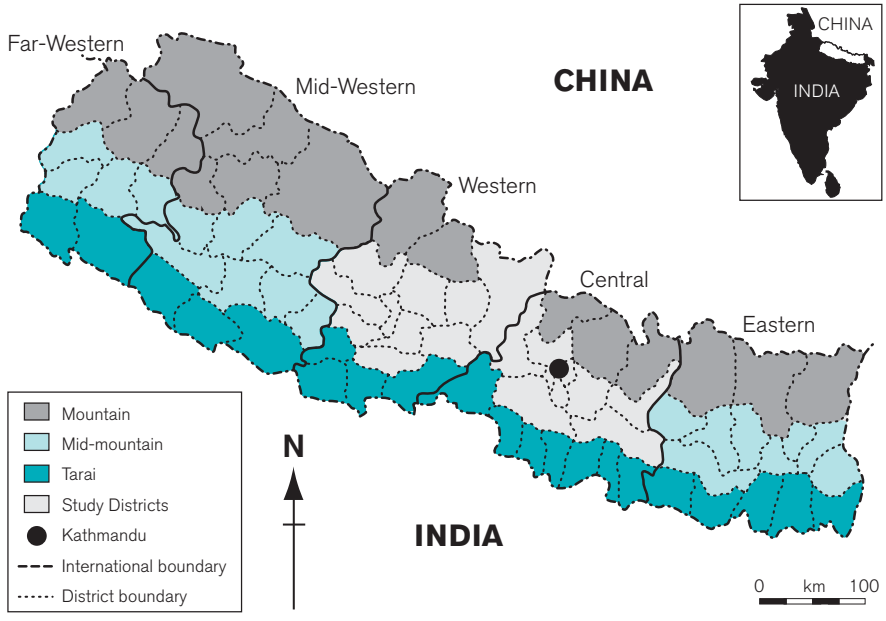
Assessing subsectors of locally controlled forest enterprises and support options in Nepal

Bhishma P. Subedi

2.1 Introduction

The case study area consists of 22 mid-mountain districts in the Central and Western development regions of Nepal. The mid-mountains constitute the major ecological zone of Nepal, amounting to about 42 per cent of the country's total land area, and they also have the highest agricultural, sociocultural and ethnic diversity among the three major ecological regions (the other two being 'mountain' and 'Tarai'; Figure 5). The case study area includes some of the country's most fertile valleys – those of Kathmandu, Pokhara, Banepa and Trishuli, which are also major centres with good road access to markets, finance, technology and other services. Among the 22 districts, 10 are in the Western Development Region and 12 are in the Central Development Region. The low-elevation areas of the two mountain districts – Dolakha and Sindhupalchok – are also included in the case study because the majority of the products from the enterprises in those districts go to Kathmandu, Dhulikhel and Banepa, the major trade centres of the mid-mountains.

Figure 5. The development regions of Nepal, showing the case study districts



The 22 mid-mountain districts in the case study area have high education levels, further opening up possibilities for interventions that lift subsistence-based activities towards business-based income generation. It is well recognised within Nepal that increasing forest and farm productivity and rural income are necessary conditions for structural transformations towards economic growth (Teigner, 2012; Restuccia *et al*., 2008; Sachs *et al*., 2001).

Nature has endowed Nepal with over 7,000 species of higher plants, of which over 700 are medicinal and aromatic plants (GoN/IUCN, 1988) and about 250 are endemic (Bajracharya *et al*, 1988). Nepal features three main geographical regions: the tropical plains (Tarai) bordering India in the south, an extensive section of mid-mountains, and the trans-Himalayan region bordering Tibet in the north.

The increasing and untapped market potential of forest and farm products from these diverse regions adds to the potential for economic growth, poverty reduction, social justice and sustainable development. For example, a conservative estimate of the annual economic potential of timber and NTFPs in the Nepalese forest sector is US$162 million and US$67.6 million, respectively (Pandey *et al*, 2010), and 60 per cent of the total forestland in the country has the potential for community forestry and enterprise-oriented forest management.

2.2 Assessment of market prospects of shortlisted subsectors

A set of four criteria was used for the preliminary shortlisting of subsector options. To be shortlisted it was decided that a subsector option should have:

- a tree component;
- a history of production, collection and trade in the area, at least locally by communities;
- potential for increasing production at the local level by introducing new varieties, crops and technologies; and
- potential for local value adding through processing and improved trade practices.

A review of literature was made based on these criteria, the current national trade strategy (the 2010 Nepal Trade Integration Strategy; MoCS, 2010a) and trade and export performance data (Nepal foreign trade statistics for 2009/10; FAOSTAT; ITC, 2011; and other UN data). Expert consultations, cursory market visits, and discussions with experienced staff at the Asia Network for Sustainable Agriculture and Bioresources (ANSAB) enabled the author to review each subsector's market trends, competitive prospects, enabling environment and resilience to climate change.

Thirteen subsectors satisfied all four criteria and were shortlisted for preliminary assessment and the next stage of screening. They are described below.

1. Fruit-based tree crops

Citrus, pears and lapsi are among the most widely grown fruits in the case study area. Many varieties of mandarin orange (*Citrus reticulata*), sweet orange (*C. sinensis*), lime (*C. aurantifolia*), lemon (*C. limon*), pear (*Pyrus spp.*), lapsi (*Choerospondias axillaries*), peach (*Prunus persica*) and plum (*P. domestica*) are cultivated traditionally.

Mandarin oranges are an important commercial fruit crop and one of the main sources of income for farmers. They have been exported traditionally to India and more recently to Bangladesh. But the most lucrative markets for Nepalese mandarin oranges are European Union countries and Russia. The production area and volume is increasing. Visits by the author to major market centres in Kathmandu indicate that lapsi, pear, plum and peach also have strong market demand.

Fruit-based tree crops can be grown with low start-up costs; they do not require major capital investment and can use family labour. Currently, yields are low compared with other countries. The fruits pass through a rather simple marketing channel involving two main stops – collection centres and assembly points. All players in the supply chain – mostly family-owned businesses – are small. Although citrus fruits have strong market prospects, they are not yet important export commodities in Nepal. The resilience of citrus fruits and pear to climate change is low because fruit quality is affected by climatic conditions during the growing period, and changes in rainfall patterns may result in a decline in production. For many years, 'citrus decline' – the sudden death of citrus trees – has been reported in some parts of the country, although the cause is unknown.

2. Highland coffee under agroforestry

Coffee production has emerged recently in more than 30 districts in the mid-mountains, involving 25,000 small farmers who cultivate using conventional methods. Arabica coffee is highly suited to these districts and is mainly grown under shade trees in various agroforestry configurations, where the associated tree component provides the added benefit of soil erosion control. Coffee production is emerging as a likely agro-enterprise with great potential to provide farm employment and income-generation opportunities in Nepal.

In the last decade, trends in the export value, area under cultivation, and production volume and yields of Nepalese coffee have been very encouraging. About 57.6 million tonnes of coffee were exported from Nepal in 2010 (UN, 2012). Japan and the European Union are the major export markets for Nepalese coffee, and the United States is also emerging as an important buyer. Yields in Nepal are still relatively low, however, compared with other major exporters, and an insect called coffee borer poses an additional challenge to coffee-growing in Nepal. Nevertheless, large tracts of land could be brought under coffee cultivation in the country. Improving yields and processing efficiency could further enhance competitiveness, and Nepal has great potential for product diversification in terms of specialty coffees such as organic coffee, one-estate coffee, one-variety coffee and highland coffee (AEC/FNCCI, 2006a). World market prospects are also very favourable. The niche for organic and highland coffee offers a real opportunity. Although such niche products occupy only about seven per cent of the total world market (AEC/FNCCI, 2006a), this is not a constraint for a small producer like Nepal.

The impact of climate change on coffee production is unclear. Some observations suggest that a slight increase in temperature will increase yields but larger increases might reduce the areas suitable for coffee-growing (and potentially eliminate them). The incidence of pests and diseases might increase under climate change, and an increase in temperature might require the greater use of irrigation, thereby increasing pressure on scarce water resources.

3. Integrated farming-based dairy

Traditional cow and buffalo farming and small-scale dairy enterprises are a source of income for many people in Nepal. The dairy subsector provides more than 60 per cent of the livestock sector's total contribution to gross domestic product (GDP; FAO, 2010a). Demand for dairy products is increasing: the 2001 National Milk Marketing and Strategy Study projected an annual growth rate of demand for milk products in Nepal of 10 per cent, and growth in the number of hotels and restaurants is increasing demand for cheese, cream and paneer (cottage cheese).

There is a supportive policy environment for the development of dairy enterprises in Nepal. The government issued the 2008 Dairy Development Policy as the main policy document for the subsector, which is also guided by the provisions and spirit of the Agriculture Perspective Plan (1995-2015), the 2004 National Agriculture Policy, the 2001 National Milk Marketing and Strategy Study, and the 2006 Agri-business Promotion Policy, among others. The government has also targeted higher growth in milk production in its plans, for example, an annual growth of 4.6 per cent in the Three Year Interim Plan for 2007-2009.

The dairy subsector is dependent on the availability of green forage. High-yielding exotic breeds of cow are very sensitive to climate change.

4. Orthodox tea

Orthodox tea is produced mainly in the mid-mountains of the Eastern Development Region, although there are some emerging districts in the Central and Western development regions (ANSAB, 2011a). Tea plants are shade-grown under trees that help maintain moisture, act as windbreaks and control soil erosion.

The market demand for and export performance of tea have been strong compared with some other subsectors, with significant growth following economic liberalisation in 1991. Export volume grew from an average of 80 tonnes in 1991 to about 8,000 tonnes in 2009/10 (ANSAB, 2011a). The area under tea expanded from 3,500 hectares in 1996 to more than 15,000 hectares in 2009/10. Some of the potential overseas markets for Nepalese orthodox teas are Canada, France, Germany, Ireland, Japan, Russia, the United Arab Emirates, the United Kingdom and the United States (MoCS, 2010b; ANSAB, 2011a).

There is high potential for the expansion of tea cultivation in Nepal and the government has set ambitious production targets. Meeting the targets is unlikely, however, due to the fragmentation of production and the lack of auctioning facilities and quarantine laboratories. The tea subsector is associated with relatively high rates of employment and seems to be a strong engine for farmer income generation and poverty reduction because it gives higher returns compared with other crops – and already involves 105,000 people.

Tea quality, production and yields are considered to be very sensitive to changes in climate, including temperature and rainfall.

5. Handmade paper

The small-scale production of handmade paper occurs throughout the country. Based on traditional skills, Nepalese handmade paper uses abundant supplies of lokta (*Daphne spp.*). The argeli plant (*Edgeworthia gardeneri*), a close relative of lokta that grows at lower altitudes, offers a promising alternative.

Nepalese handmade paper is popular for its strength, durability and resistance to insects, and demand is growing. A diverse range of paper products is exported to European Union countries, Japan and the United States (AEC/FNCCI, 2006b). Tourists also buy significant volumes. There is scope to increase high-end market share in the European Union and the United States. There is also potential to diversify into markets for stationary, cards and envelopes, artist's paper, bookbindings and household items such as lampshades. The profit margins for all market actors involved in handmade paper – from lokta producers to exporters – are high (EEC, 2008). The small-scale and dispersed nature of production means, however, that the capacity of the subsector to scale up is relatively low. Lokta grows slowly as an understorey shrub and is susceptible to pressures such as fire and grazing.

6. Essential oils

Enterprises that produce essential oils based on wintergreen (*Gaultheria procumbens*) and juniper (*Juniperus spp.*) are good sources of income for farmers – including poor farmers – in remote areas in the case study area. Nevertheless, there is a limited market for such oils, and only a few companies – such as Herbs Production & Processing and Himalayan Bio-Trade – buy essential oils from local processors. Fluctuations in market prices are a risk for both producers and traders. The degradation of wintergreen resources outside areas covered by community management plans (on marginal forestland) is also a problem; plants are being uprooted at a premature stage. There is a lack of effective conservation practices on both public and private land.

Wintergreen collection and processing favours disadvantaged people and farmers with small landholdings. Such people can obtain collection permits to collect wintergreen in natural forests from district forest offices. Unnecessary checkpoints and fees, and informal taxes from distillation to export, are the main constraints to both production and trade.

7. Medicinal and aromatic plants

Medicinal and aromatic plants produced in Nepal are increasingly finding an important place in local and international markets. Tejpat (*Cinnamomum tamala*), dalchini (*Cinnamomum zeylanicum*) and chiraito (*Swertia chirayita*) are the major medicinal and aromatic plants in the case study area that are collected and sold (in dried form) for domestic consumption and export. India is the major export market for these products.

There is a global consumer trend towards natural, healthier foods, healthcare and cosmetics and consequently an increasing demand for medicinal and aromatic plants. Cultivation and processing is currently limited and small-scale in Nepal, although large-scale cultivation is feasible. Improper drying and storage also leads to wastage and unnecessary losses. Considerable improvements can be made to primary processing, such

as by sorting and grading, powdering, boiling, cooking and making aqueous solutions, to add value to this subsector.

Severe non-tariff barriers during transportation and export limit Nepal's export capacity for medicinal and aromatic plants. Climate change has the potential to become a significant threat in the future. There is concern that local plant populations and genetic diversity could be lost due to changes in temperature and weather patterns.

8. Gums and resins

The chir pine (*Pinus roxburghii*), from which resin is sourced, is widely distributed over 405,000 hectares in Nepal's mid-mountains. People use chir pines for timber, small wood, firewood, animal bedding (from chir pine needles) and mulching. There is potential to tap approximately 60,000 tonnes of resin per year (DFRS, 2004). Normally, a chir pine tree yields 3-6 kg of resin annually. Resin-tapping is carried out for about eight months per year (March to October).

Products made from resin include turpentine oil and rosin, which are raw materials in the manufacture of soap, rubber, paper, paints, varnishes and a variety of chemicals. Turpentine oil and rosin both fetch good prices in national and international markets. At least 15 resin-tapping companies are registered in Nepal, with permission to collect about 40,438 tonnes of resin annually (DFO, 2007). However, these companies operate below capacity, and many forests have unexploited potential because of a shortage of skilled labour. There is an urgent need to attract, train and involve local people in resin-tapping to make it a sustainable business.

The government has granted resin-tapping permission to companies who have annual agreements with community forest user groups (CFUGs) and pay them a royalty of six rupees per kg of resin. The companies have to take care of the trees and forest health, preventing damage to the trees and forests, while tapping resin and managing the labourers. There is an increased risk of forest fire where resin-tapping occurs.

9. Biomass-based energy

Biomass-based energy – for cooking, room heating and warmth for traditional baby massage – in the form of briquettes and charcoal is an emerging source of energy in the mid-mountains. The briquettes are made from plants, including invasive alien species, not used for any other purpose. In one briquette-marketing company in Kathmandu, more than 195 people received direct income totalling US$101,355 in 2011/12. Briquette production at a commercial scale has emerged only recently, however, with technical assistance since 2007 from ANSAB.

The demand for briquettes (as well as charcoal) has grown significantly in recent years, from about 5,000 briquettes in 2007 to 500,000 briquettes in 2012, aided by acute shortages of other sources of energy, such as electricity, kerosene and liquid petroleum gas. Some supermarkets in Kathmandu have started to provide separate stalls for the sale of briquettes because of their increasing popularity among urban users. One retailer estimated that at least 10,000 families (about 50,000 individuals) in Kathmandu were

buying its briquettes. Briquettes emit fewer greenhouse gases per unit energy than fossil fuels and thus may attract clean-energy incentives. The current national shortfall in energy supply is predicted to last for several more years. There is no shortage of raw materials for briquette manufacture, which can be done at the local level with low start-up costs.

Through a Forest Connect initiative implemented by ANSAB, a briquette producer association has been established with guidelines for quality control and technology (machine and furnace) for briquette producers. The raw materials for briquettes are unlikely to be threatened by climate change.

10. Ecosystem-based organic vegetables

Farmers in the mid-mountains have initiated commercial 'ecosystem-based' farming that can help produce more from available land, water and labour resources without causing social or environmental harm and increasing resilience to climate change. Ecofriendly-product shops that target tourists are burgeoning in Kathmandu and Pokhara. Upper middle-class families, restaurants and some hotels are the main consumers of these products. A limited price premium prevails but there is no established framework for pricing these products. Increases in purchasing power, education and awareness about health and food quality, and a willingness to pay for healthy foods among consumers (Bhatta *et al*., 2009), have increased the demand in urban areas for ecosystem-based farming products (Aryal *et al*., 2009).

An estimated 800,000 hectares (26 per cent) of cultivated land in Nepal is 'organic' by default (Dahal, 2011), and the area of land recognised as organic is increasing. Organic farming was being actively pursued on about 1,000 hectares in 2005 and 8,187 ha in 2007, of which 7,737 hectares were fully converted to organic (FiBL and IFOAM, 2009). With the recent establishment of the National Organic Agriculture Accreditation Body and the National Coordination Committee for Organic Agriculture Production and Processing System, and other policies supporting organic agriculture, there is a favourable enabling environment for this subsector.

Ecosystem-based farming offers resilience against climate change by enhancing the adaptive capacity of farming communities while simultaneously sequestering carbon (Dahal, 2009). The application of traditional skills, farmer knowledge and soil fertility-building techniques, and a high degree of diversity, make this system highly adaptable to climate change (Niggli *et al*., 2009).

11. Large cardamom

Large cardamom is a high-value crop produced mostly in the eastern part of the country. It is a shade-loving plant and is grown as an understorey crop between and below trees such as *Albizia species, Castanopsis hystrix, Schima wallichii* and *Alnus nepalensis*.

The recent trend in exports of Nepalese large cardamom is encouraging. Nepal is one of the major producers of large cardamom and is considered to be a high-quality source, and it has a 50 per cent share of total world exports. Tariffs for Nepalese large cardamom are low in the major importing countries, and, compared with other exporters, Nepal (together

with Sri Lanka) enjoys a highly preferential tariff rate on exports to Indian markets. About 90 per cent of the Nepalese production is exported, mostly to India, where it is then often re-exported to Pakistan, Singapore and the United Arab Emirates. There is great potential for increasing production, both by increasing the cultivation area and improving production techniques. Encouraging a number of derivative products, such as essential oils, could further expand demand for large cardamom.

The impact of climate change on the production of large cardamom is unclear. Some observations indicate that increased temperatures improve yields, but there is also an opposing view that higher temperatures could increase the incidence of disease, with potential impacts on cardamom production. Currently, one disease threatens the production of Nepalese large cardamom.

12. Ginger

Ginger is a major agricultural export-based crop; of all the spices, it has the highest production and covers the largest area in Nepal. Ginger is a shade-loving plant that is often grown as an understorey crop and also as an intercrop among crops such as maize, beans and other vegetables. Nepal accounts for 11.5 per cent of total world ginger production and has been one of the top ten exporters of ginger for the last decade.

More than 75 per cent of the total quantity of ginger produced in Nepal is exported (ITC, 2007). A recent ANSAB (2011b) study shows that there was steady growth in exports until 2007, when it peaked at 41,731 tonnes valued at about US$8.41 million. According to the 2010 Nepal Trade Integration Strategy, the most attractive markets for ginger are in the Middle East, Southeast and East Asia, the member countries of the South Asian Association for Regional Cooperation, and northern developed countries. Kathmandu is the major domestic market, where most of the ginger is distributed through the Kalimati Fruit and Vegetable Wholesale Market.

Nepalese ginger is superior in quality for the production of dried ginger, oleoresins and essential oils. Due to the lack of processing facilities in the country, however, farmers have to sell their products fresh or in a traditionally dried form (ANSAB, 2011b). To date, proper value added has not been attempted in Nepal, and India captures much of the value of the product. Improved sorting, grading, cleaning, peeling, drying and packaging is needed. The 2009 trade policy prioritises ginger and has a programme for its commercialisation. Nepal has free access to India's market for ginger trade but faces restrictive non-tariff measures. The major Indian markets of Gorakhpur, Lucknow and Siliguri impose import bans, ostensibly for quarantine reasons, when they have sufficient product (Ghimire, 2009).

13. Wood

The contribution of wood to national revenue in Nepal is significant, amounting to about US$8.33 million in 2008/09, which was more than 90 per cent of total forest-sector revenue (DoF, 2009). Wood is also the main source of income for CFUGs: Banjade (2012) reported that about 70 per cent of the total income of CFUGs in Dolakha was derived from wood. The main commercial opportunities in this subsector are:

- **Wood harvesting enterprises**. These involve significant manual labour in Nepal, with commercial extraction increasing from 24,360m^3 in 1992/93 to 80,540m^3 in 2002/03. Nationally, an estimated 2.2 million m^3 of wood is consumed per year as timber or fuel.
- **Sawmills**. The estimated demand for sawnwood was 438,000m^3 in 2010. Eighty-six per cent of all production is small-scale, while the Timber Corporation of Nepal and private sawmills do most of the industrial sawmilling in the Tarai. Outside the industrial region, sawnwood is produced by hand sawing or pit sawing and is considered an extension or by-product of forestry. Private sawmills are licensed but depend on parastatals for their log supply.
- **Plywood enterprises.** An estimated 3.3 million m^2 of plywood is consumed annually in Nepal. The country imports plywood from India to cover two-thirds of local demand. Raw-material shortages mean that, despite high national demand, the local plywood industry is operating at about half-capacity.
- **Furniture-making enterprises.** Such enterprises include modern factories, hundreds of small workshops and thousands of individual carpenters. To meet future demand, there is room for additional modern factories, but existing factories are already unable to operate at full capacity because of a lack of raw materials. There are also problems to be solved in product quality, the availability of suitable designs, and knowledge of export markets. Some CFUGs have initiated community furniture enterprises with the support of non-governmental organisations (NGOs). These enterprises meet local demands for furniture, doors, windows and agricultural tools (ANSAB/FAO, 2009), but there is a pressing need for further research and capacity-building in sustainable production, management and marketing.
- **Wooden handicrafts enterprises**. Woodwork is part of traditional architecture in Nepal, and approximately 4,000 people country-wide produce wooden handicrafts as a cottage industry, often in family-based enterprises. Most of the woodcraft industry is focused on providing local people and tourists with collectible items such as picture frames and statuettes. The contribution of wooden handicrafts to Nepalese total export earnings is small but has been increasing.

Abundant forest resources in Nepal, especially as a result of the activities of CFUGs, mean that timber demand is unlikely to threaten supply if forests are managed sustainably. Yet the sector lacks investment, and the market for wood products is vulnerable to competition, particularly from producers elsewhere in Asia. For example, countries such as China and Indonesia that can produce low-cost, innovatively designed products dominate the international supply of wooden handicrafts.

From a regulatory point of view, unnecessary interference and a lack of transparency in timber extraction have discouraged the growth and efficient running of wood-based enterprises in Nepal. The imposition and lifting of timber trade bans has caused serious price fluctuations. There are also unnecessary hurdles in tendering, trading and transportation, resulting in widespread bribery and, ultimately, market prices that reduce the industry's competitiveness.

2.3 Assessment of integrated impacts of subsector options

The 13 subsectors described above were screened using an attractiveness matrix (Table 1) by plotting them against two parameters: industrial growth potential, and income potential for smallholders. Industrial growth potential was assessed by reviewing market demand (market trends and comparative and competitive advantages), the enabling environment, and resilience to climate change. The income potential for smallholders was assessed using estimates of current and potential future smallholder earnings. Each subsector received a ranking of high, medium or low for these two parameters.

Table 1. Attractiveness matrix of forest subsectors in the mid-mountains, Central and Western development regions, Nepal

Income potential	**High**	Handmade paper Essential oils Large cardamom	Biomass-based energy Highland coffee under agroforestry Wood Orthodox tea Ginger	Ecosystem-based organic vegetables
	Medium		Fruit-based tree crops Medicinal and aromatic plants	Integrated farming-based dairy
	Low			Gums and resins
		Low	Medium	High
		Industrial growth potential		

Table 1 shows that most subsectors could be considered to have high potential. The main reason for this is that the subsectors were shortlisted on the basis of a review of market demand and their competitiveness. In other words, all the subsectors could be important, depending on location, the individuals involved and other factors.

The nine subsectors – biomass-based energy, highland coffee under agroforestry, wood, orthodox tea, ginger, ecosystem-based organic vegetables, fruit-based tree crops, medicinal and aromatic plants and integrated farming-based dairy – that achieved high or medium rankings for both parameters were subjected to further review. Each was screened for its likely social and environmental impacts on three social foundations (gender, food security and energy security) and three environmental boundaries (climate change adaptation and mitigation, biodiversity, and soil fertility and nitrogen inputs), as described in Chapter 1. Each subsector was scored on the likely contribution it would make to each criterion, as follows: 5 = a positive contribution to the social foundation or environmental boundary is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely. Scores were assigned on the basis of expert consultations and discussions with experienced ANSAB staff. Thus, the higher the overall score of a subsector, the higher its potential to deliver a balanced set of integrated impacts. Table 2 presents the integrated impact scoring for the nine subsectors.

Table 2. Integrated impact scoring for nine subsectors

Impact criterion	Subsector								
	Fruit-based tree crops	Integrated farming-based dairy	Highland coffee under agroforestry	Medicinal and aromatic plants	Biomass-based energy	Ecosystem-based organic vegetables	Ginger	Wood	Orthodox tea
Gender	4	4	4	4	5	4	4	4	5
Food security	4	5	4	4	4	5	4	4	4
Energy security	3	4	3	3	5	4	3	4	3
Climate change mitigation and adaptation	4	4	4	4	5	4	4	4	4
Biodiversity	4	4	4	4	4	5	3	5	2
Soil fertility and nitrogen inputs	4	4	4	4	4	5	4	4	3
Total	**23**	**25**	**23**	**23**	**27**	**27**	**22**	**25**	**21**

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Gender. All nine subsectors are likely to contribute to income-generating opportunities for women. The briquette and charcoal subsector received the highest possible score because more than 52 per cent of the subsector's current total workforce is female, mostly in briquette production. The orthodox tea subsector, which has a high involvement of women in harvesting, also received the highest possible score.

Food security. Each of the subsectors is likely to contribute to some extent to food security because they help diversify household incomes and generate income that increases the purchasing power of households for staple foods. The integrated farming-based dairy and ecosystem-based organic farming subsectors received the highest scores because they contribute to the direct production of food.

Energy security. It is moderately likely that the integrated farming-based dairy and ecosystem-based organic farming subsectors contribute to the provision of household energy with their byproducts. Livestock waste and agricultural crop residues can be used to enhance energy security by producing biogas and briquettes. The briquette subsector is emerging because of its potential to supply energy for cooking, heating and other purposes.

Climate change mitigation and adaptation. All nine subsectors contribute to the resilience of both social and ecological systems and are therefore likely to contribute to climate change mitigation and adaptation. Because biomass-based briquettes can substitute for high carbon-emitting energy sources and thus help reduce CO2 emissions, that subsector scored highest. Although the animals used in the integrated farming-based dairy subsector emit methane, that subsector is likely to build the resilience of communities to climate change by increasing diversification and was therefore scored as being moderately likely to make a positive contribution to climate change adaptation.

Biodiversity. Ecosystem-based organic farming requires the maintenance of diverse natural ecosystems and is therefore highly likely to contribute to biodiversity conservation; it is also likely to enhance agro-biodiversity. The monocultural cultivation deployed in orthodox tea enterprises might have a negative impact on biodiversity.

Soil fertility and nitrogen inputs. The ecosystem-based organic farming subsector received the highest possible score for this criterion because its systems avoid the excessive use of nitrogenous chemical fertilisers and add organic matter to the soil through crop residues. The orthodox tea subsector has no likely effect on soil fertility or nitrogen input because of the monocultural cultivation associated with it.

Conclusion. The assessment shows that all nine subsectors have prospects for generating high integrated impact scores, with the top three subsectors (based on their total scores) being:

- biomass-based energy;
- ecosystem-based organic vegetables; and
- wood.

2.4 Assessment of support priorities

An assessment of support priorities for the three subsectors with the highest integrated scores were carried out against the four main areas of enabling investment identified by Macqueen (2012): i) potential to secure commercial resource rights; ii) potential to develop business capacity and upgrade; iii) potential to organise to achieve scale efficiencies and negotiating power; and iv) potential to attract fair investment deals in subsectors often characterised as high-risk. Each of these is important if the challenge of fair and balanced asset investment is to be addressed.

Biomass-based energy

In Nepal, the government and some donor agencies and NGOs have been supporting the small-scale production of biomass-based briquettes for a decade. However, there remains huge latent demand for such briquettes in urban markets and huge production potential in rural areas. In 2007, ANSAB designed and piloted a project along the entire value chain with the objectives of substantially increasing the demand for community-produced biomass-based briquettes in targeted markets in Kathmandu; enhancing the production capacities of rural processing enterprises to meet the new demand and increase their revenue; integrating or creating processing enterprises in rural areas to meet the new demand; conserving more forests and improving more livelihoods; and developing a platform in Kathmandu for marketing the briquettes. As a result, the proof-of-concept for briquette production and marketing has been established, and the subsector is now ready for scaling-up and expansion.

A number of challenges remain for the briquette industry, however. Our participatory analysis shows that there is a need to address the following issues to assist the development of the subsector: (i) briquette enterprises have capacity constraints in the uptake of new technologies and other froms of upgrading; (ii) the proper resource management and sustainability of the enterprises are not ensured; (iii) there is scope to upgrade products (pellets, briquettes) and accessories for market expansion, especially in the industrial segment; (iv) there are economic inefficiencies in production and distribution; (v) existing policy provisions and practices are cumbersome and need to be addressed through advocacy; and (vi) the limited access to markets, finance and improved technology discourages actors from upgrading operations and increasing production.

Investment in the following four prioritised support activities could address the above constraints and leverage high integrated impacts:

- **Support for new technologies and product development including accessories.** There is scope to improve technologies, specifically for quick ignition and the production of briquettes and stoves in sizes and shapes suitable for industrial purposes. A study is necessary to explore quick-ignition options and to introduce and test accessories for industrial uses.

- **Organisation-building for market expansion and appropriate promotion strategies.** At present almost all briquettes are traded through department stores and

retail grocery shops in the Kathmandu valley. These are mostly targeted at traditional baby massage and high-income groups. In this context, a comprehensive study is needed to assess the possibility of growing other market segments, such as use in barbecues, hotels and restaurants and among low-income consumers.

- **Organisation-building to strengthen the value chain.** Growing demand, combined with an immature supply chain, has led to inefficiencies in production and distribution and a lack of sustainability. This needs to be addressed by ensuring sustainable biomass production and harvesting by enterprises and creating a common vision among actors about the value chain.

- **Brokering deals for improved policy incentives and practices.** Current policy provisions and practices for biomass-based energy enterprises could be improved by government recognition of briquettes as a green energy source through fiscal incentives, the removal of existing trade barriers in transportation, and assistance with certification and ecolabelling.

Ecosystem-based organic vegetables

Nepal has a comparative advantage in developing sustainable agriculture, and the existence of good practices in various parts of the nation is an asset. But efforts are still lacking to consolidate such good practices, adopt new technologies, develop viable products and pursue emerging markets and business possibilities. There is a widespread negative perception among local people of farming as menial, tedious and lacking in prestige, partly due to the low remuneration and the use of traditional farming practices. These factors have led rural people, especially youths, to migrate to urban areas and abroad in search of a better life. The following three support activities are recommended for investment in this subsector:

- **Support for developing appropriate business models.** The capital-intensive agribusiness model may be very effective for production and marketing in land-rich, developed countries but is simply not working in Nepal, due to the small size of landholdings and other socio-economic complexities. A new model needs testing and scaling up – with best practice in ownership structures and shareholding mechanisms as well as the selection of appropriate farming components, practices, inputs and technologies.

- **Organisation capacity-building in value-chain options and technologies.** There is a need to build the capacity of farmers and other stakeholders in practices such as soil and nutrient management, composting and other organic fertiliser production, irrigation management, nursery management and transplanting, intercropping operations, and harvesting and post-harvest handling. Such capacity-building could be done through formal and informal training and exposure visits.

- **Organisation-building and investment brokering.** Potential activities to increase the access of smallholders to markets, finance and technology include buyer–seller meetings; participation in exhibitions and trade fairs; marketing campaigns; meetings and linkages with financial institutions; the identification of technology suppliers and interaction with

them; and meetings between farmers and technology suppliers. Investment is required to facilitate the engagement of farmers and locally controlled enterprises in such activities and to build a strong constituency for influencing policy decisions.

Wood

Despite the significant contribution of timber to CFUG income and government revenue, the subsector has been neglected by the general public, the media and the government. Such neglect constrains the growth of wood-based enterprises in Nepal. The general public has the view that every tree-felling is illegal and motivated by corruption. The forest sector has failed to portray timber as a renewable resource. The scale of governance failures, forest encroachment, illegal logging, corruption and the misuse of authority have left most smallholders feeling that participation in the commercial wood subsector is beyond them. On the other hand, wood entrepreneurs are discouraged from investing in wood industries because they are constrained by, for example, insufficient finance, difficulty in maintaining adequate product quality and quantity, and difficulties in transportation and export expansion. To address such constraints and to leverage the potential integrated benefits of the subsector, the following four support activities should be prioritised for investment:

- **Support for improving productivity in a sustainable way.** The cultivation and sustainable management of suitable timber species is the foundation on which the subsector must be built – and current policy provisions must create a commercial incentive to encourage this. Assistance in wood certification could be provided to help ensure sustainable forest management and transparency in the wood business. A study to identify users' preferred species could be designed, which in turn would help ensure product quality and quantity.

- **Media work to change public attitudes towards wood-growing and trading.** There is a need to address misunderstanding about the wood subsector among the public with scientifically-backed information on the regenerative capacity of the resource and its role in high value-added uses, such as furniture manufacturing.

- **Organisation-building to improve smallholder participation in the value chain.** Smallholders could be encouraged to participate in the value chain by mapping their needs and applying business models involving community–private partnerships. Wood depots could be established at the community level to enable smallholders to trade their products and also to gain increased benefits from trade with outside members. There are examples of such community depots in Dolakha, which were established by CFUGs with ANSAB support.

- **Brokering deals for increasing investment.** The lack of finance for investment in planting, harvesting and processing could be addressed by support activities. To begin with a study is needed to explore the status and potential of public–private funding in the subsector.

Conclusion

Through a rapid assessment, this case study identified and made a quick scan of 13 promising subsectors of locally controlled forest enterprises in 14 mid-mountain districts in the Central and Western development regions of Nepal. While all these subsectors offer opportunities for smallholder actors, three – biomass-based energy, ecosystem-based organic farming, and wood – were selected for the design of support options because of their relatively high overall integrated impact on three social foundations and three environmental boundaries.

Support is needed to develop these enterprises and value chains in ways that are inclusive, innovative and built on local natural and social capital, and which use ecosystem-based commercial approaches. The case study shows that locally controlled forest enterprises offer prospects to improve local livelihood benefits and resilience while optimising the global imperative of a fair green economy. Supporting them will help lay the necessary foundations for the structural transformation of low-income countries such as Nepal, many of which are endowed with rich natural capital but in which a large portion of the population is still engaged in agriculture with very low farm and labour productivity.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DIY retail outlet selling community timber products in Brazil.

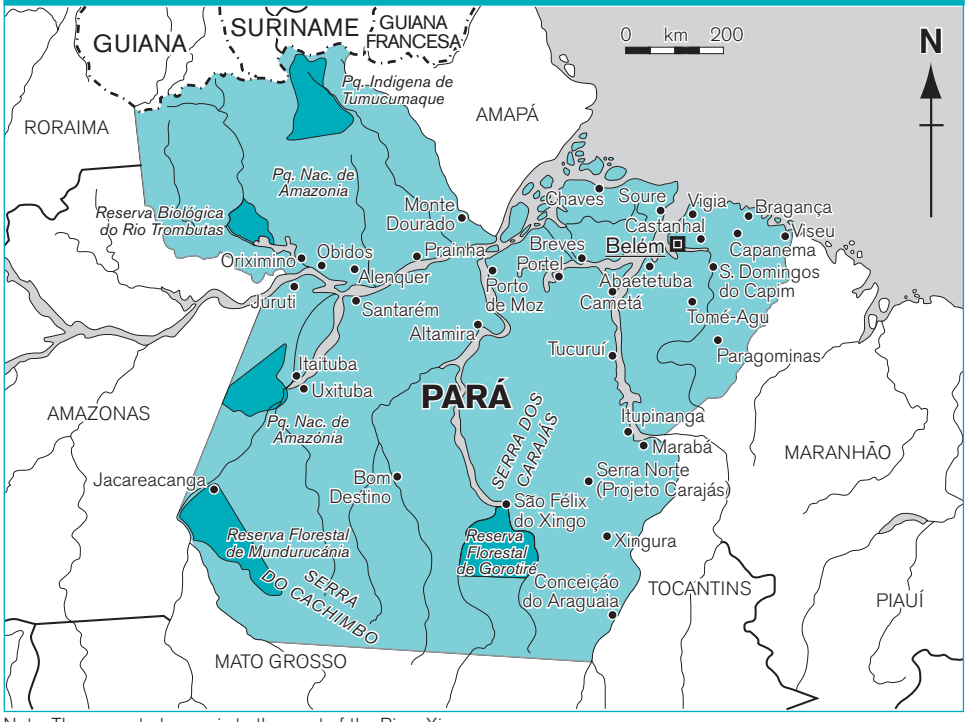
Assessment of locally controlled forest enterprise subsectors in the Brazilian Amazon

Shoana Humphries, Stella Schons and David McGrath

3.1 Introduction

The focus of this case study is the Brazilian Amazon region and specifically western Pará state, a major region of smallholder settlement that is representative of conditions throughout the Amazon (Figure 6). The predominant vegetation type is evergreen tropical forest, which covers approximately 63 per cent of the region (Pereira *et al*., 2010). There are also significant areas of savannah, especially in the state of Roraima in the far north. The Brazilian Amazon region is under increasingly intense pressure for land clearing; as of 2009, an estimated 18 per cent of the Amazon forest biome had been cleared and a comparable area had been degraded by a combination of extensive logging and forest fires associated with agricultural clearing (Pereira *et al*., 2010).

Figure 6. Pará state, Brazil



Note: The case study area is to the west of the River Xingu.

The population of the Brazilian Amazon region increased substantially during the two rubber booms in the late 19th century and early 20th century, respectively (Weinstein, 1983; Barham and Coomes, 1994; Dean, 1987). The booms brought substantial wealth to a few families but often extreme poverty to rubber workers, who were lured to the Amazon but discouraged from growing food for subsistence. In the 1970s, concerns over sovereignty and economic development drove large-scale infrastructure development and the provision of incentives to cattle ranchers – whose efforts to evict forest families often escalated into conflict. The resulting social movement convinced the Brazilian government to create areas that formally recognised the rights of traditional peoples (Allegretti, 1990, 1994).

Today, the total population in the Brazilian Amazon region is 15.9 million people, and it is surprisingly urban, with only 26 per cent living in rural zones. The poverty rate is relatively high, at 32.5 per cent (compared with the national average of 21.4 per cent) (IPEA, 2013). The rural population consists of three main groups:

- indigenous peoples, most of whom live in designated indigenous territories and continue to practice traditional forest-based subsistence activities;
- traditional peoples of mixed African, European and indigenous descent, many of whom moved to the region in the late 19th/early 20th centuries during the two rubber booms (called *serengueiros* or 'rubber-tappers') or are descendants of escaped slaves (called *quilombolos*); and
- migrants (first- or second-generation) from other regions of Brazil, whose families benefited from government incentives (including land reform) to develop the region, which started in the 1970s and continues today – these include families with small and large landholdings.

Land reform has provided migrants with access to land (2,039 settlements based on 100-hectare family plots) and more secure tenure for traditional and indigenous peoples (these comprise many models, including extractive reserves). Table 3 shows current land tenure in the Legal Amazon, an area established by law encompassing all seven states of the North Region (Acre, Amapa, Amazonas, Pará, Rôndonia, Roraima and Tocantins) as well as part of Mato Grosso and most of Maranhão (in this book, the terms 'Brazilian Amazon region' and 'Legal Amazon' are used synonymously).

The focus of this case study is on traditional peoples, reliant on shifting cultivation and fishing, hunting, small animal raising, and the extraction of NTFPs such as rubber, Brazil nuts and resins; and smallholder migrants, whose income is usually derived predominantly from livestock, often related to forest clearance. However, with the economic decline of the extractive economy and the increasing regulation of markets for NTFPs (described below), traditional peoples, even those in sustainable-use conservation units, are turning to timber extraction and livestock, with the potential to increase the historically low deforestation rate in such areas (INPE, 2013). Despite falls in deforestation rates in the Amazon since 2005, several researchers have noted that the rate at which colonist settlements are growing has remained stable or even increased (Brandão and Souza, 2006; Peres and Schneider, 2011). Small producers need assistance to help them overcome the many challenges posed by these changes.

Table 3. Land tenure in the Legal Amazon

State	Area ('000km²)	Public land					Private lands (%)	Areas under dispute (devolved and private) (%)
		Protected areas (%)			Special areas (%)			
		Indigenous lands	Conservation units		Rural settlements	*Quilombola* communities and military lands		
			Integrated protection	Sustainable use				
Acre	152.6	15.9	10.6	23.6	11.6	0	22.80	15.50
Amapa	142.8	8.3	33.3	28.8	7.8	0	6.10	15.70
Amazonas	1570.7	27.3	7.8	15.8	2.2	0.1	2.30	44.50
Maranhão	249.6	8.7	5.4	12	3.7	0.1	39.10	31.00
Mato Grosso	903.4	15.2	3.3	1.3	4.8	0	52.90	22.30
Pará	1247.7	22.77	10.1	22.2	6	1.9	18.00	19.10
Rôndonia	237.6	21	9.3	12.4	17	0.1	35.10	5.10
Roraima	224.3	46.3	4.7	7.3	4	2.7	7.60	27.50
Tocantins	277.6	9.2	3.7	8.5	2	0	51.50	23.20
Total (i.e. Legal Amazon)	5006.3	21.7	8	14.2	5.6	0.6	22.70	27.00

Source: Based on data compiled from different sources by Pereira *et al.*, 2010

Productive activities occur on private, indigenous, public (for example, extractive reserves) and other special-category (such as quilombola) lands. Family farms, as defined by Brazilian law[1], account for 84.4 per cent of all agricultural establishments in Brazil, with the remainder being managed by commercial interests or other types of agricultural producers (Table 4). In the Brazilian Amazon region, family producers accounted for 86.8 per cent of the total agricultural establishments in 2006 but represented only 30.5 per cent of the total agricultural area (tables 4 and 5).

Table 4. Number of agricultural establishments, 2006

	Family producer	Other producer	Total
Brazil	4.37 million (84.4%)	800 million (15.6%)	5.17 million
Amazon region	413,101 (86.8%)	62,674 (13.2%)	475,775

Source: IBGE, 2007a

Table 5. Area of agricultural establishments (ha), 2006

	Family producer	Other producer	Total
Brazil	80,250,453 (24.3%)	249,690,940 (75.7%)	329,941,393
Amazon region	16,647,328 (30.5%)	38,139,968 (69.6%)	54,787,296

Source: IBGE, 2007a

Other types of producers involved in agro-extractive production that did not qualify in the government census as family agricultural establishments include small and medium-sized producers on private or public land who either exceeded size limits or received more income from extractive products, such as brazil nut or timber, than agricultural products. An example of an 'other producer' is one who lives in sustainable-use conservation units, a public-land category in which families typically have individual holdings of 200-400 hectares of mostly forest and generate much of their income from NTFPs.

The main subsectors of forest enterprises in Brazil are:

- timber products harvested for sale as logs for the finished wood products industry, or as charcoal and firewood;
- NTFPs for food, fibre, oils, resins and other uses; and
- agroforestry products for food and other uses.

It is difficult to know exactly how many of the 400,000 family farmers and 62,000 other producers are using or selling timber and agroforestry products and NTFPs. It is safe to assume, however, that most family farms, all families in sustainable-use conservation units, and many other producers use and sell a variety of timber products and NTFPs.

1. Family agriculture (agricultura familiar) is defined in Law No. 11.326 of 24 July 2006 as having the following characteristics: fall below a maximum size limit; rely predominantly on family members (versus hired labourers) for farm labour; farm enterprise-related income is the predominant source of family income; and the farm or farm-related business is managed by the family (IBGE, 2007a).

The Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatistica – IBGE) estimated that 64,967 producers sold at least one NTFP and 4,750 producers sold timber products in 2006 (IBGE, 2007b). Production systems typically involve a variety of agricultural, agroforestry and forest products (timber and non-timber), as well as livestock and small animals. Products are used for consumption as well as sold for income. The 2006 agricultural and livestock census (IBGE, 2007a) found that family producers in the Amazon use almost equal areas (approximately 41-43 per cent) for pasture and forest/agroforestry, followed by 12 per cent for crops and 3.5 per cent for other uses (Table 6). Family producers in the Amazon had a greater proportion of their land under forest cover than did Brazilian family producers in general, although the proportion was still well below the legal minimum requirement for forest retention on private land in the Amazon of 80 per cent.

Table 6. Land-use distribution within agricultural establishments as a percentage of total area for family and other types of agro-extractive producers in the Brazilian Amazon region and Brazil overall

Land use	Amazon region		Brazil	
	Family producer	Other producer	Family producer	Other producer
Pasture	42.97	50.75	45	49
Forest and agroforestry	41.34	40.41	28	28
Crops	12.17	5.68	22	17
Other uses	3.51	3.15	5	6

Source: IBGE, 2007a

In 2006, agricultural producers in Brazil generated a total of 114 billion reais (R$) from vegetative (plant-based) production, including agricultural, agroforestry and forestry products (IBGE, 2007b), which was 65 per cent of the total value of agricultural production. The total production value for producers in the family producer category was R$61.9 billion, of which 62 per cent was from vegetative production (IBGE, 2007a). In the Brazilian Amazon region, the value derived by family farmers from vegetative products accounted for 70 per cent of their total income, including temporary crops (45 per cent), permanent crops (15 per cent), natural forest products (7 per cent) and planted forest products (2 per cent) (IBGE, 2007c,d; IBGE, 2012a,d).

For the Brazilian Amazon region, IBGE (2012a,d) estimated that, in 2011, the total value of forest production for all producers (in both natural and planted forests) was R$2.3 billion for timber and R$385 million for non-timber products, for a total of R$2.7 billion. For Brazil as a whole, three-quarters of the value of forest production derived from plantation sources, but in the Amazon, natural forests provided 84.3 per cent (R$2.3 billion) of the total value (IBGE 2012a,d). The most important timber product in the region was logs (R$1.7 billion), which constituted 65.7 per cent of national log production (IBGE, 2012a,d). The production of charcoal and firewood was relatively small compared with other parts of the country, with the exception of Pará state, which was the fourth-largest producer of charcoal nationally in 2011 (IBGE, 2012a,d). The most important NTFPs in terms of value

in the Brazilian Amazon region in 2011 were açaí (R$291 million) and Brazil nut (R$65 million), and these also ranked among the top NTFPs nationally (IBGE, 2012a,d).

Below, we analyse the three main timber products and, faced with over 30 commercial NTFP and agroforestry species, we provide details on two NTFPs and two agroforestry products that are experiencing marked increased demand and/or production in the region. We use data generated by the annual survey of the production of extractive resources to provide time series analysis of production volume estimates, and data from the agricultural and livestock census to provide a more detailed description of agro-extractive activities by family and non-family producers. Other sources of data used, which were usually inconsistent with the IBGE data, include recent studies relying more heavily on field visits and interviews by Imazon, the Brazilian Forest Service (Serviço Florestal Brasileiro – SFB) and the Amazon Environmental Research Institute (Instituto de Pesquisas Ambientais da Amazônia – IPAM). We also interviewed IPAM staff with expertise in forest enterprises in the Brazilian Amazon region.

3.2 Assessment of market prospects for subsectors

Our case study focuses on a few products within each subsector and, geographically, on western Pará.

1. Timber products

Timber is the most valuable forest product category in Brazil and the Amazon region. SFB (2013) described two main organisational models in the timber industry. For the production of cellulose, paper, veneer, plywood and fibreboard, production is dominated by a small group of very large, vertically integrated companies. In contrast, for the production of sawnwood (for example, lumber and other dimensional wood products), plywood and furniture, a large number of locally controlled enterprises are involved (see also May *et al*., 2003). Pereira (2011) identified 2,227 such timber-processing operations, comprising all kind of operations, from sawmills to plywood-makers, and only 29 per cent of the timber they used was from land they owned or leased. Small agricultural producers are an important source of timber for the rest of the industry.

Small agricultural producers in the Brazilian Amazon region have two main options for selling timber legally. Most commonly, they obtain a licence each year to clear a portion of their land for agriculture or pasture, until the total cleared area reaches the 20 per cent maximum (compliance with this maximum is increasing due to incentives and/or fear of fines). Most of the 4,750 timber producers identified by IBGE in its 2006 census sold their timber in this way (IBGE, 2007b,e). The other option for small producers is to apply for an environmental licence and submit a forest management plan and related documentation to sell timber from their legal forest reserves. This can be done as an individual (family) or a community (through an association). Few pursue this option, however, due to the expense of submitting a forest management plan and the bureaucratic delays associated with it (Pinto *et al*., 2011).

In a 2009-2010 study, Pinto *et al*. (2011) found 902 family-owned or community-based forest enterprises producing timber in five Amazonian states, of which 86 per cent were family-owned and 14 per cent were community-based. Amazonas state had the most community and family initiatives for timber (89.9 per cent), followed by Pará (5.3 per cent), Acre (2.5 per cent), Rôndonia (1.8 per cent) and Amapá (0.4 per cent) (Pinto *et al*., 2011). In most states, the community-based and family timber producers were concentrated in a few municipalities, where government programmes and/or sources of assistance were most active; the exception was Amazonas state, where the initiatives were more dispersed (Pinto *et al*., 2011). While the number of family or community-based timber producers was low in 2009-10, it represented marked progress since the 1990s, when community forestry initiatives for timber began in the region. In the 1990s, 218 community forest management plans were submitted and only eight were approved; but in 2003-2005, 837 plans were submitted and 815 were approved (Amaral Neto *et al*., 2008).

Sales of timber from deforested areas are usually managed through informal agreements between loggers and individual families and associations but the families and associations usually receive very little of the value. When timber is sold from legal forest reserves, agreements are often more formal, and there is greater variety – in terms of scale and complexity – in the production model employed. In some cases, communities sell standing trees to logging companies. In others, the communities fell the trees and either cut them into boards using portable sawmills or chainsaws or hire operators to remove the trees to a permanent sawmill, where community members then saw the trees. Some communities also make finished products, such as the Oficinas Caboclas initiative supported by IPAM in Santarém, Pará (IPAM, no date). There is a considerable range in the scale of such operations: a small association may manage a total area of less than 20 hectares, but a larger one might manage 1,000 hectares or more. (see Humphries, 2010).

In 2009, the Amazon timber industry harvested 14.2 million m^3 of commercial logs. Seventy two per cent of this was transformed into 5.8 million m^3 of processed wood in the form of low-value sawnwood products, such as joists, rafters and boards; 15 per cent was used for solid wood products, for example, furniture and doors; and 13 per cent was used for laminates or plywood (Pereira *et al*., 2010). The total estimated value of production in 2009 was R$4.94 billion (Pereira *et al*., 2010).

The proportion of production from planted forests in the Amazon is: 6.3 per cent of charcoal, 9 per cent of firewood, 2 per cent of logs for paper and cellulose, and 4.3 per cent of logs for other uses (IBGE, 2012b). Nonetheless, as agricultural producers increasingly come under pressure to reforest their land to comply with minimum forest-cover requirements,[2] the area and value of production from planted forests and/or tree species may increase. The contribution of planted products to total timber production value in the region was around 10 per cent for the last 10 years, increasing to 15 per cent in 2010 and 2011.

2. Recent revisions to the Forest Code have relaxed the requirement to maintain 80 per cent forest cover, but a minimum coverage may be required for landholders to access credit or other incentive programmes.

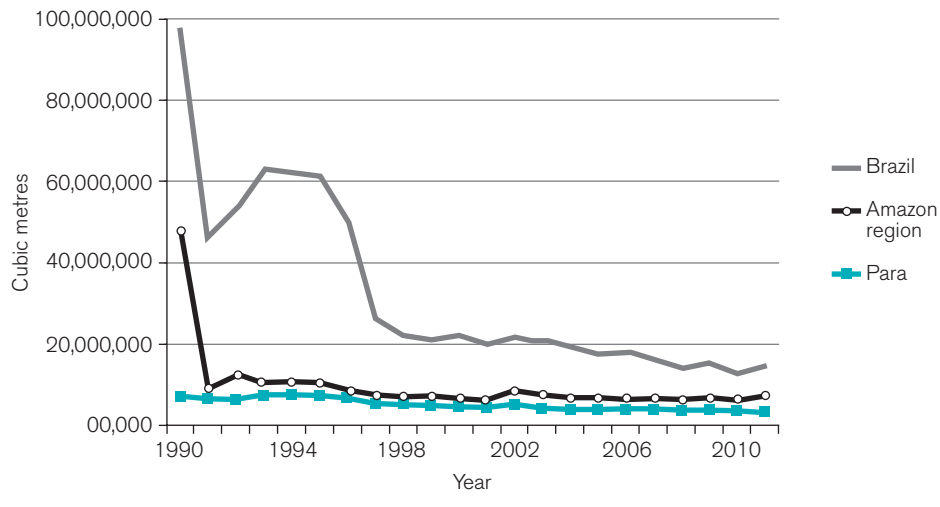
Logs. The consumption of logs by the forest industry in the Legal Amazon decreased from 28.3 million m^3 in 1998 to 24.5 million m^3 in 2004 and 14.2 million m^3 in 2009 (SFB and Imazon, 2010). The three main likely reasons for this significant drop were: the substitution of alternative products for tropical wood, for example in construction and the furniture industry increased control of deforestation and illegal timber; and the 2008 global financial crisis (SFB and Imazon, 2010).

The Brazilian Amazon region is the main source of natural forest logs in Brazil. By state, the top three producers of natural forest logs in 2009 were Pará, Mato Grosso and Rôndonia, while Acre was the fifth-largest producer and its production increased by ten per cent in 2009 compared with the previous year (Figure 7) (SFB and Imazon, 2010). Most log production from plantations takes place in southern Brazil.

Sawnwood. The majority of logs harvested in the Brazilian Amazon region are transformed into sawnwood (lumber and other roughsawn products). In the period 1998 to 2009, the range in proportion of processed wood products was as follows: 63-72 per cent sawnwood; 13-21 per cent veneer or plywood; and 11-15 per cent processed wood (wood that has been further processed and is ready to be a part of a finished product, but is not a finished product yet) (SFB and IMAZON, 2010).

Charcoal and firewood. The production of charcoal and firewood is steadily decreasing in the Brazilian Amazon region as the main source of these products changes from natural to planted forests (figures 8 and 9). Within the region, Pará is the most significant producer of charcoal, although its production has fallen significantly in the last ten years. Previously, a main source of demand was the pig-iron industry in Carajás, but that demand fell significantly after 2003 due to rising awareness of the environmental impacts of charcoal-related wood extraction from natural forests, a government crackdown on illegal

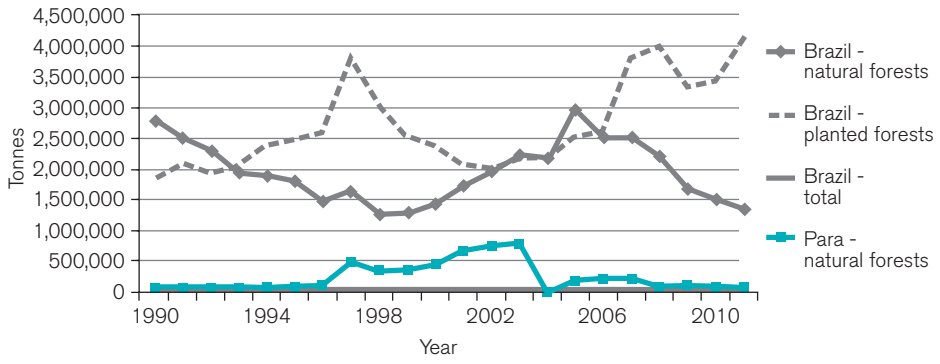
Figure 7. Log production in Brazil, 1990-2011 (m^3)



charcoal producers, and the 2008 global financial crisis. Pará has also been the historical leader in firewood production in the Brazilian Amazon region, and (in contrast to charcoal) it continues to supply around five per cent of firewood in the national market.

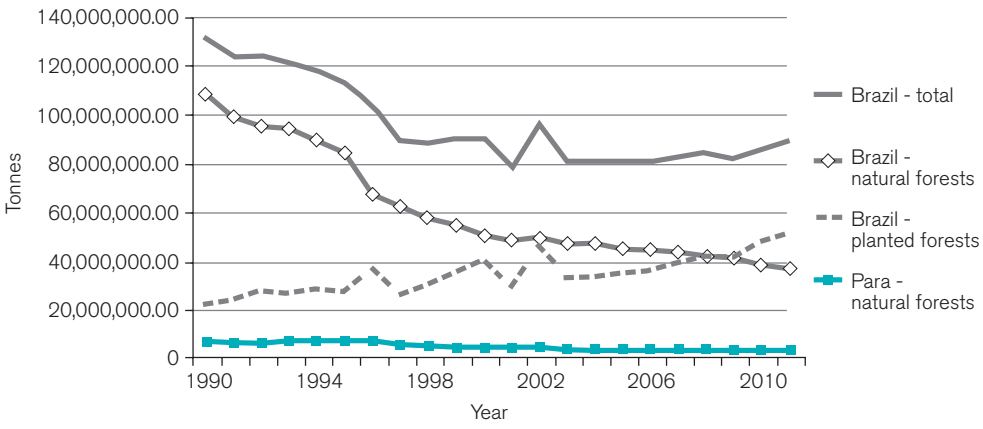
Market prospects. The majority of processed wood harvested in the Brazilian Amazon region is consumed within Brazil: domestic consumption has been between 65 and 86 per cent of total production since 1998. The percentage of processed wood products that were exported increased from 14 per cent in 1998 to 36 per cent in 2004, due to increased demand in European, North American and Asian markets. They declined to 21

Figure 8. Charcoal production in Brazil, 1990-2010 (tonnes)



Source: IBGE, 2012b

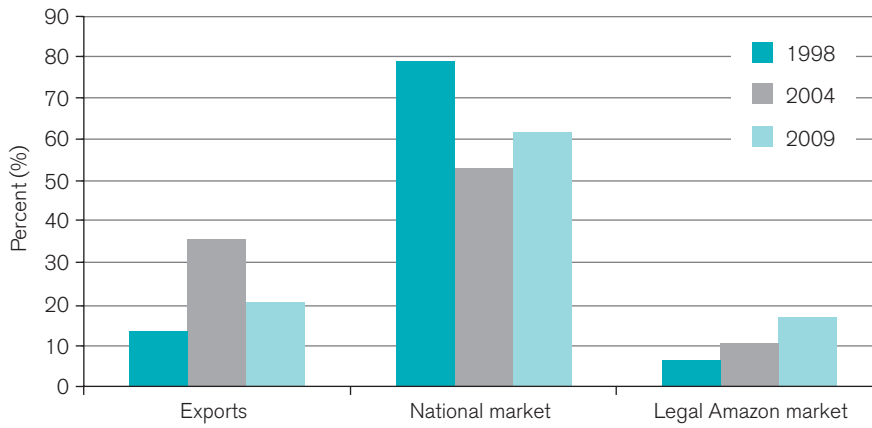
Figure 9. Charcoal production in Brazil, 1990-2010 (tonnes)



Source: IBGE, 2012b

per cent in 2008 due to the global financial crisis and a stronger Brazilian currency (Figure 10) (SFB and Imazon, 2010). The state of São Paulo is the biggest domestic market (SFB and Imazon, 2010).

Figure 10. Markets for processed wood from the Legal Amazon in 1998, 2004 and 2009



Source: SFB and Imazon, 2010

Government policies and practices designed to regulate the timber industry present both challenges and opportunities for family and community producers of timber products. Many state and federal programmes have helped family and community producers in their efforts to extract timber from legal reserves by providing free technical assistance, purchasing equipment, providing training and helping to find buyers for products (Amaral Neto *et al*., 2008). It remains to be seen, however, if such operations will be viable when support programmes end. The federal government has also decentralised responsibilities for approving documentation to the states, and state governments are simplifying procedures for environmental licensing and the approval of management plans for small and community producers, which has helped boost the number of family and community plans submitted and approved.

The small size of many family and community operations and the limited volumes of commercial species result in poor economies of scale, meaning high costs per unit of production compared with larger operations. Many family and community operations are in isolated locations, resulting in high transport costs and poor access to markets and market information. Such operations not only have to compete with larger companies, which have better economies of scale, but also with illegal operations, which Pinto *et al*. (2011) estimated produced 36 per cent of the total volume of logs in the market in 2009. Illegal producers do not face the same costs or regulations and the large volume of cheap products they place on the market drives down prices.

Despite these challenges, Humphries *et al*. (2012) found that community-based forest enterprises in which families come together for timber production can be financially viable by sharing costs, for example, for documentation, technical assistance and machinery; and collaborating within and across associations to consolidate wood volumes, negotiate prices with buyers (Macqueen *et al*, 2005), and obtain certification for responsible forest management – although many communities are too isolated to receive market benefits for certified products (Molnar *et al*., 2007 and Wiersum *et al*, 2011). Forming partnerships with forest product companies is also an important strategy by which smallholders can overcome some of their challenges, especially those related to documentation and access to capital and markets. The timber industry will remain largely dependent on small-scale farmers for its supply until the new forestry concession system is fully implemented, a situation that presents both challenges and opportunities.

Policies that help drive demand for timber products from small producers include: the My House My Life Programme (*Programa O Minha Casa Minha Vida*), a federal programme that provides credit for the building of houses in rural and urban areas, for which the construction timber is bought locally (Adriana Margutti, personal communication); Acre's significant state investments to encourage timber product companies committed to buying from community producers; and the establishment by the Acre government of a flooring factory close to communities that are producing legal and Forest Stewardship Council-certified timber (Anonymous, 2006). Other initiatives the authors have heard about include municipalities buying wood and wooden furniture for schools from local small and community producers.

Recent changes to Brazil's forest-related policies may have significant impacts on community and family forest producers. In 2006, a national forestry policy was passed that was designed to concentrate commercial forestry in state and national forests. Few concessions have been granted to date (SFB, 2013), so it is unclear if these new sources of timber will reduce pressure on colonist forests, or conversely, reduce opportunities for small and community timber producers to access markets. In addition, in 2012 the Forest Code was revised to loosen requirements for maintaining forest reserves on smallholder lots; 80 per cent forest cover should still be maintained, but farmers and ranchers who cleared areas prior to 2008 will not be penalised if they do not meet this threshold. The impacts of these changes on smallholders are not yet known.

Although the climate of the Amazon may be changing as a result of global warming, timber production is likely to remain quite robust. Major droughts in 2005 and 2010 have thinned forests but the decline in timber volumes was small: less than five per cent of forest biomass died as a result of those droughts, equating to about one tree per hectare.

2. NTFPs for food and other uses

NTFPs are 'biological materials, other than timber, which are extracted from forests for human use' (de Beer and McDermott, 1989). Although the economic importance of rubber for the livelihoods of agro-extractive families has fallen dramatically, the harvest of other NTFPs in natural forests, together with fishing and subsistence agriculture, are still major sources of subsistence and income for people in the Amazon (Rueda, no date).

In its annual survey on the production of extractive resources, IBGE collects data on 33 NTFPs organised into eight categories: food such as fruits and nuts; aromatic, medicinal, toxic and dyes; rubber; waxes; fibres; non-elastic gums; oils; and tanning products. The monitored NTFPs are a small fraction of the complete set of identified NTFPs in the Brazilian Amazon, however (Shanley *et al*., 2008). For some NTFPs, best management practices are being developed to help improve sustainability and labour safety for example, Melo *et al*., 2011, although challenges in disseminating these practices and purchasing recommended equipment make adoption a slow process.

Pinto *et al*. (2011) found 325 cases of small producers selling at least one of seven NTFPs in the previous five years in the six states they examined. These producers all belonged to some type of formal or informal organisation for either production or access to land, and either acted individually or as part of a group according to different opportunities (14 of the producers also sold timber). Pinto *et al*. (2011) acknowledged that NTFP producers are difficult to identify because they do not have to have an environmental licence to harvest NTFPs; their estimates, therefore, are probably too low. By comparison, IBGE (2007b) showed that there were 64,967 producers of at least one NTFP in the same six states in 2006, although this included a range of 33 NTFPs. In our experience, families with forest on their properties always at least use NTFPs to meet some of their subsistence needs.

Our calculations based on IBGE's 2006 agriculture and livestock census (IBGE, 2007b) indicate that NTFP production values represent only 0.8 per cent of the income generated by the rural sector in Brazil and 2.7 per cent of that in the Brazilian Amazon. In the Amazon, food (including açaí and other fruits) is by far the most important NTFP category; almost 250,000 tonnes of edible NTFPs were produced in 2011, 60 per cent more than in 1994 and two per cent less than in 2010. Fibre extraction is the second most important NTFP: just over 2,500 tonnes were harvested in 2011, 60 per cent more than in 1994 and 32 per cent less than in 2010 (IBGE, 2012a).

In a recent workshop in Pará, the fruit trees, natural forest products, food products and other types of agricultural products shown in Table 7 were identified as the highest-priority cultivated products for the three subregions that comprise western Pará. Based on these findings, IPAM implemented studies on açaí, andiroba oil, banana and manioc flour in 2012.

In the following sections we provide information on two NTFPs that have received a lot of attention recently in western Pará: açai and andiroba.

Açaí. Açaí is a palm that occurs in the Amazon, especially along estuaries, in Brazil, Colombia, Ecuador, Guyana, Suriname and Venezuela (Nogueira, 2006; Carmelio, 2010). In Brazil, Pará is the main distribution centre for açaí products (Nogueira, 2006; Carmelio, 2010; Cunha, 2006). There are at least ten açaí species, but the two most common ones are *Euterpe oleracea*, which is mainly found in várzea areas of the eastern Amazon, and *Euterpe precatória*, which is more common in the western Amazon in both floodplain (*várzea*) and upland (*terra firme*) ecosystems (Pinto *et al*., 2010).

Table 7. Priority family agriculture production products for the three subregions of western Pará

Production system	Subregion		
	Tapajós and BR-163 areas	Baixo Amazonas area	Transamazônica and Xingu areas
Orchards/ agroforestry	Banana, cocoa, cupuaçu and açaí (agroforestry systems and organic orcharding)	Pineapple, açaí, banana, cocoa, passion fruit and cupuaçu	Cocoa in agroforestry systems, organic cocoa, conventional cocoa and açaí
Extractive products	Extraction for the production of oils – Brazil nut, babaçu and andiroba, production of babaçu mesocarp flour and other products	Extraction for the production of oils – Brazil nut, babaçu and andiroba; timber and latex	Extraction for the production of oils
Food security	Manioc, horticulture, beekeeping, cattle raising and small animal ranching	Manioc, beekeeping, seed production and cattle raising	Manioc, seed production, horticulture, cattle raising, and small and medium animal ranching
Other production systems	Curauá fibre extraction and handicrafts	Aquaculture, fishing, handicrafts, curauá and jute fibre extraction	Aquaculture and fishing

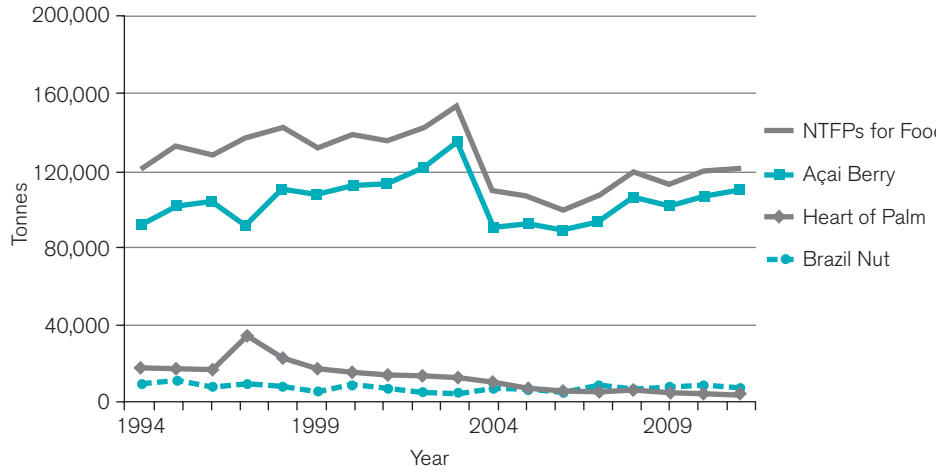
Source: Relatório II Ciclo de Debates Estratégicos, Projeto BR163 Sustentável: Florestas Desenvolvimento e Participação.

The açaí palm tree has many uses, ranging from sheltering material to handicrafts, but it is traditionally cultivated for its nutritious food products (açaí juice and palm heart – Pinto *et al*., 2010). Palm heart was more commonly harvested until the beginning of the 1990s, when concern grew over the consequences of removing the whole palm and the Brazilian government established harvesting controls (Cunha, 2006). Thereafter, the extraction of açaí berry juice became more common. The marketing of the berry's energy-inducing properties in the early 2000s led to increased demand in markets in Brazil and abroad (Cunha, 2006).

The harvesting of açaí berries by families using traditional skills is now a main source of income in the Amazon River estuary region and may represent as much as 80 per cent of the income of many riverine families (Carmelio, 2010; Cunha, 2006; Homma, 2006). The berries are sold mainly to intermediaries and usually transported by river in the Amazon estuary, or by road in the Transamazon and BR163 regions, to bigger markets. For local consumption, women often extract the juice using artisanal machinery. For commercial consumption, the berries are sold to processing facilities that either freeze or freeze-dry the juice.

Pará is the largest açaí berry producer in Brazil, producing over 109,000 tonnes in 2011 (IBGE, 2012b; Figure 11). Most of the açaí consumed in the Santarém area is from *açaizais* (areas where the palm is found naturally). However, some farmers are starting to plant the palm tree in monocultural and agroforestry systems focusing on both the local market, which is not yet fully supplied, and international markets (SEBRAE, 2012). The common perception among researchers in the region consulted for this report is that domestic demand and international demand in the United States and Europe far outweigh supply, and demand is expected to continue to grow. This is prompting concern that the price of the fruit could become prohibitive for rural populations (Figure 12). In fact, real prices[3] for açaí (fruit) paid to producers in Pará have increased by 250 per cent since 1994, including 200 per cent in the last decade and 10 per cent between 2010 to 2011 (IBGE, 2012a,b). It is not clear what impact this will have on residents who purchase açaí for consumption.

Figure 11. NTFP extraction for food (main products), Pará

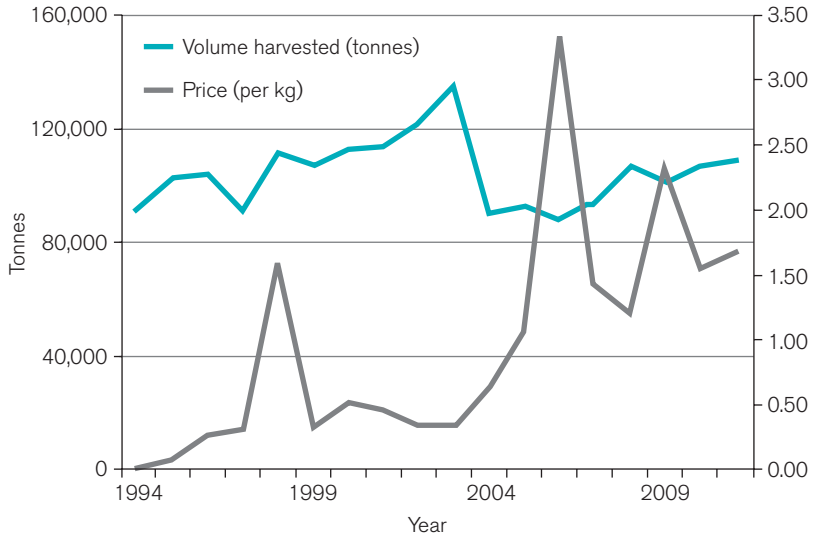


Source: IBGE 2012a, b

Andiroba (Carapa guianensis). Andiroba is a tree that can reach up to 55m in height. It occurs in tropical forests in South and Central America and Africa, mainly along river margins and on floodplains, as well as in upland areas (Klimas *et al*., 2007; Maués, 2008; Menezes, 2005; Shanley and Medina, 1998). Its main product is the oil extracted from its seeds; this oil has long been used by indigenous peoples in the Amazon as an insect repellent, and (together with *urucum*) for making tattoos. Based on its antiseptic, anti-inflammatory and antipyretic properties (Menezes, 2005), andiroba oil is commonly used for medicinal purposes, including to treat skin problems, hematomas, muscular pain, scratches and skin lesions, and rheumatism (Shanley and Medina, 1998; Boufleuer, 2001; Shanley and Swingland, 2002; Klimas *et al*., 2008; dos Santos and Guerra, 2010). Because of its medicinal and repellent properties, andiroba oil has been used widely by both domestic and international cosmetic, pharmaceutical and candle industries (Menezes, 2005), and it has also been used as biodiesel (Guedes *et al*., 2008).

3. Prices are adjusted for inflation to 2011 values.

Figure 12. Açaí production and prices in Pará



Source: IBGE 2012a,b

Men usually collect the andiroba seeds in the forest and women extract the oil using simple mechanical presses. Producers usually sell the oil to local end-consumers or intermediaries, although some also sell directly to regional markets, either to end-consumers there or to vendors. Producers receive up to 40 per cent more if they sell directly to end-consumers (both local and regional) than if they sell to intermediaries (Schons and Costa, 2012d). The average consumption of andiroba oil in the vicinity of the Transamazon Highway in Pará is less than one litre per family per year, and income from andiroba oil sales varies from family to family; for example, some families sell as few as one or two litres per year and others sell more than 100 litres (Schons and Costa, 2012d). Many families store the oil for when they need cash. In the Santarém region, producers were paid R$18-30 per litre in 2012 (Schons and Costa, 2012d).

3. Agroforestry

The term 'agroforestry system' is generally used to refer to land-use systems in which forest species are associated with agricultural and/or animal species, but it does not have a universal definition (Farrel and Altieri, 2012). IBGE (2007a) defined an agroforestry system as a type of land use in which forest species are combined with agricultural crops and/or ranching, simultaneously or in temporal sequence, and which interact economically and ecologically.

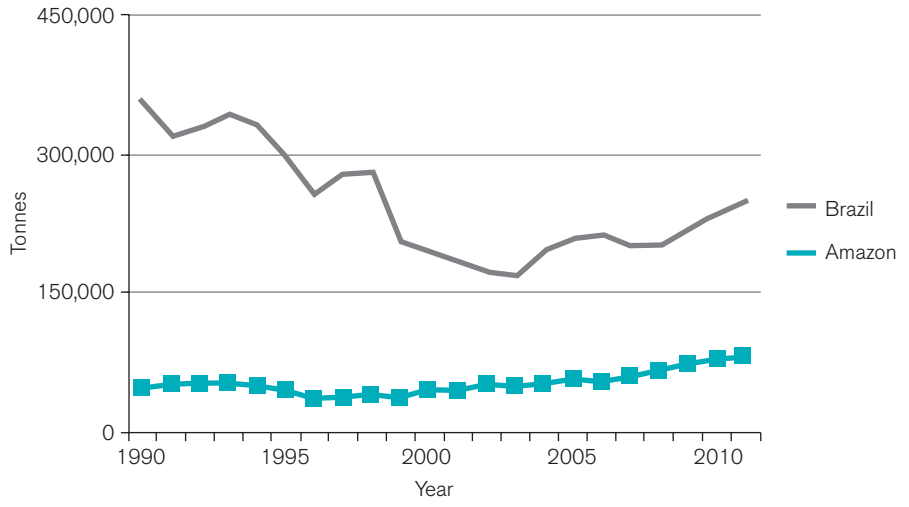
IBGE's 2006 agriculture and livestock census (IBGE, 2007f) found that 2.86 per cent of the area of family farms in the Amazon was used for agroforestry, and in Pará the area was 3.97 per cent. Agroforestry systems have been used in the region for two main reasons: (i) increased perceived demand for timber and NTFPs that adapt well to agroforestry systems (such as andiroba, cumaru and cupuaçu); and (ii) the need to recover degraded and (mainly)

deforested land to comply with the 80 per cent legal forest reserve rule. A recent banana supply-chain study by IPAM in the Transamazon Highway region in Pará indicated that a transition in agroforestry is occurring away from intercropped cultivation systems based on cocoa and banana, where banana is planted to provide shade for cocoa seedlings, towards other species with the aim of increasing land productivity. For example, small producers are increasingly planting açaí in either monocultures or agroforestry systems. Market supply chains vary greatly for agroforestry products, depending on demand. Products may be taken to local markets (for example, bananas) or sold to intermediaries, where they may eventually end up in international markets (such as cocoa).

There are strong arguments for actively promoting agroforestry systems in the region, but there are also some risks in doing so. Homma (2012) proposed the active domestication of NTFPs with greatest commercial success and their production on cleared or degraded lands, simultaneously increasing forest cover, generating jobs and reducing pressure on natural forests. But small producers who shift their labour and resources to intensively producing a smaller variety of products may be more vulnerable to market downturns, and their crops may be more susceptible to pests and diseases because of the high density of only a few species. IPAM recommends improving agroforestry systems as part of diverse agro-extractive production systems.

Nevertheless, we focus here on cocoa and banana production because cocoa has been an important agroforestry product for many years and its production as part of banana-cocoa agroforestry systems is increasingly being used in western Pará. IBGE (2012c) estimated that the national production of cocoa and banana was 248,000 tonnes and 7.3 million tonnes, respectively, in 2011 (figures 13 and 14). Cocoa production fell in

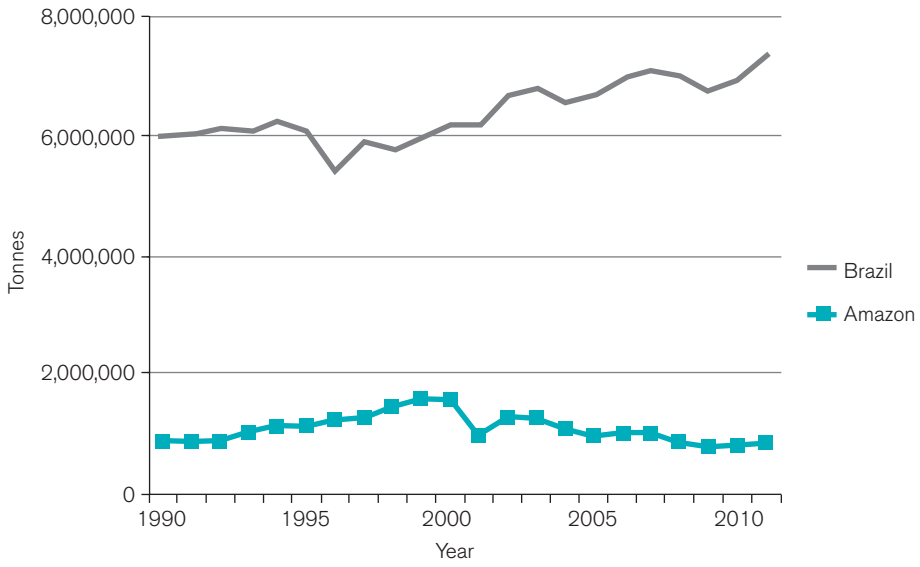
Figure 13. Cocoa production in Brazil and the Brazilian Amazon region (tonnes)



Source: IBGE, 2012c

Brazil from 1994 to 2003, due largely to problems with a disease called witch's broom, but has been increasing since then, except for a small dip in 2006 and 2007. In contrast, banana production has grown since 1990, when it was about six million tonnes. In the Amazon region, cocoa production grew somewhat between 1990 and 2011, while banana production has been relatively stable at around one million tonnes. Mecilândia, in the Transamazon Highway region in Pará, is now considered the Brazilian capital of cocoa.

Figure 14. Banana production in Brazil and the Brazilian Amazon region (tonnes)



Source: IBGE, 2012c

Banana. Banana is an important product for food security and income in tropical areas worldwide (Borges and Souza, 2004). It is on the list of the most consumed foods in Brazil (CONSEA, 2010), and IBGE (2009) estimated that family farmers in Brazil consume as food about 12 per cent (rising to 45 per cent in the Amazon Region) of the bananas they produce. According to IBGE´s research on family income (IBGE, 2009), the per capita consumption of bananas in the Amazon was 2.87kg per year in urban areas and 2.28kg per year in rural areas. A recent IPAM study, however, estimated a per capita annual consumption of 43kg/year for a group in Santarém and 92kg for a group in Altamira (Schons and Costa, 2012a).

Family farms are the major producers of bananas in Brazil (SEBRAE/ESPM, 2008; Christante, 2011). They produce 63 per cent of total production value nationally and 67 per cent in the Amazon region (IBGE, 2007b). Bananas account for 23 per cent of the total value of family agriculture permanent crop production in Brazil and 15.7 per cent in the Amazon (IBGE, 2007b). Schons and Costa (2012a) found that farmers in the Transamazon

Highway region of Pará who cultivated the crop mainly to provide shade for cocoa, sold their bananas in local markets, even though the quality was not considered very high.

Cocoa. The cocoa tree has been cultivated since pre-colonial times and is native to the Amazon region. More intensive cultivation began in the Amazon region in 1965 when the Executive Board of the Cocoa Crop Plan was transformed into a federal agency and expanded to various Amazonian states. The National Programme for the Expansion of Cocoa Cultivation, known as PROCACAU, helped consolidate production in the Amazon (Silva and Pinto, 2009). Cocoa trees may be planted in agroforestry systems, and these areas may be registered as legal reserves to help farmers comply with the Forest Code (Calvi *et al*., 2010). In a Federal University of Pará study in the region, 70 per cent of the people surveyed used forest species for shading in cocoa-based agroforestry systems. The species used were mahogany (21 per cent of survey respondents), ipê (9.7 per cent), andiroba (8.3 per cent), African mahogany (7.6 per cent), Spanish cedar (6.6 per cent), tatajuba (5.5 per cent), açaí (4.1 per cent), and Brazil nut (3.4 per cent), among others (Calvi *et al*., 2010).

Cocoa accounts for 2.17 per cent of the total value of permanent crops grown on family farms nationally and 6.51 per cent of that value in the Brazilian Amazon region. About 40 percent of the national cocoa crop is grown on family farms and about 51 per cent is grown in the Amazon region. The Transamazon Highway region of Pará, where cocoa is the main agricultural activity, is that state's biggest cocoa producer (Calvi *et al*., 2010).

Market prospects. Given the increasing tendency to domesticate NTFPs and shift their production from natural forests to agroforestry systems, here we discuss the NTFP and agroforestry subsectors together. Again, we highlight issues around the production of and markets for açaí, andiroba, cocoa and banana.

Many forest and agroforestry fruits have been in increasing demand in recent years, driven both by state policies and commercial industries. While many NTFPs produced in Brazil are consumed in local markets as raw fruits, an increasing amount is being processed locally or regionally and then sold in national and international markets. This is especially true for açaí, which may be sold in liquid form as a juice (*vinho*) or either frozen or freeze-dried, and also for andiroba oil.

Consumers appear to value these products because: of their health benefits; they contribute to forest conservation; and/or they boost local economic development. In Brazil, experts estimate that the market for cosmetic products using natural materials grew by about seven per cent in 2012, an increase attributed to consumer perceptions of the health advantages of these products compared with cosmetics containing synthetic products, as well as perceptions about the role of these products in environmental conservation (Bio Brazil Fair, 2012). Such perceptions have been significant in the demand for açaí, which is marketed as an energy supplement in many international markets and increasingly within Brazil, as well as for andiroba oil, which is used in many cosmetic products.

For cocoa and banana, domestic demand is greater than supply. Brazil is a net importer of cocoa, and its domestic production has had many problems with pests (which are now under control). Barriers posed by documentation requirements and a lack of infrastructure have limited the extent to which Amazonian banana producers have been able to market their products in southern Brazil, where demand is high (SEBRAE/ESPM, 2008).

Despite growing demand for natural products, including andiroba oil and açaí, local producers face many challenges in seizing the opportunity this represents. Challenges encompass:

- **Quality.** Extraction processes require a lot of care, especially if artisanal, so that the product is not contaminated. In recent years, chagas disease has been linked to açaí production processes, and the quality of andiroba oil is also greatly affected by the method of extraction. On the basis of interviews with a series of companies who buy andiroba, copaíba and Brazil nut oil, Enriquez (2007) found that the quality of the oil was the main obstacle that companies encountered in buying these products, although it could be overcome with training.
- **Scale.** Labour limitations and the slow, low-yield extraction process can make it difficult for producers to meet demand.
- **Supply of the natural resource**. In the case of andiroba, the trees do not produce seeds all year round, which affects communities´ ability to meet contractual commitments. This limitation is encouraging small producers to plant açaí and andiroba, as well as other species.

Overall, such challenges limit the ability of communities to capture value from their forest products and reinforce their dependence on intermediaries.

The federal government has adopted policies that could have important positive impacts on demand for NTFPs and agroforestry products and thereby stimulate production. Two such policies are aimed at purchasing food from family producers: the Food Procurement Programme (Programa de Aquisição de Alimentos – PAA) and the national school meals programme (Programa Nacional de Alimentação Escolar – PNAE). The PAA commenced in 2003 with the dual objectives of strengthening family agriculture and reducing hunger in the country. Under it, agricultural produce is bought from small landholders (including rural settlements and traditional peoples), individually or organised in groups, to build up strategic inventories of food to be distributed to families in need. The value of produce sold by family varies between R$4,000 and R$8,000 per year, depending on the purchase modality (MDA, 2012). Under PNAE, municipal governments are required to buy at least 30 per cent of the food provided in schools from family farms. From July 2012, each family can sell up to R$20,000 worth of produce to the government. Farmers may sell to both programmes; products sold include Brazil nut and derivates, babaçu derivates, and açaí.

The federal government has also had a minimum price policy for agricultural products since 1966. In 2008 it expanded the programme to include NTFPs, or 'sociobiodiversity products' (this subprogramme is known as PPGM-Bio), through which the government defines minimum prices for some products. If the producer is unable to sell the product for the minimum price, the government will pay the difference between the 'official price'

and the actual selling price. As of August 2012, the policy had benefited 29,970 families (including 5,753 families in 2011) with expenditure of nearly R$7 billion in 11 states, five of them in the Amazon region (MDA, 2012).

Another example of government helping to drive NTFP demand is in the purchase of condoms manufactured using natural latex in Acre. A federal and state government-supported company is purchasing natural liquid latex from 750 agro-extractivist families in several reserves (Veras, 2012). The latex is used to make condoms, which are then purchased by the government for distribution within Brazil as part of AIDS awareness programmes. The company pays 1.78 times more than the normal market price for latex and is also the second-largest employer in the small town of Xapuri.

At the same time, government control measures make it very difficult for small producers to sell agro-extractive products in processed forms and in more formal markets. The documentation required to sell fruit and fruit derivatives in Brazil varies depending on the fruit in question and the buyer. To take advantage of the government procurement programmes described above, producers must provide documentation that they qualify as a 'family agriculturalist' (this document is known as a DAP – *declaração de aptidão*). To receive a DAP, producers must apply to the National Institute of Colonization and Land Reform (Instituto Nacional de Colonização e Reforma Agrária – INCRA) and present documentation of their tenure or use rights to their land. This requirement poses two main challenges. First, very few producers in the Brazilian Amazon region have documentation of their tenure. Second, INCRA has very limited capacity to respond to the quantity of applications for DAPs, either directly or through contracted agents in rural areas. In addition, if a producer wants to sell a derivative product, such as açaí juice or andiroba oil, they must present an inspection seal (*sello de inspeção*). For sales within the state, this can be issued by the state ministry of agriculture, but for sales to other states or to export markets, the seal must be issued by the federal Ministry of Agriculture. These requirements present real barriers for innovation and income generation, especially for women, who are usually engaged in primary processing.

In addition, since 2001, Brazil has had in place specific legislation (known as *Medida Provisória* 2.186) for the use of what are called 'biodiversity products', under which payments to traditional communities may need to be paid for the use of their traditional knowledge and genetic resources. The law establishes an institution to enforce rules around the use of such products. Starting in 2010, the Brazilian Institute of Environment and Renewable Natural Resources (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA) has been issuing fines to companies and research institutions for not complying with the legislation, even though its requirements are not well understood. This creates uncertainty in the use of some NTFPs as production inputs in industry and may lead companies to seek alternatives.

Forest-based production systems in the Amazon are likely to be more resilient to climate change than conventional production systems that not only contribute to drier conditions but are also vulnerable to the increased frequency of droughts that may occur as more areas are cleared. Also, to the extent that forest-based production systems meet the income and subsistence needs of smallholder households, they reduce the reliance of those households on shifting cultivation for annual crops and the need to clear forest to raise cattle, activities which lead to increased CO_2 emissions and disrupt hydrological processes.

3.3 Assessment of integrated impacts for each potential subsector

The following scale was used to rank each subsector: 5 = a positive contribution to the social foundation or environmental boundary is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely. Tables 8-13 present the scores of the subsectors against each criterion, and Table 14 summarises the assessment.

Table 8. Gender analysis: what is the likely contribution of each subsector to income-generating opportunities for women and thereby the likely impacts on household well-being (including any issues to do with reproductive health)?

Subsector/product	Score	Supporting information
Timber	1-2	In general, timber extraction and processing is a male activity, although there are some exceptions.
NTFPs – açaí/andiroba	3-5	The collection and transport of fruit is a male activity, but women often undertake local processing. The degree of local processing may be critical to opportunities for women to be involved.
Agroforestry – banana/cocoa	2-4	Both men and women can be involved in agricultural activities. Where products are processed locally, women may have opportunities for greater participation.

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or the environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 9. Impacts on food security: what is the likely contribution of each subsector, either (i) directly to increased food security through the enhanced agricultural production of staple foods produced locally or (ii) indirectly through increased diversification income generation that affords households greater purchasing power to buy staple foods?

Subsector/product	Score	Supporting information
Timber	2-4	The effect is largely indirect. Timber can be the most valuable forest product on a smallholder's property. The income generated from sales can be used to purchase food and/or invest in food production or in other income-generating activities. However, if logging removes or negatively affects NTFP species, it can have negative direct impacts if the NTFPs are harvested, or negative indirect impacts if the NTFPs are food sources for game.
NTFPs for food – açaí	4	Açaí is an important part of local diets in the Amazon. It is likely that, in most cases, sustainable management can increase availability for both food and income. However, there is concern that rising prices will adversely affect the ability of the urban poor to purchase the fruit.
NTFPs for other uses – andiroba	4-5	The sale of andiroba is likely to have positive indirect effects by increasing income to purchase food.
Agroforestry – banana/cocoa	4-5	Banana is an important part of rural diets. Its sale is also likely to increase purchasing power.

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or the environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 10. Impacts on energy security: what is the likely contribution of each subsector to the provision of household energy, either (i) directly where energy is the main business (such as firewood, charcoal or biogas) or (ii) indirectly where tree products or agricultural crop residues can be used to enhance energy security?

Subsector/product	Score	Supporting information
Timber	5	Sustainable forest management for timber can improve energy security by increasing the availability of firewood and charcoal and providing income to purchase alternative cooking fuels.
NTFPs – açaí/andiroba	3	Negligible impacts.
Agroforestry – banana/cocoa	3	Negligible impacts.

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or the environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 11. Impacts on climate change mitigation and adaptation potential: what is the likely contribution of each subsector to carbon emissions reductions (including replacement of alternative emissions sources) and how important is it likely to be for adapting and building resilience to known future climate change scenarios?

Subsector/product	Score	Supporting information
Timber	4	While timber extraction leads to moderate increases in carbon emissions, sustainable management maintains healthy forests and mitigates the impacts of climate change, including by conserving hydrological processes.
NTFPs for food – açaí/andiroba	4	NTFP production generally increases carbon stocks and strengthens the resilience of household production systems to climate change.
Agroforestry – banana/cocoa	3-4	Agroforestry production systems accumulate more biomass and carbon stocks than agricultural crops and strengthen the resilience of household production systems to climate change.

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or the environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 12. Impacts on biodiversity within actual system and on adjacent natural systems: what is the likely contribution of each subsector to biodiversity conservation? For example, to what extent does the subsector require the maintenance of biodiverse natural ecosystems or enhance the degree of agro-biodiversity through its operations?

Subsector/product	Score	Supporting information
Timber	4-5	Low-impact extraction may have minimal impacts on biodiversity. The forest canopy is maintained, so there is minimal environmental change in the forest interior. Some patchiness can enhance biodiversity.
NTFPs for food – açaí	2-3	There is concern that biodiversity might be lost as açaí is increasingly planted, especially when planted in monocultures. However, when it is planted in agroforestry systems, the negative impact on biodiversity is likely to be much smaller.
NTFPs for other uses – andiroba	2-3	Negligible impacts.
Agroforestry – banana/cocoa	2-3	Agroforestry systems are unlikely to have a significant effect on biodiversity. Much depends on the diversity of the agroforestry systems and the proximity of natural forest.

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or the environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 13. Impacts on soil fertility and nitrogen inputs: what is the likely contribution of each subsector to the use of natural forest management or on-farm soil husbandry techniques that enhance long-term soil fertility without the excessive use of nitrogen fertilisers?

Subsector/product	Score	Supporting information
Timber	4-5	With low-impact extraction in sustainable forest management systems, the impact is expected to be negligible.
NTFPs for food – açaí	4-2	The harvesting of açaí is likely to have minimal negative effects on soil fertility but this could change if incentives or market pressures encourage farmers to plant pure stands.
NTFPs for other uses – andiroba	5	Andiroba agroforestry systems and natural forest management are very likely to enhance long-term soil fertility.
Agroforestry – banana/cocoa	2-3	Agroforestry systems of cocoa and banana are not likely to promote the use of fertilisers but could contribute to soil management that enhances long-term fertility.

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or the environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 14. Summary of assessment of integrated impacts for each potential subsector

Impact criterion	Score		
	Timber products	NTFPs	Agroforestry
Gender	1-2	3-5	2-4
Food security	2-4	4-5	4-5
Energy security	5	2	2-4
Climate change mitigation and adaptation potential	4	4	3-4
Biodiversity	4-5	2-3	2-3
Soil fertility and nitrogen inputs	4-5	2-5	3-4
Total	20-25	17-24	16-24

Note: Impact criteria are described in the text.
Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

In summary, all potential subsectors – timber products, non-timber products, and agroforestry products – present important opportunities for cash income, which can strengthen food and energy security. Timber can be particularly valuable, especially when producers are adequately organised and informed of market price – and it can be an important source of capital for investment in other agro-extractive products. Açaí, cocoa and banana are important for food security, and andiroba is important for traditional medicine.

Typically, men are more involved than women in the extraction of forest products, whether it is trees or fruit. Women and men both participate in agroforestry production. When wood is processed locally, it is usually also by men with some exceptions, but women are usually involved in processing fruits, especially in the case of andiroba oil extraction and açaí *vinho* production. Reducing the bureaucracy around the sale of processed goods, and training in quality management, would help more producers, especially women, capture greater value from processing.

None of the products analysed in this chapter present great risks in terms of climate change, biodiversity or soil fertility. In fact, having a diversified production strategy that includes forests and agroforestry systems increases biodiversity, stabilises soils, helps mitigate climate change and increases the resilience of families who depend on the environment and on selling natural products for their livelihoods.

3.4 Assessment of support priorities

Families in the Amazon – both migrants and traditional families – derive their living from a mixture of timber products, NTFPs and agroforestry products. Demand for certain products in these subsectors is growing, and the 400,000 family farmers who live in the region are well positioned to take advantage of this demand, but they need support to formalise and strengthen their roles in supply chains.

The many challenges faced by small agro-extractive producers include violent and tragic disputes over land; regulations that push producers towards illegality; low soil fertility; and a lack of infrastructure. These producers desperately need documentation of land titles or usufruct use rights to help fight landgrabbing and to enable them to access certain markets and government programmes. In addition, they need: regulations that recognise smallholder realities; greater access to government services, especially technical and financial assistance, to help them invest in new production models (such as fire-free soil preparation methods and agroforestry systems); improved infrastructure for transporting products; and assistance to obtain better access to buyers and improved prices.

We recommend that support is provided for family and community producers whose products originate from responsible forest management and agroforestry and which support low-carbon socio-economic development and the conservation of the natural environment. Such support could focus on the:

- formation of associations and cooperatives for small-scale timber production by families and/or communities;
- primary processing for timber;
- installation of agroforestry systems for cacao, andiroba and açaí; and
- primary processing of andiroba and açaí.

Three main types of activities are recommended, as described below. Specific activities will depend on the specific opportunities and challenges faced by the families and communities involved.

- **Tailored training.** Demand for the products described in this chapter is growing among both public and private buyers in domestic markets and, for some products (especially açaí), in international markets. As production intensifies and becomes increasingly formalised (licensed), however, producers need training in best practices in production, harvesting, processing, packaging, sales and business management, including how to obtain licences and maintain other documentation.

- **Organisation for business.** One of the best ways to improve economies of scale is to organise producers into first-tier organisations (such as associations or cooperatives). Further organisation into second-tier groups (such as state-level or regional producer groups) would bring together first-tier organisations within and across regions. First-tier organisations can help members obtain access technical assistance and credit, facilitate training and help with legal documentation. First-tier and second-tier producer organisations are likely to be more effective than individual producers in communicating needs and requests to governments and civil-society organisations. Strategic partnerships with companies in relevant industries can also provide opportunities to overcome challenges and share risks. Notably, guidelines have been developed at the international level to help communities and companies or other third parties prepare for investment in community-based forest enterprises, and this guidance could be useful for Brazilian initiatives (Elson, 2012).

  Partnerships involving government, civil-society and academic organisations that work with producers are also important ways to increase learning and generate new approaches for responsible, climate-friendly production and marketing systems. IPAM currently works with two international networks focused on supporting producers, companies, universities, governments and civil-society groups that are working to shift states and other jurisdictions towards low-carbon agricultural and forest production models that support families.

- **Research.** Research can inform all aspects of responsible forest enterprise production, including by monitoring production and financial data and by investigating markets, production systems and impacts on families and the environment. A host of actors, such as families, cooperatives, technicians and scientists, can implement different aspects of this research, including data collection, entry and analysis, and the distribution of findings and other information.

To implement such activities, efforts are needed to engage the following main actors from inception: producers, including small families and community associations; buyers and processors of production (including small, medium-sized and large companies); government organisations, including regulatory and technical assistance agencies; civil society; and academic institutions. IPAM is planning a project in western Pará aimed at promoting the sustainable management of resources and the increased productivity of agro-extractive and livestock activities in rural land settlements. Specifically, it will involve 21 settlements covering a total area of 514,258 hectares and including 5,720 families.

Shea butter women's producer group, Burkina Faso.

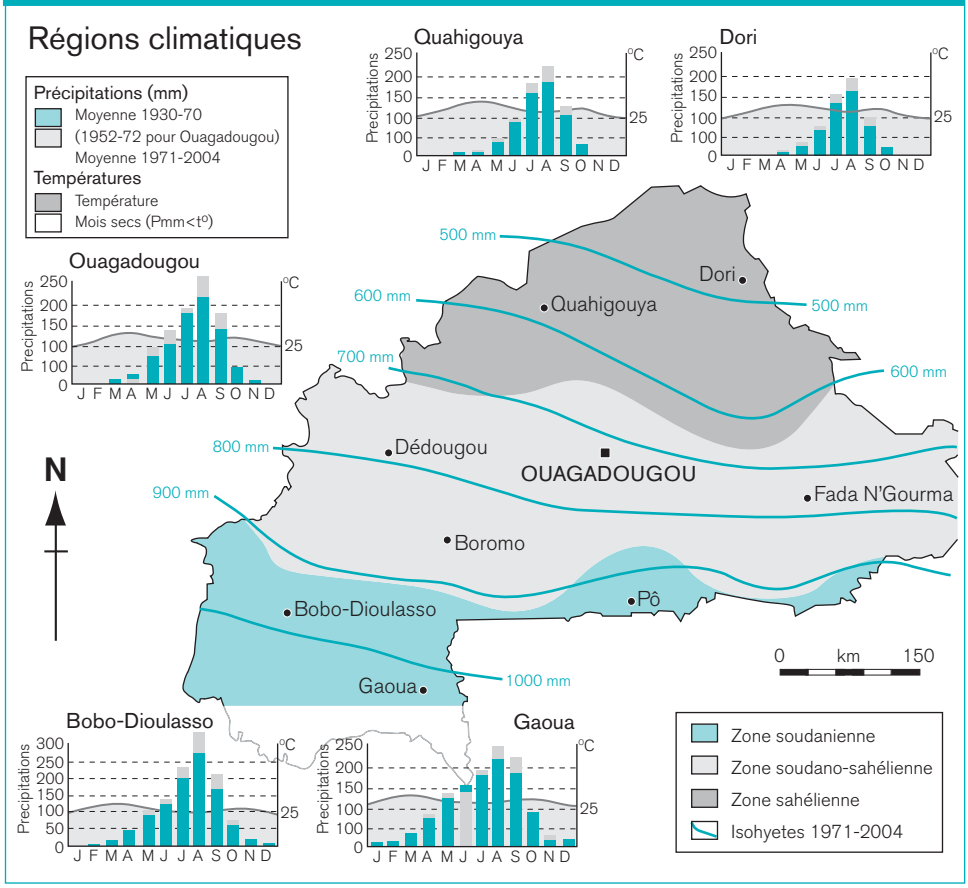
Assessment of forest enterprise subsectors in Burkina Faso

Tony Hill, Elvis Tangem and Barthelemy Kabore

4.1 Introduction

Burkina Faso, like Chad, Mali and Niger, is situated in the Sahel region of Africa. In Burkina Faso there are three climatic zones (MEDD, 2012a) – the Sahelian zone, the Sudano-Sahelian zone (a narrow transitional zone located in the Central North and Northern administrative regions and encompassing Barsalogho, Segenega, Ouahigouya, Yako, and so on), and the Sudanian zone (Figure 15).

Figure 15. Climatic regions of Burkina Faso



Source: www.fructifera.org

From Ouagadougou extending to the south of the country are natural forests made up of semi-deciduous tree species. This region is characterised by relatively high rainfall (600-1,000mm per year) and, as a result, it faces less of a threat from climate change than the Sahelian climatic zone. South of Ouagaodougou, agriculture is more developed than in any other area, and plantation agriculture, with crops such as sugarcane, banana, mango, cashew, lemon and orange, can be found. People are less dependent on trees and tree products there than in other regions of Burkina Faso because they can grow a greater range of crops and obtain higher yields due to the higher rainfall and more fertile soil. Substantial towns and cities in this region include Bobo-Dioulasso, Fada N'Gourma, Léo and Banfora.

In contrast, the Sahelian zone in northern Burkina Faso has relatively sparse tree cover, due partly to the less favourable climatic conditions. The Sahelian zone is subject to long dry seasons, an annual harmattan (a dry and dusty West African trade wind) and annual rainfall of around 300-400mm. The main subsistence activity is animal rearing because soils are unable to support extensive agriculture. People living in the Sahelian zone have limited experience with sustainable land management practices and there is a history of overexploitation of natural resources. Such overexploitation has led to greater degradation of the environment and the impoverishment of local households, further increasing their vulnerability.

In the south, the Sudanian zone has more tree and vegetation cover and an abundance of NTFPs with great commercial, nutritional and medicinal potential (Tincani, 2011) that has not yet been fully realised. Interventions to support locally controlled forest enterprises based on these products could go a long way towards improving local livelihoods and boosting the integration of tree production in climate-smart agriculture.

Our TreeAid team selected as our case study region the central Sudano-Sahelian zone because interventions here could have a significant impact on poverty reduction. Poor people living in this region are more reliant on tree and forest resources than people living further south. This is particularly the case during the lean season, when trees and forests become important alternative sources of food and income generation. Investing in this zone will contribute towards reducing the spread of desertification. The national forest inventory currently underway should provide solid data on deforestation rates and where they are highest. In the meantime, using data from 1992 and 2002, Burkina Faso's Ministry for Environment and Sustainable Development (Ministère de l'Environnement et du Developpement Durable – MEDD) considered that rates are highest in parkland savannah in the Sudano-Sahelian zone (MEDD, 2012a).

Within the Sudano-Sahelian zone, we selected several key enterprise subsectors on the basis of TreeAid's extensive experience in supporting forest communities in the region (Table 15). Each of these subsectors operates across a range of landscapes and land uses – such as natural forest, parkland savannah, intensive agroforestry, orchards and woodlots.

Table 15. Entrepreneurial subsectors in the Sudano-Sahelian zone of Burkina Faso		
Subsector	**Relevance**	**Requirement for enhanced biocapacity**
1. Agroforestry food-product enterprises (principally mixed smallholder farming producing cereal staples, vegetables and livestock) – where trees serve to improve soil fertility for conventional agricultural crops		
Natural forest	n/a	
Naturally regenerating field trees (parkland savannah)	Parkland savannah is the most extensive vegetation type in Burkina Faso (MEDD 2012a). Natural regeneration of field trees builds on traditional land management practices.	The traditional fallow cycle needs to be curtailed or eliminated altogether. The suboptimal tree density needs to be addressed to compensate for unaffordable fertiliser inputs. Quality and species mix may also be suboptimal and could be improved. Need to address woodfuel demand, which is leading to further tree clearance.
Intensive agroforestry systems (planted with exotics)	Higher investment cost and less biodiversity and resilience to climate change than natural forests.	By definition implies investment in enhanced biocapacity.
Orchards and woodlots	n/a	
2. Tree-crop food enterprises – where tree fruits/leaves/stems, or nectar products such as honey, are used directly for food		
Natural forest	Limited in extent, local control	
Naturally regenerating field trees (parkland savannah)	Conversion of natural forest to this vegetation type as pressure for agricultural land increases.	Moderate incentives could intensify semi-natural systems of NTFP production.
Intensive agroforestry systems (planted)	Relevant where tree-crop values are high enough to justify high investment costs; is often a transition from agroforestry to orchard production.	Higher price incentives could lead to the transformation of savannah parkland to more intensive agroforestry and orchard systems – but tenure insecurity acts as a brake on these processes (TFD, 2011b).
Orchards and woodlots	Current examples: Maraicharge de baobab; Moringa orchards at Reo; mango, cashew, citrus.	
3. Biomass energy enterprises – where on-farm or natural forest wood products are used for energy		
Natural forest formations	Existing forest management groups (TFD, 2011a) plus emerging arrangements for community forest management and (perhaps?) direct management of some forests by communes.	At best, this could fully exploit natural forest increment. But poor control and perverse incentives might lead to overcutting and reduce growth potential. There is limited knowledge of the demand–supply balance.
Naturally regenerating field trees (parkland savannah)	n/a	

Intensive agroforestry systems (planted)	n/a	
Woodlots	Principle management objective for most woodlots is construction material, not biomass, so n/a.	Demand for biomass, but would take a different approach to production before it could displace construction material as principle objective of production.
Orchards	Jatropha – for example, the existing (small-scale) transformation plant in Ouagadougou.	The long-term prospects for scaled-up biodiesel in Burkina Faso are unclear.
4. Construction-material enterprises – where on-farm or natural-forest trees are used for sawnwood, carpentry or thatching		
Natural forest formations	Limited scope for investment – except perhaps enrichment planting, but tenure precludes this. Natural potential of elephant grass for thatching.	Very slow increment – which means the tree resource is a difficult investment prospect, but small-scale local capacity for processing might be attractive.
Naturally regenerating field trees (parkland savannah)	Significant source of subsistence, but unit production rates are probably too slow to justify consideration as a basis for enterprise.	Very slow increment – which means the tree resource is a difficult investment prospect, but small-scale local capacity for processing might be attractive.
Intensive agroforestry systems (planted)	Tree species traditionally used for construction materials are not suitable for intercropping.	Debatable whether new species and production technology could make this a more attractive option for enterprise – not a high probability.
Orchards	n/a	
Woodlots	Eucalypt (and teak?) woodlots could produce poles (also neem used, but not really an enterprise). An attractive investment proposition for wealthier men with land – but not for poor women.	Prospects for improving both quality and quantity of production through conventional investments in tree breeding and silviculture, plus research on new species options.
5. NTFP enterprises – where on-farm or natural forest trees are used for medicinal, cosmetic, craft or other purposes		
Natural forest formations	Many options such as karité, gum arabic, balanites.	Potential for intensification of production, both in natural forests (enrichment planting and silvicultural measures in semi-natural forest) and on-farm production (planting/grafting improved stock, pruning/thinning, optimal spacing and crop mixes).
Naturally regenerating field trees (parkland savannah)	Well-established livelihood option, accessible to poorer households and women.	Question of tenure/control of land a barrier to investment for poor but there are examples of negotiated access for investment.
Intensive agroforestry systems (planted)	n/a	
Orchards and woodlots	n/a	

Key: □ = good prospects; ▒ = moderate prospects; ■ = not applicable.

4.2 Assessment of market prospects for each potential subsector

After selecting several key enterprise subsectors recognised across a range of landscapes, the TreeAid team assessed the income-generating potential of only the good and moderate options. The assessment was carried out using the following criteria:

- Criterion 1 – scale of market demand for products or services derived from enterprises in the subsector;
- Criterion 2 – identification of markets which have the greatest potential for expansion and income generation based on given market trends;
- Criterion 3 – issues of competitive advantage;
- Criterion 4 – issues related to the enabling environment (such as product restrictions, bureaucratic hurdles); and
- Criterion 5 – resilience in the face of likely climate change.

Table 16 shows the results of the assessment for each subsector against these criteria.

Table 16. Analysis of market prospects by subsector

Subsector		Score, by criterion*					Total score	Balanced rank
		1	2	3	4	5		
1	Agroforestry food-product enterprises, where trees serve to improve soil fertility for conventional agricultural crops	3	4	4	3	4	20	1
2	Tree-crop food enterprises – where tree fruits/leave/stems or nectar products such as honey are used directly for food	3	3	4	3	3	16	2nd
3	Biomass energy enterprises – where on-farm or natural-forest wood products are used for energy	5	4	4	2	5	20	1
4	Construction-material enterprises – where on-farm or natural-forest trees are used for sawnwood, carpentry or thatching	4	4	4	4	4	20	1
5	NTFP enterprises – where on-farm or natural-forest trees are used for medicinal, cosmetic, craft or other purposes	4	5	5	3	3	20	1

* The key to the criteria is given in the text.
Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Below, we explain our scoring in Table 16.

For agroforestry food-product enterprises, where trees serve to improve soil fertility for conventional agricultural crops, the TreeAid team anticipated increases in cereal and vegetable crop demand, fertiliser costs and livestock feed costs. The integration of trees into agricultural landscapes will reduce the risk of soil degradation in periods of drought

and during flood and storm events and help maintain soil fertility, which in turn will support better crop (and tree) growth (Boffa, 1999). Thus, there is scope to promote more robust biological processes that will increase resilience to climate change, at least within certain climatic limits.

The markets for tree-crop food enterprises involving tree fruits, leaves or stems, or nectar products such as honey, are growing as the population grows. There is high potential for the greater use of tree foods for nutritional security. ICI/TreeAid (2008) indicated particularly good market prospects for:

- honey,
- poudre de feuille de baobab (TreeAid, 2011),
- *Acacia machrostachya seed,*
- tamarind pulp and juice,
- baobob fruit powder, for use in juices and biscuits (Boffa, 1999), and
- néré pulp (transformed into the condiment *soumbala*).

Nevertheless, production is species-specific, and therefore there may be less flexibility in adapting to environmental trends related to climate change.

In the case of biomass energy enterprises, where on-farm or natural-forest wood products are used for energy, a growing population and currently limited alternatives mean that the demand for woodfuel is increasing and there is likely to be a supply deficit in most regions (MEDD, 2012b). In the medium term, there is a risk of substitution by liquid petroleum gas and solar energy (and possibly more hydro power). In the short to medium term, however, there is potential for the introduction of more efficient systems for using bioenergy in electricity generation. The production of woodfuel in natural forests is a competitive option for generating income and a significant source of local employment for men. Existing relevant legislation, if applied consistently, would reduce ambiguity on legal aspects of investment, but the control of illegal trade in woodfuel is far from watertight, and such trade constitutes unhelpful competition. The very broad flexibility in species choice for woodfuel production implies capacity for adaptation to climate change but the 'liquidation' of forest resource assets to produce short-term cash income from firewood and charcoal is a common coping strategy for rural communities in the face of climatic stresses and shocks. If the level of harvesting in slow-growing natural forest is unsustainable, biomass production is more of a mining exercise than a sustainable enterprise. Many stakeholders fear that a sustainable enterprise can too easily transform into a mining exercise, particularly when tenure rights are obscure and governance of the resource is poor.

In the case of construction-material enterprises, where on-farm or natural-forest trees are used for sawnwood, carpentry and thatching, much of the national timber supply comes from the south of the country and even more of it comes from the other side of the southern border. Such transborder supplies will dry up as forest resources in Ghana and Côte d'Ivoire are exhausted, and there may be increasing interest in harvesting savannah species for timber. Pole construction dominates rural housing and this is likely to continue, although woodless construction methods are also being introduced. The production of

building poles is a competitive income-generation option for those rural households with secure long-term access to land. Plantation production is likely to be the favoured method; legislation has reduced ambiguity in the investment environment but, as with all tree-growing, insecure land tenure can be a constraint. As with the biomass energy enterprise option discussed above, where the resource base is a slow-growing natural forest, enforcing the allowable cut would be a preoccupation for many stakeholders.

In the case of NTFP enterprises, where on-farm or natural-forest trees are used for medicinal, cosmetic, craft or other purposes, there are strong traditional local, national and sub-regional markets. The export market outlooks for shea products (Lovett, 2010; Sama, 2011, 2012) and gum arabic remain good. NTFP enterprises are an attractive option for income generation, particularly for rural women, and are reckoned to be the third most important source of employment in Burkina Faso (MEDD, 2012a). Nevertheless, the environment for investment is hampered by the absence of a relevant legislative framework for the exploitation of NTFPs. The production approach for NTFPs is species-specific, and therefore there may be less flexibility in adapting to environmental trends related to climate change.

Overall, the market prospects for all five subsectors appear relatively strong, and the balance of advantages and disadvantages leaves little to choose between them, even between tree-crop food enterprises and the other subsectors.

4.3 Assessment of integrated impacts for each potential subsector

Gender

The team assessed the contribution of each subsector to income-generating opportunities for women and the likely impacts on household well-being, including any issues to do with reproductive health. The customary tenure of land and trees, which prevails in most rural areas, tends to exclude women, and cereal crop farming is traditionally the responsibility of men. Male heads of households dominate management decisions on arable land management and control the income derived from cereal and cash crops. Women are equally involved in supplying labour inputs, however, so they may also bear the burden of the greater labour inputs required in more intensive agroforestry systems.

Natural forests are generally accessible to both men and women for the collection of NTFPs but access to naturally regenerating field trees (and the NTFPs they bear) is increasingly being privatised as the commercial value of these products increases (Tincani, 2011). Women in families with rights to such trees are likely to be heavily involved in commercialising the products, and other women may be able to negotiate to gain access to them for domestic use.

In Burkina Faso, men are more likely than women to plant trees. Women often face barriers to tree-planting but they may be able to negotiate to plant trees on family land. Less frequently, women's groups may obtain access to land for planting orchards or woodlots. The production and harvesting of construction material is male-dominated. Products from planted trees are not generally accessible to women outside the family, with the possible exception of some secondary products, such as edible leaves. In this latter

regard, the principle responsibility for family diet and food preparation lies with women, so new options to make better use of edible tree products to improve nutritional security could benefit them and their children.

Both women and men participate in firewood and charcoal production but men dominate formal enterprises and women's involvement is more informal and irregular. This situation could change with the introduction of more equitable community forest management systems but there are few existing examples (Drabo, 2012).

Food security

Another important consideration is the assessment of the likely contribution of each subsector either (i) directly to increased food security through the enhanced agricultural production of staple foods produced locally, or (ii) indirectly through the increased diversification/income generation that affords households greater purchasing power to buy staple foods.

Agroforestry system outputs can substitute for external agricultural inputs, for example, fertiliser and animal feed, and so buffer farm enterprises against rises in input costs, thereby maintaining productivity and/or profitability. This will, however, depend on the shadow cost of labour inputs, which tend to be higher for agroforestry systems. Agroforestry systems can also offer opportunities to integrate new production systems, which could make farm systems less vulnerable to shocks and stresses.

The optimal use of tree foods could improve nutritional security by bridging gaps in the nutritional calendar, particularly for mothers and young children. The strong seasonality of production is a challenge, so preparation and storage could be just as important as domestication and silviculture in realising this potential. The scope for establishing profitable enterprises based on edible and non-edible NTFPs is already well established but the tree resources concerned are largely found in natural forests and naturally regenerating fields. Investments in intensive tree food-crop production demands more careful consideration in the allocation of precious capital and natural resources. This is an interesting area for innovation and evaluation.

Enterprises producing biomass energy and construction poles have the potential to generate good financial returns that could boost household budgets for food purchases, especially when the household has full control over the means of production (the land). There are few existing examples, however, of sustainable returns from the production of sawlogs from naturally occurring native species.

Energy security

A third area for consideration is the likely contribution of each subsector to the provision of household energy, either (i) directly where energy is the main business (such as charcoal, firewood or biogas), or (ii) indirectly where tree or agricultural crop residues can be used to increase energy security. With biomass likely to remain the major source of energy in Burkina Faso for the foreseeable future, enterprises producing this commodity

on a sustainable and profitable basis will be critical for meeting national energy needs. Household energy security will depend on the capacity for self-provisioning and/or the affordability of supplies in local markets. Will locally controlled forest enterprises prove to be the most competitive and sustainable approach to supplying local energy markets? There are reasons to believe so but much will depend on the regulatory climate within which such enterprises must operate. All forms of agroforestry can be valuable options by which farming households can self-provision in woodfuel and, in so doing, offset pressure on natural forests. By-products from the production of construction poles and tree fodder may constitute the largest source of woodfuel but there is still some resistance to using wood from fast-growing exotic species in the household energy market.

Climate change mitigation and adaptation potential

Here we assess the likely contribution of each subsector to carbon emissions reductions, including replacement of other sources of emissions, and how important is it likely to be in terms of adapting to and building resilience to known future climate change scenarios.

The integration of trees into farming systems offers the possibility of increasing the resilience of those systems to climate change, both by supporting robust ecological processes and by spreading risk through diversification. Although unit rates of carbon flux are modest by comparison with the wet tropics, the Sahelian-Sudano zone is large and the mitigation potential may be significant, particularly where the rapid replication or scale-up of relatively capital un-intensive approaches is a realistic possibility. Biomass energy and construction-material enterprises are unlikely to substitute for non-renewable sources in Burkina Faso. Where such enterprises are moving towards sustainable production and acting as vehicles for new investment in the subsector, however, they will help reduce deforestation and provide urban consumers with an affordable alternative to switching from biomass and wood to fossil fuels and non-renewables to meet their energy and construction needs.

Biodiversity

Either within the production system itself, or in adjacent natural systems, it is important to assess the likely contribution of each subsector to biodiversity conservation. For example, to what extent does the subsector require the maintenance of biodiverse natural ecosystems or enhance the degree of agro-biodiversity through its operations?

Enterprises that depend on, and invest in the maintenance of, natural forests will have the greatest positive impact on biodiversity. Those based on semi-natural parkland savannah also score highly but are likely to select for certain favoured species. More intensive production systems could still incorporate a certain level of structural and species diversity, but woodlots and orchards are more likely to be monocultures of exotic species and may use a narrow range of varieties. Selective harvesting from natural forests of preferred species for timber and woodfuel may degrade biodiversity, unless such practice is matched by the selective regeneration of the same species. Forest beekeeping is likely to support biodiversity directly and also provide positive incentives for local people to conserve a range of flowering plants and habitats.

Soil fertility and more sustainable nitrogen inputs. Here we examine the likely contribution of each subsector to the use of natural forest management or on-farm soil husbandry techniques that enhance long-term soil fertility without the excessive use of nitrogen fertilisers – although Burkina Faso is not noted for the latter.

Agroforestry has great potential to benefit soil organic matter content and nutrient status, although the extent to which it does so varies according to the system employed. Soil fertility is stable in undisturbed natural forest ecosystems. Exploitation of such forests may disturb that stability but where harvesting is restricted to the sustainable yield, impacts on soil fertility should not be severe. Intensive production in monocultural orchards and woodlots may modify soil conditions in the medium term for better or worse, depending on species and soil type, but it is worth noting that planting is often targeted at land that has already been degraded through earlier mis-use, so the net effect is less likely to be negative.

Conclusion

Based on the issues considered above, we quantified the potential of each of the main enterprise options against the following criteria:

- Criterion 1 – the likely contribution of each subsector to income-generating opportunities for women and thereby the likely impacts on household well-being, including any issues to do with reproductive health;
- Criteria 2 – the likely contribution of each subsector directly to increased food security through the enhanced agricultural production of staple foods produced locally;
- Criteria 3 – the likely contribution of each subsector to food security indirectly through increased diversification/income generation that affords households greater purchasing power to buy staple foods;
- Criteria 4 – the likely contribution of each subsector to the provision of household energy directly where energy is the main business, such as firewood, charcoal or biogas;
- Criteria 5 – the likely contribution of each subsector to the provision of household energy indirectly where tree or agricultural crop residues can be used to enhance energy security;
- Criteria 6 – the likely contribution of each subsector to carbon emissions reductions, including replacement of other sources of emissions;
- Criteria 7 – the likely contribution of each subsector to adapting to and building resilience to known future climate change scenarios;
- Criteria 8 – the likely contribution of each subsector to biodiversity conservation; and
- Criteria 9 – the likely contribution of each subsector to the use of natural forest management or on-farm soil husbandry techniques that enhance long-term soil fertility without the excessive use of nitrogen fertilisers.

Table 17 shows that a number of enterprise subsectors (and landscape options within them) offer positive integrated impacts. Each has been assigned a rank of 'A' (having the highest positive impacts), 'B' (having mixed positive impacts) or 'C' (fewer positive impacts). These results are discussed below for each subsector.

Table 17. Analysis of integrated impacts, by subsector

Subsector	Score, by criterion*										Balanced rank
	1	2	3	4	5	6	7	8	9	Total	
1. Agroforestry food-product enterprises, where trees serve to improve soil fertility for conventional agricultural crops											
1.1 Naturally regenerating field trees (parkland savannah)	3	5	3	n/a	3	3	4	4	5	30	A
1.2 Intensive agroforestry systems (planted with exotics)	2	4	4	n/a	3	2	4	3	5	27	B
2. Tree-crop food enterprises, where tree fruits/leaves/stems, or nectar products such as honey, are used directly for food											
2.1 Natural forest	5	3	5	n/a	2	2	4	5	5	31	A
2.2 Naturally regenerating field trees (parkland savannah)	4	4	4	n/a	3	2	4	4	5	30	A
2.3 Intensive agroforestry systems (planted)	3	4	3	n/a	3	2	4	3	5	27	B
2.4 Orchards and woodlots	3	4	3	n/a	3	2	3	2	3	23	
3. Biomass energy enterprises, where on-farm or natural-forest wood products are used for energy											
3.1 Natural forest	3	n/a	3	5	n/a	3	3	4	5	26	B
3.2 Orchards/woodlots	2	n/a	4	5	n/a	3	3	2	3	22	C
4. Construction-material enterprises, where on-farm or natural-forest trees are used for sawnwood, carpentry or thatching											
4.1 Natural forest	1	n/a	3	n/a	2	2	2	4	5	19	C
4.2 Naturally regenerating field trees	1	n/a	2	n/a	3	2	2	4	5	19	C
4.3 Intensive agroforestry systems (planted)	1	n/a	4	n/a	3	3	3	3	4	21	C
4.4 Woodlots	2	n/a	5	n/a	3	3	3	2	3	21	C
5. NTFP enterprises, where on-farm or natural-forest trees are used for medicinal, cosmetic, craft or other purposes											
5.1 Natural forest	5	n/a	5	n/a	2	2	4	5	5	28	B
5.2 Naturally regenerating field trees	4	n/a	4	n/a	3	2	4	4	5	26	B

* The key to the criteria is given in the text.
Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

4.4 Assessment of support priorities

The combination of low rainfall and the reliance of local people on tree products for their livelihoods means that the Sudano-Sahelian zone is a prime geographical region in which to optimise the pro-poor impact of locally controlled forest enterprise subsectors. Based on the screening and analysis described above, we propose, for this zone, the following three support priorities (depicted in Figure 16).

1. Agroforestry food-product enterprises, where trees serve to improve soil fertility for conventional agricultural crops

There are good prospects for enhancing the biocapacity of naturally regenerating field trees (parkland savannah) to support agroforestry food-product enterprises. Increased soil fertility will mean that less labour input is required, particularly for women, who are generally responsible for tilling and weeding arable farm crops; this will have positive impacts on women's reproductive health. Furthermore, fertile soils will improve harvests, which, in turn, will translate into increased nutrition and income, leading to good health outcomes, reproductive or otherwise. There is high certainty of strong market demand for agricultural outputs.

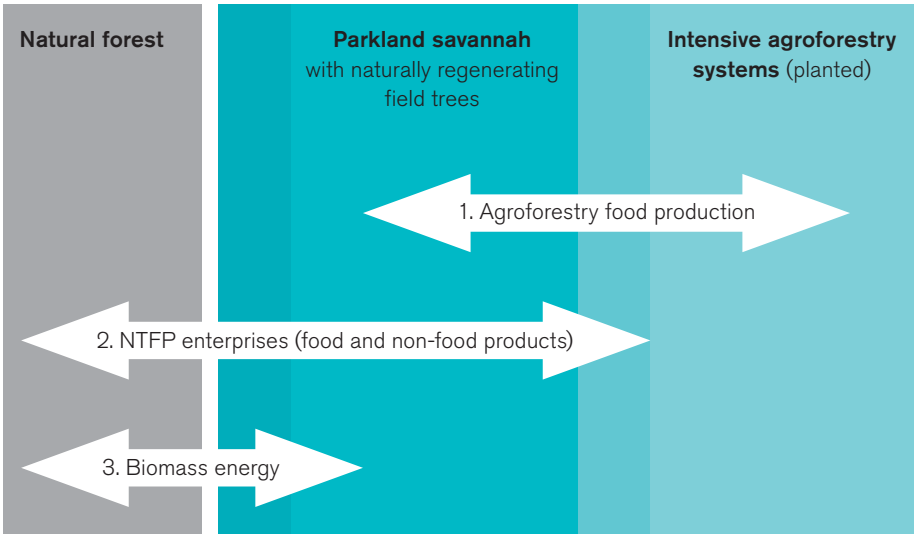
2. NTFP enterprises, including production of tree food products and commodities traded for cash (notably shea nuts and gum arabic)

The prospects for enhancing the biocapacity of parkland savannah to support NTFP enterprises are good. If demand is sufficiently strong, systems could grade into more intensive forms of domestication. Although the potential to increase NTFP production in natural forests is not as clear, this option is worth exploring because the benefits are very attractive. Market prospects are good and could be improved further with appropriate social marketing and a supportive regulatory environment. The potential for women to benefit from opportunities to trade in NTFP products has already been well demonstrated (SECAM, 2012). There is excellent potential to integrate production into resilient, biodiverse agroforestry farming systems.

3. Biomass energy production based on natural forest

The market for biomass energy is strong and growing. Women and youths are already involved in marketing firewood, especially during the dry season. Engagement in the firewood trade is an important coping mechanism for many rural households in lean periods. Although men dominate formal exploitation, biomass energy production is an important source of revenue for women; new, more inclusive forms of community forest management could secure their rights to engage in this trade. Opportunities to enhance biocapacity depend on optimising the exploitation of natural forest within sustainable limits, which requires not only new technical skills but also transparent and accountable regulation. The potential rewards justify the cost of addressing these substantial challenges.

Figure 16. Priority forest enterprise subsectors versus landscape types



Interventions that merit support for each of these main forest enterprise subsectors (within the broad framework for action shown in Figure 17) are described below.

Agroforestry food-product enterprises, where trees serve to improve soil fertility for conventional agricultural crops

An important aim of any proposed interventions would be to promote better natural resource governance and tenure arrangements to create the right environment to promote investment in parkland savannah field tree management. Interventions are needed to influence government and business policies on agricultural intensification, which have the potential to undermine parkland savannah landscape management. In addition, there is a need to build technical capacity to improve the efficiency of tree management interventions, including by providing support for the dissemination of ideas and knowledge on parkland savannah agroforestry management and for farmer-led experimentation and innovation on crop–tree synergies. Another intervention possibility is providing support for farmer experimentation with new tree species and varieties.

NTFP enterprises, including production of tree food products and commodities traded for cash (notably shea nuts and gum arabic)

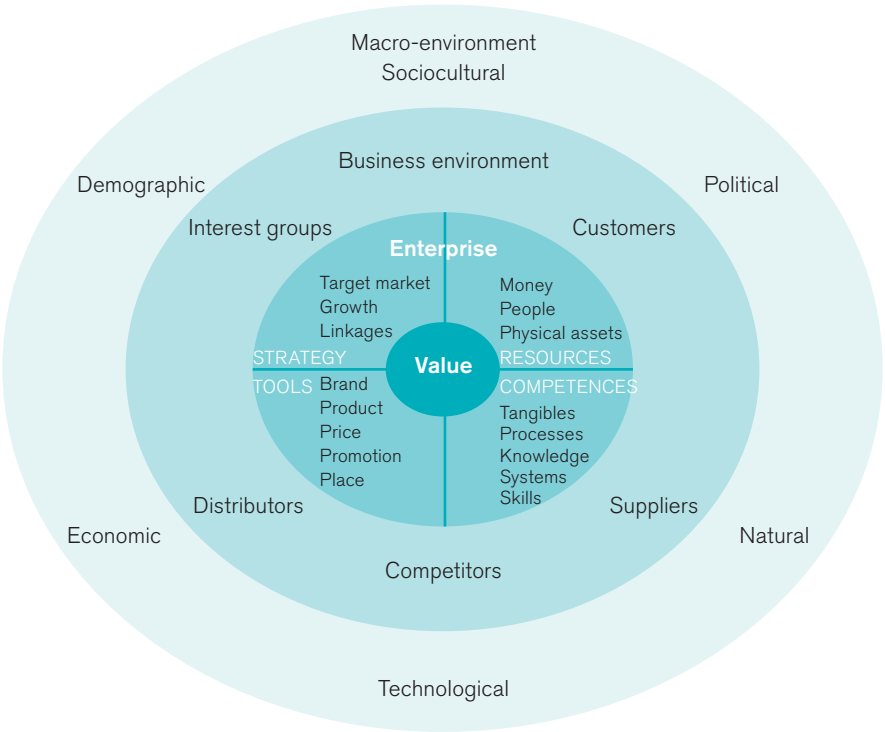
This subsector requires better natural resource governance and tenure arrangements to create an environment that promotes investment in tree resources to supply raw materials for NTFP enterprises. Support is needed for the formation of producer groups and the development of business planning skills and business linkages through the village-level facilitation of the 'market analysis and development' approach. A priority is to catalyse the provision of demand-led business development services and access to financial services and networking between NTFP producers to improve the commercial environment (as

illustrated below) and to enable them to obtain greater value in the market. Technical capacity-building is also needed to intensify production, both in natural forests (such as through enrichment planting and silvicultural measures) and on-farm (for example, by transforming from semi-natural to more intensive parkland savannah management systems).

Biomass energy production based on natural forest

A starting point here would be to review current forest inventory information and relevant research on dryland forests, as well as current practice in local management planning and agreements on woodfuel production in natural forests. This would establish an evidence base for decisions on sustainable natural forest management for biomass energy production and the rational planning of supply through inclusive local management structures. On this basis, interventions could aim to build stakeholder relationships and alliances for the development of sustainable woodfuel value chains. A necessary component would be to facilitate supportive local government attitudes and know-how on how best to support local communities in sustainable woodfuel production in natural forests through, for example, advice, enforcement and the supervision of revenue collection.

Figure 17. Framework for action for priority interventions



Vietnamese community forest leader showing forest conservation effort.

5

Prioritising scarce support for locally controlled forest enterprise subsectors in Vietnam that best deliver critical outcomes

Nguyen Quang Tan and Martin Greijmans

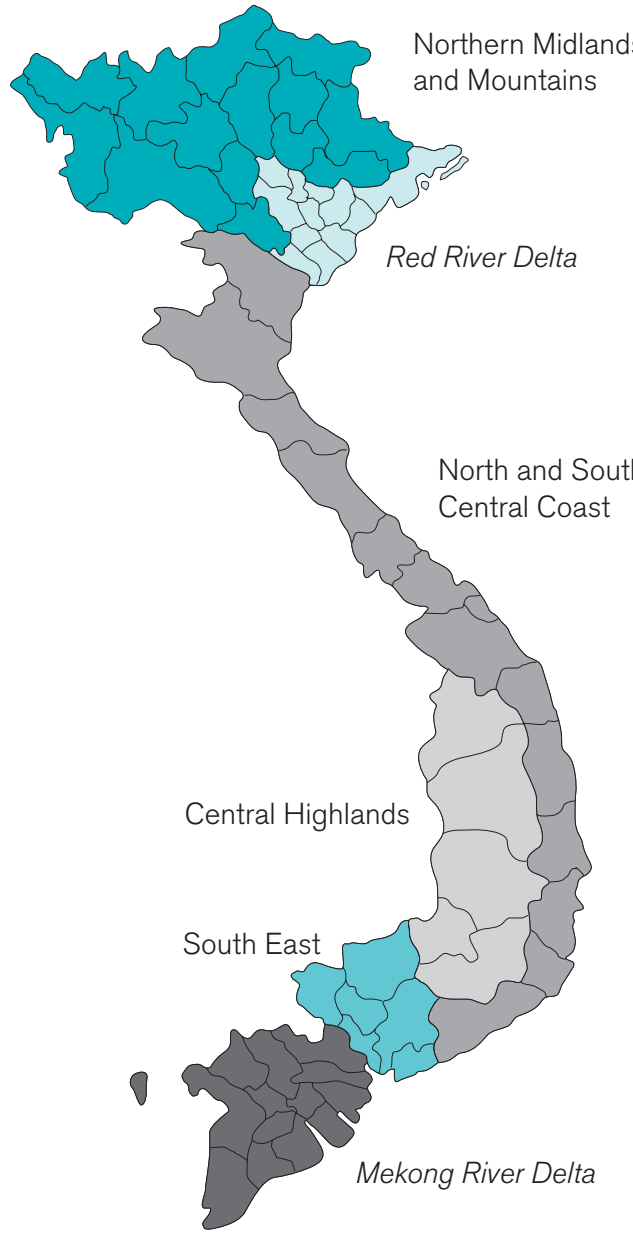
5.1 Introduction

Vietnam has a total area of 330,958 km^2 and shares borders with China to the north and Laos and Cambodia to the west. The population is estimated at 87.8 million people (as of December 2011), with an average density of 265 people per km^2. Around 32 per cent of the country's population is urban and 68 per cent live in rural areas. Vietnam has 54 different ethnic groups. The Kinh is the majority group, accounting for around 86 per cent of the national population, and other groups are classified as ethnic minorities. Among the latter, the two largest groups are Tay and Thai, with a population of around 1.6 million people each, and the two smallest are O Du and Brau, with fewer than 400 people in each group.

Vietnam is divided into 63 provinces, five of which are municipalities at the same administrative level as provinces, located in the following six economic–ecological regions (see Figure 18 and Table 18):

- Northern Midlands and Mountains – this region encompasses 14 provinces and is dominated by high limestone mountains and plateaus, with flat valleys. The region is inhabited by over 20 ethnic groups and has the country's highest poverty rate.
- Red River Delta – this region comprises the delta area formed by the Red River and covers nine provinces and two municipalities. The region is characterised by lowlands and highly populated areas, and the Kinh is the dominant ethnic group.
- North and South Central Coast – this region covers 13 provinces and one municipality. Topographically it includes high mountains, hills, and a narrow strip of lowland along the coast. The region is inhabited by over 25 ethnic groups.
- Central Highlands – this region consists of a series of contiguous plateaux surrounded by high mountain ranges and includes the territories of five provinces. It is the richest region in terms of ethnic composition, with around 46 ethnic groups.
- Southeast – this region comprises five provinces and one municipality. It is the country's most economically developed and urbanised region, with more than 50 per cent of the population living in urban areas.
- Mekong River Delta – this region consists of 12 provinces and one municipality. The landscapes are complex, ranging from mountains and highlands to broad, flat, floodplains. The region is highly vulnerable to floods resulting from rises in sea level due to climate change. The people living in this region are mostly Kinh, but there are also some minority ethnic groups.

Figure 18. The regions of Vietnam



Vietnam has made significant progress in reducing poverty in the last two decades: the poverty rate declined from 58.1 per cent in 1993 to 14.2 per cent in 2010, and the country met the Millennium Development Goal on poverty reduction. Nevertheless, the following issues are worth highlighting (Baulch *et al.*, 2009; Mueller *et al.*, 2006; Swinkels and Turk, 2006; World Bank, 2009):

Table 18. Basic information on Vietnam's regions

Region	No. of provinces	Population ('000 people)	Area (km^2)	Population density (people/km^2)	% forest cover	% poverty rate†
Northern Midlands and Mountains	14	11,291	95,264	119	45.0	29.4
Red River Delta	11	19,999	21,068	949	5.2	8.3
North Central area and Central Coastal area	14	19,047	95,838	199	54	20.4
Central Highlands	5	5,282	54,641	97	52.0	22.2
Southeast	6	14,891	23,598	631	15.1	2.3
Mekong River Delta	13	17,331	40,548	427	4.2	12.6
Whole country	63	87,840	330,958	265	39.7	14.2

Note: data are of December 2011, unless otherwise stated.
† Poverty rate is as of 2010, where a person is considered to be living in poverty if their income is less than 480,000 Vietnamese dong (VND) per month for rural areas and VND600,000 per month for urban areas.
Source: www.gso.gov.vn

- There are significant disparities in poverty rates across regions. Most poverty reduction so far has occurred in the delta and lowland areas. The poverty rates in upland forest regions (the Northern Midlands and Mountains, the North and South Central Coast, and the Central Highlands) are much higher than the national average (see also Table 18).
- There are substantial differences in poverty rates between urban and rural areas. Data from the 2010 Vietnam household living standard survey show that the poverty rate in urban areas is 6.9 per cent, whereas the rate in rural areas is 17.4 per cent.
- Forests of high local and global value are located in areas where the incidence and severity of poverty are strongest and where livelihood strategies are based on agricultural and forest activities.
- Poverty rates are high among ethnic minorities. Overall, the Kinh and Chinese are doing much better economically, with the poverty rate among those two groups declining from 54 per cent in 1993 to 10 per cent in 2006. In the same period, the poverty rate among the ethnic minorities declined from 86 per cent to 53 per cent. The upland regions mentioned above, in which poverty remains much higher than the national average, correlate with concentrations of ethnic minority groups.
- The high levels of poverty among upland ethnic minority groups are likely due to, among other things, a lack of assets (including productive lands and financial resources), capacity (particularly education) and political voice.

The approval of the Forest Protection and Development Law and the Land Law in the early 1990s was the starting point for a process of forestland allocation aimed at devolving forest management rights to local communities in Vietnam. The two laws laid down the basic framework for the emergence of novel forest management arrangements (Box 1). The government issued various decrees to guide the implementation of the forestland allocation

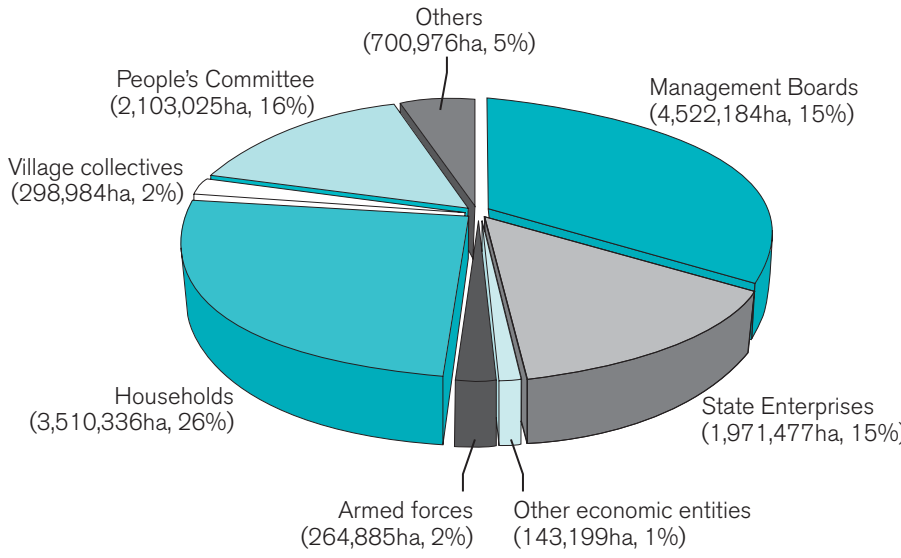
process. In addition to allocating forest rights to individuals and households, the allocation of forests to village collectives was piloted in the 1990s. Experiments in community-based forms of forest management during this period contributed to the legal recognition of community land tenure (under the new Land Law passed in 2003) and community forest tenure (under the new Forest Protection and Development Law passed in 2004).

The process of devolving forest management has resulted in a major shift away from exclusive state forestry towards more people-centred forestry. Locally controlled forestry is proving popular, with local people (households and village collectives) managing around 28 per cent of the country's forest area (Figure 19; see also Sikor and Nguyen, 2011).

Box 1. Major milestones in the legal framework related to the devolution of forest management in Vietnam

1976: Nationalisation of forest resources, marking a period of state forestry
1991: Forest Protection and Development Law passed, marking an effort to involve local people in forest protection and development
1993: Land Law passed, recognising individuals and households as legal holders of land rights
1994: Decree 02/CP on the allocation of forestland to organisations, households and individuals
1995: Decree 01/CP on contracting land for agricultural, forestry and aquacultural purposes
1999: Decree 163/1999/ND-CP on leasing land for forestry purposes
2003: Land Law passed, recognising the legal status of communities in land tenure
2004: Forest Protection and Development Law passed, recognising common property as a legal forest management arrangement

Figure 19. Forestland tenure, by stakeholder group, 2011



Source: www.kiemlam.org.vn

In addition to forestland allocation, forest contracting is an important means by which local people have been able to become involved in forestry activities. Under the National Five Million Hectare Reforestation Programme, 2.5 million hectares of forest, which officially are under the management of management boards or forest enterprises, were contracted to local communities for protection. In general, community forest management has been a priority for the forest sector in Vietnam, as indicated in its sectoral strategy (MARD, 2007). At the moment, Vietnam is implementing a community forest management pilot project in ten provinces, which aims to build capacity at all levels and develop a policy framework for community forest management implementation nationwide.

From the perspective of local people, community forest management is not new, it has been practised for generations. Forests are important for local people, not only for the products that they provide for daily use – such as timber, mushrooms, bamboo, medicines and leaves – but also for farming (for example, by maintaining a water supply for paddy fields) and cultural life (Nguyen, 2005).

Based on this short descriptive analysis, future project(s) would ideally focus on regions with high rates of poverty and high ethnic diversity. Three regions stand out on the basis of these criteria: Northern Midlands and Mountains; North and South Central Coast; and Central Highlands. Among these, priority could be given to the Central Highlands, where the poverty rate among ethnic minorities is much higher than that of the other (in-migrating) ethnic groups and the Kinh and where the sustainable management of natural resources, particularly forests, is challenged by market pressures for timber and agricultural products (such as coffee and black pepper) and by the growth of the migrant population. Nevertheless, it is important to note that the poverty impacts of any potential project go beyond the biophysical and demographic conditions of a region and also depend on human resource capacity, including among the leadership.

5.2 Assessment of market prospects of shortlisted forest enterprise subsectors

This section provides an overview of the prospects for various locally controlled forest enterprise subsectors that contribute to integrated, intensified and climate-smart land-use. There are many options for locally controlled forest enterprises and it is not possible to discuss them all in this brief chapter. This section therefore focuses on three main categories: cash crops (rubber, coffee and pepper); NTFP extraction; and tree plantations for pulp and construction materials. These subsectors are common in Vietnam and are often considered to have had (negative) impacts on forest ecosystems and (poor) ethnic minority groups, particularly in the Northern Midlands and Mountains, North and South Central Coast, and Central Highlands regions. Many other options, including for example agroforestry, contour farming and soil-erosion control species, are not discussed here due to their limited popularity.

Cash crops

For the last two decades, Vietnam has made impressive advances in developing cash crops. Below we discuss three of the most important farm/forest cash crops: rubber, coffee and (black) pepper.

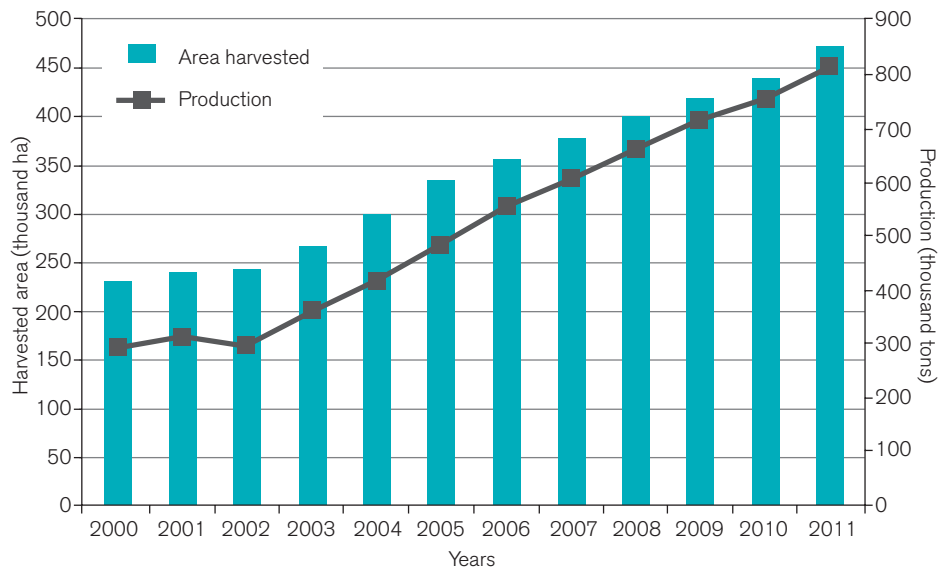
Rubber. In recent decades, rubber has gained significant attention in Vietnam. By the end of 2011, there were about 834,000 hectares of rubber plantation in Vietnam, of which 472,000 hectares were productive. This thereby achieved, ahead of schedule, the 2015 target for rubber plantation development, set according to Prime Minister's Decision 750/QD-TTg dated 3 September 2009. This is an impressive expansion since 1985, when there were about 182,000 hectares of rubber plantation – 64,000 hectares of which were actively harvested. Most of the expansion took place from the mid 1990s, at an average rate of 38,700 hectares per year in the period 1996-2011 (GSO 2002, 2012).

In line with the expansion of rubber plantations, the production of natural rubber has also increased sharply in recent years, making Vietnam the world's fifth-largest producer of rubber, after Thailand, Malaysia, Indonesia and India (FAO, 2011d). By 2011, Vietnam rubber production had reached 812,000 tonnes, almost three times the volume produced in 2000 (Figure 20).

Most rubber plantations in Vietnam are concentrated in the Central Highlands and Southeast regions, with some in the North and South Central Coast and Northern Midland and Mountain regions. Companies (mostly under the Vietnam Rubber Association) manage more than half the total rubber plantation estate. Smallholder rubber plantations, which are often around four to five hectares in size and involving two to three labourers, account for approximately 46 per cent of the total area of rubber plantations (Tran, 2008).

In 2011, Vietnam exported 816,500 tonnes of natural rubber, with an export turnover of US$3.2 billion (see thitruongcaosu.net). Its market encompasses more than 25 countries worldwide, with the top importers being China (accounting for around 60 per cent of

Figure 20. Harvested area and production of rubber in Vietnam, 2000-2011



Source: http://faostat3.fao.org; http://gso.gov.vn

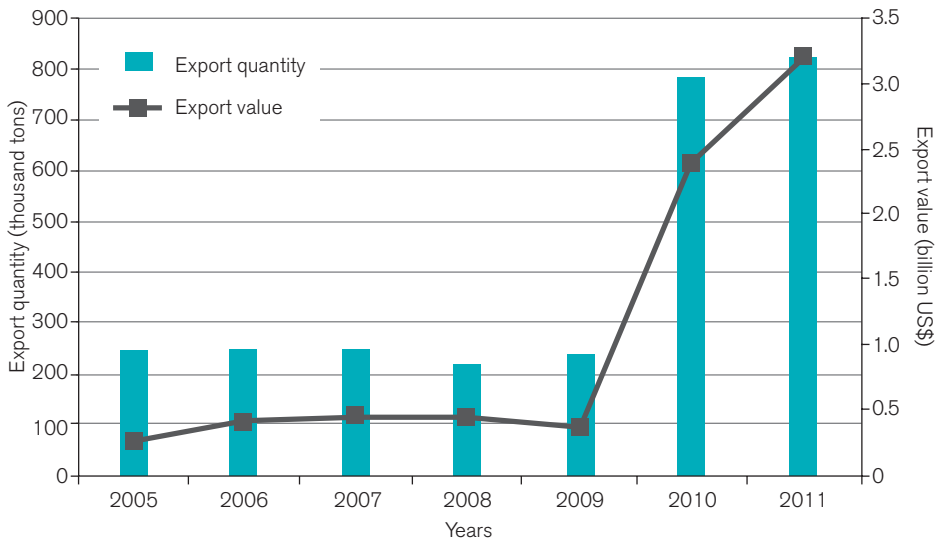
the total export by volume), India, Malaysia, Taiwan and Germany; Figure 21 shows the dramatic growth in exports. Returns from rubber are also promising at the farm level: one productive hectare of rubber can yield an annual revenue of around US$2,880 for a productive period of up to 25 years (see duclonggroup.com).

The approval of the Development Strategy for Rubber in Vietnam to 2015 (Decision 750 in September 2009) has created an enabling environment for the further development of rubber in the national economy. The strategy provides an opportunity for regions, particularly the Central Highlands, Southeast, and North and South Central Coast regions, to expand their rubber plantations. The strategy is not just for rubber companies: the opening up of the market for rubber and the enabling policy framework is also designed for an expansion of smallholder rubber plantations, particularly in the Central Highlands and Southeast regions.

Even though rubber has great potential as a source of income, not many smallholder farmers can afford the high cost of installation. It is estimated that the total cost of setting up a rubber plantation is around VND100-135 million per hectare (see krongbong.daklak.gov.vn). This is a considerable amount of money for smallholder farmers, particularly the poor. More importantly, it takes a long time for a rubber plantation to start generating income. On average, a rubber tree becomes productive after six years, which is usually too long to wait for an average farmer, whose immediate need for food takes priority. As a result, poor ethnic minority households are often unable to invest in rubber plantations.

Fresh latex is often collected at the farm by mobile traders/collectors. The trader fixes the price, and smallholder rubber-planters often have no scope to negotiate. Most fresh latex

Figure 21. Quantity and value of rubber exports from Vietnam, 2005-2011



Source: faostat3.fao.org; thitruongcaosu.net

is exported – currently, less than ten per cent of the natural rubber produced in Vietnam is used for domestic use. There is limited value added to the rubber products that Vietnam exports, and exported products have only limited processing (Tran, 2008).

There is a connection between the expansion of rubber plantations and the loss of forest areas and biodiversity. Although only degraded forests are permitted to be converted to rubber plantations, in many localities forest has been cleared for agriculture in the name of rubber development, including on high-biodiversity conservation sites. In the Central Highlands, for example, more than 100,000 hectares of natural forest were cleared between 2007 and 2011 (Box 2). Such forest clearing has also occurred in Quang Nam and Tay Ninh provinces.

Box 2. Rubber expansion and deforestation in the Central Highlands

In the Central Highlands region, 53 management boards for protection forest manage over 950,000 hectares of (mostly natural) forest. Even before the approval of the rubber development strategy in 2009, forestland under the management of these boards was cleared for cash cropping (mostly rubber). In some cases, land-use titles were issued for cropping land recently converted from forest. Around 130,000 hectares of natural forest in the five provinces of the Central Highlands region were cleared between 2007 and 2011, of which around 101,000 hectares were converted for cash crops, mostly rubber.

Source: www.tienphong.vn/phap-luat/597137/mat-hon-100000-ha-rung-do-chuyen-doi-dat-tpp.html

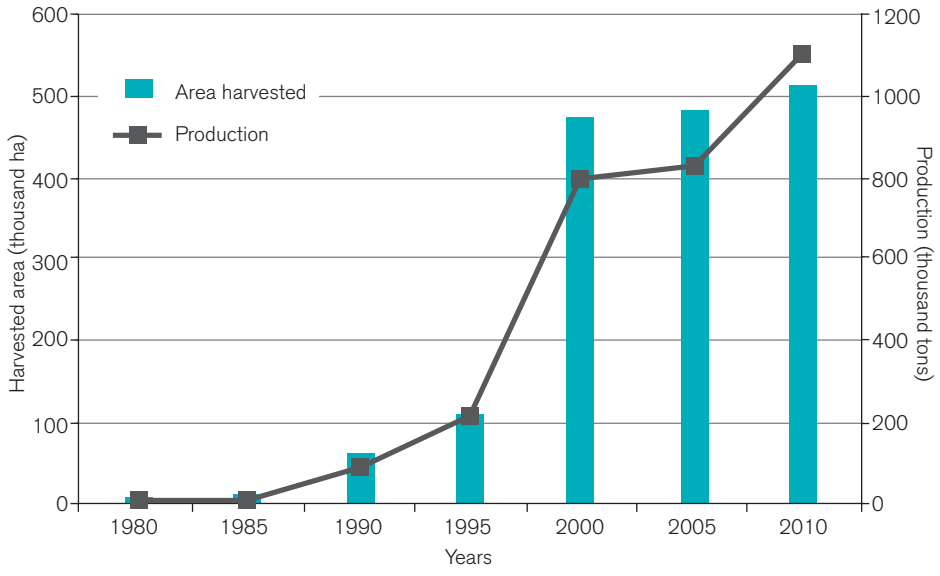
Coffee. Coffee was introduced to Vietnam as a crop only after the era of French colonialism, and the coffee subsector only started to develop after the launch of the Doi Moi (economic reform) policy in the late 1980s. The area under coffee cultivation increased sharply in the 1990s before stabilising in the 2000s. At the end of 2011 there were around 533,000 hectares of productive coffee plantations nationally. This is more than 50 times the productive area in 1980 and eight times the productive area in 1990, but only 12 per cent more than the area in 2000. Most coffee plantations are un-shaded and owned by smallholder farmers, and they are concentrated in the Central Highlands region, where soils and weather conditions are favourable.

Coffee production rose sharply in the 1990s, particularly between 1995 and 2000, and then at a more moderate rate in the 2000s. By 2010, total annual coffee production in Vietnam was over 1.1 million tonnes fresh (Figure 22).

Vietnam became the world's fourth-largest coffee exporter in 1997 and is currently in second position, after Brazil. In 2010, Vietnam exported over 1.2 million tonnes of (fresh) coffee, with an export turnover of US$1.85 billion. Its market encompasses around 90 countries, with the main importers being Germany, Italy, Japan, South Korea, Spain and the United States. Vietnamese coffee also has a big domestic market. In the last 15 years, coffee-drinking has become an increasingly common habit among the Vietnamese, in both urban and rural areas.

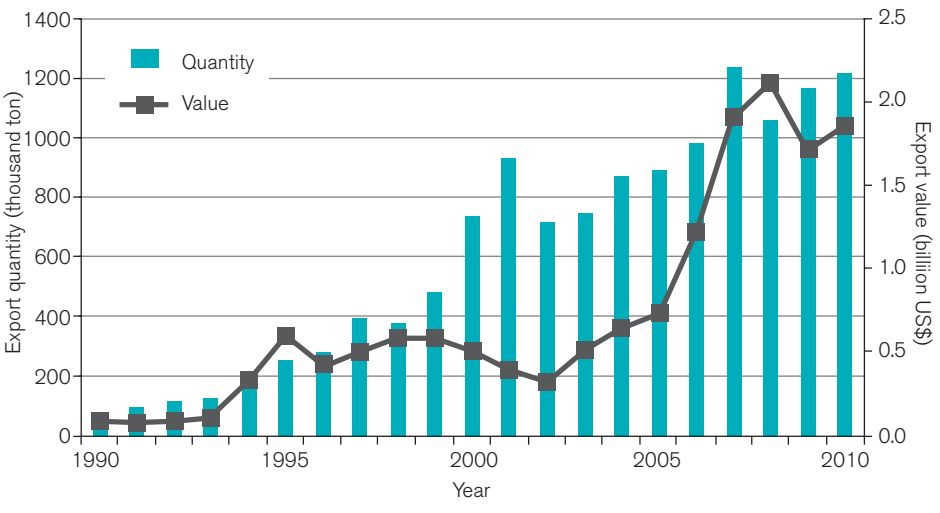
The market price for coffee has been unstable in the last 15 years, however (Figure 23). It dropped after the boom in the late 1990s, and many coffee-growers decided to replace

Figure 22. Harvested area and production of coffee in Vietnam, 1980-2010



Source: faostat3.fao.org; gso.gov.vn

Figure 23. Quantity and value of coffee export from Vietnam, 1990-2010



Source: faostat3.fao.org; gso.gov.vn

their coffee plantations with other crops. The price increased again in the mid 2000s but declined in 2012, and coffee-growers are turning to pepper, the price for which is rising.

Coffee is more 'friendly' to smallholder farmers than rubber; in fact, private farmers grow most of the country's coffee plantations. Although the cost of establishing coffee plantations is high – almost twice as much as that of rubber – it takes only three years for coffee trees to start producing a marketable product (half the time required for rubber to become productive). This makes a substantial difference to the economic viability of the exercise for smallholder farmers.

Generally, local traders/collectors collect the (fresh) coffee beans from farmers, similar to rubber and other farm products. Traders fix the price, and there is little, if any, room for negotiation. Farmers can, however, choose not to sell the beans and wait for a higher price.

Although coffee may seem to be purely an agricultural (cash) crop, it has a strong negative connection with forests in the Vietnamese context because the expansion of coffee plantations has often been at the expense of forests. Although no data are available on the loss of forest due to coffee-growing, various cases in which large tracts of forest, including national parks, have been cleared for coffee expansion have been reported in the media (Box 3).

Box 3. Deforestation and coffee-growing in the Northwest region

A recent survey in one district in the Northwest region indicated that a large area of forest has been converted into a coffee plantation. Forty-five surveyed households in one commune have converted a total area of 471 ha of forest to coffee plantations, although only five possess legal permits for such conversion. The illegally converted land includes part of a protected area. According to a district official, deforestation in the local area for coffee plantations is widespread and not restricted to the surveyed commune. Coffee expansion has been a provincial policy, but a lack of planning and guidance has resulted in increased deforestation.

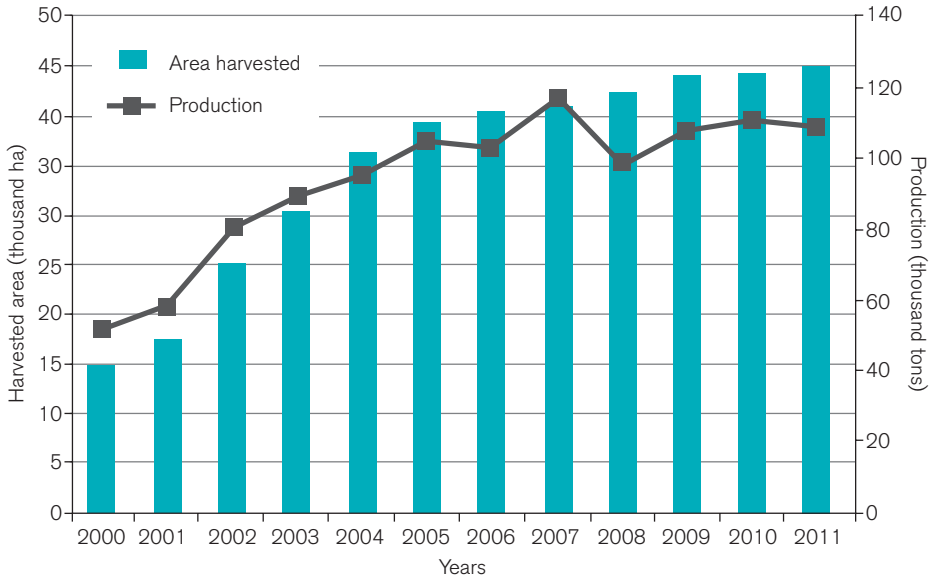
Source: www.monre.gov.vn/v35/default.aspx?tabid=428&cateID=24&id=53178&code=BHGII53178

Pepper. Vietnam has the fourth-largest area of pepper plantations after India, Malaysia and Indonesia. Pepper is grown in most regions of the country, from the North and South Central Coast to the Mekong River Delta, with a concentration in the Central Highlands and Southeast regions, where the natural conditions (soil and weather) are most suitable for pepper cultivation. In 2011, the total area under pepper cultivation was around 55,800 hectares, of which 4,800 hectares were in the North and South Central Coast, 22,600 hectares were in the Central Highlands, 600 hectares were in the Mekong River Delta and 27,700 hectares were in the Southeast.

Vietnam produced around 110,000 tonnes of pepper in 2011 (almost one-third of the total global pepper production) and has been the world's top pepper producer since 2002, when it surpassed India and Indonesia. Figure 24 shows harvested area and production for pepper for 2000-2011. Pepper productivity in Vietnam is higher than the world average, particularly in the Central Highlands and Southeast regions. In the Central Highlands, for example, pepper productivity can reach up to 45.2kg per hectare, which is more than five times the world average and almost twice the national average.

Pepper plantations are mostly owned by smallholder households. The average smallholder pepper plantation is around one hectare, although size varies within and across regions. Each plantation requires one to two full-time labourers.

Figure 24. Harvested area and production of pepper in Vietnam, 2000-2011

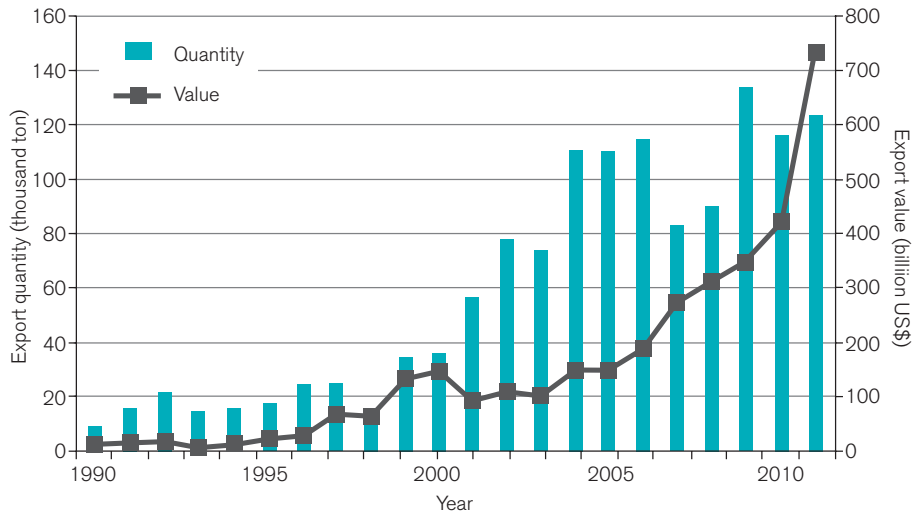


Source: faostat3.fao.org; gso.gov.vn

For more than a decade, Vietnam has been the world's top pepper exporter. Its market encompasses over 80 countries, with the main importers being Egypt, Germany, India, the Netherlands, Pakistan, Russia, Spain, the United Arab Emirates, the United Kingdom and the United States. Vietnamese pepper accounts for 40-50 per cent of the global trade, by volume. In 2011, Vietnam exported 123,808 tonnes of pepper worth US$732 million. Returns from pepper exports have grown in the last decade, especially the five years to 2011, as shown in Figure 25. In 2011, the export volume grew by six per cent but the export value increased by almost 74 per cent.

The market price has a clear impact on the area of land under pepper cultivation. As prices rise, pepper-growers have hurried to expand their farms. While pepper is an agricultural cash crop, such an expansion can have negative impacts on forests, especially by increasing demand for timber poles, which are used to support the pepper vines and are often taken from nearby forests. On average, for each hectare of new pepper plantation, about 1,100 poles (3.5m in length) are needed (Nguyen, 2005). If two poles can be taken from one tree, over 500 trees would be felled for every hectare of pepper planted. The result is that pepper expansion inevitably places pressure on (natural) forests.

Figure 25. Quantity and value of pepper export from Vietnam, 1990-2011



Source: faostat3.fao.org; gso.gov.vn

Tree plantations for pulp and construction materials

With a partial logging ban in effect since the mid-1990s, the domestic supply of wood in Vietnam is met mainly by tree plantations. In 2009, for example, over 95 per cent of the 3.88 million m^3 of wood harvested in Vietnam came from tree plantations, and less than five per cent came from natural forests.

Tree plantations started to boom in the late 1990s, when the market began to develop. The area of land under tree plantations expanded from 745,000 hectares in 1990 to over three million hectares in 2010 (Sikor and Nguyen, 2011), an average annual expansion of about 116,000 hectares over the period. It is not possible to disaggregate the area of tree plantations established for watershed protection and special uses from those established for commercial purposes, however. Several factors contributed to this expansion:

- National and provincial afforestation programmes – since the early 1990s, two important national programmes have supported the expansion of tree plantations in Vietnam: the National Program on Regreening of Bare Land and Denuded Hills, also known as the 327 Programme, which took place between 1992 and 1997; and the Five Million Hectares Reforestation Programme, also known as the 661 Programme, which started in 1998 and ended in 2011. In addition, there have been various provincial projects and programmes, which run on local budgets and support afforestation efforts at the provincial level.
- Donor-supported projects/programmes – in addition to national efforts, international support has been directed at boosting the development of tree plantations in the country. The main donors in this area are the German Bank for Reconstruction, the World Bank, the Asian Development Bank and the Japan International Cooperation Agency. In the past, support for tree plantations also came from the Swedish International Development Agency and the World Food Programme.

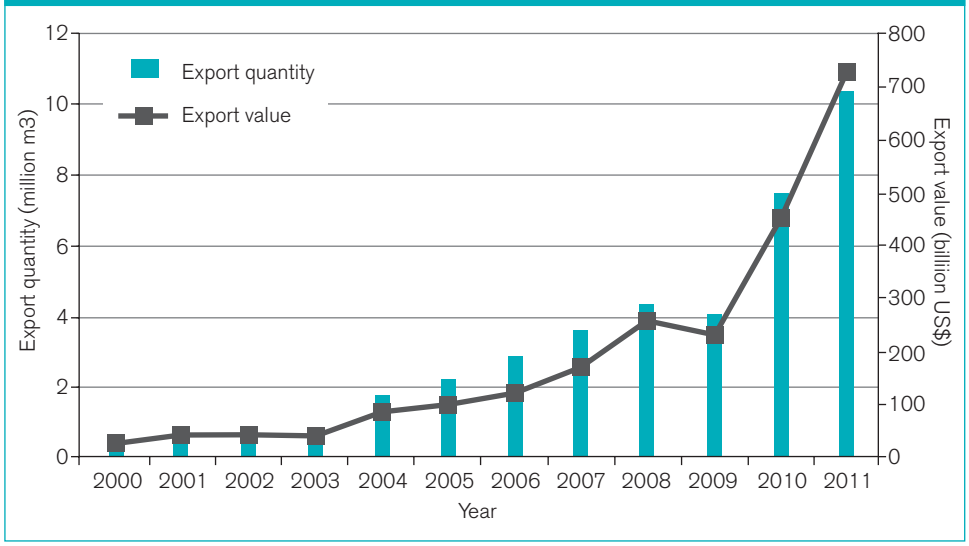
- Private investments – the development of a market for construction material led to private investments in tree plantations from private and joint-venture companies and smallholder farmers. By 2010, over 1.4 million hectares of tree plantations were under smallholder farmers (around 500,000 hectares of which were new plantations), double the area held by smallholders in 2002, and 83,000 hectares were held by private/joint-venture companies (42,000 hectares of which were newly planted), four times the area held by such companies in 2002.

Most tree plantations in Vietnam focus on fast-growing species, mainly monocultures of acacia, eucalypt and pines. Trees on smallholder farms are often harvested early – at year four or five (Nguyen, 2011). Bamboos of various varieties have also been planted and used as construction materials. The area of bamboo plantations is relatively limited, however, at less than three per cent of the total tree plantation estate.

Wood-construction material in Vietnam has largely been developed for international markets. Starting in the late 1990s, woodchip exports have also been on the rise, with the emergence of international buyers operating in joint ventures with Vietnamese partners (Barney, 2005). As indicated in Figure 26, the value of exports of woodchips and wood particles reached US$730 million in 2011, more than 25 times the value in 2000 and seven times the value in 2005. The main markets are Japan, Korea and Taiwan.

Much of the wood comes from smallholder plantations in coastal provinces in the North and South Central Coast region that are close to seaports. In the last decade, the landscape in this region has changed drastically, with formerly bare land being converted to eucalypt or acacia plantations. 'Plantation fever' has, however, also resulted in the clearing of natural forests for tree plantations.

Figure 26. Quantity and value of woodchip and wood particle exports from Vietnam, 2000-2011



Source: faostat3.fao.org; gso.gov.vn

The wood market has created income for various groups of people. Nevertheless, while some benefits accrue to local farmers, most go to local collectors and collecting agents. As described in Box 4, average tree-growers holding two hectares of plantations and producing around 14 tonnes of wood per year receive the lowest aggregated income per year of all the actors in the commodity chain, even though their marginal benefit per tonne of wood is highest of all.

Box 4. Production and marketing chain of woodchips in Binh Dinh province

Smallholders in Binh Dinh province produce significant quantities of woodchips. Trees are grown in monocultural plantations (mostly eucalypt or acacia) for four to five years before they are sold for chipping. The wood market chain is relatively direct, involving seven groups of actors: tree-growers, local collectors, woodcutters, bark peelers, truckers, company collecting agents and industrial buyers. Wood from growers' plantations first goes to the local collectors, who hire woodcutters to fell the trees and workers to peel the bark. After that, the de-barked wood is taken to industrial buyers in Quy Nhon (the provincial capital) with the help of the truckers.

In a transaction for a given amount of harvested wood, the tree-grower obtains the most percentage of the price of the log (around 55 per cent of the total). Local collectors obtain around 25 per cent of the total and bark peelers about 12 per cent. Collecting agents, woodcutters and truckers obtain least, with benefits of less than 4 per cent each. These latter actors make up for the low percentage per unit of wood, however, by handling much more wood. On average, a single tree-grower will produce 14 tonnes of wood per year, obtaining income of VND4.8 million, which is only 1 per cent of the total benefit. Bark peelers obtain 2 per cent of the total income, woodcutters 8 per cent and truckers 10 per cent. Between them, local collectors and collecting agents obtain over 76 per cent of the benefit because of the large quantity of wood (over 2,000 tonnes) they transact per year.

Source: Nguyen, 2011

The domestic market is largely overlooked. Wood from tree plantations is sold domestically only when international buyers are inaccessible – for example, if the wood is grown too far from processing facilities, there is a drop in the international wood price, or the wood is only available in inappropriate sizes. Although Vietnam has a large demand for roundwood for furniture manufacturing, domestic supply meets only 30 per cent of the demand and the rest is imported. Nevertheless, the government policy and direction is to promote domestic wood supply to feed the country's wood furniture industry, and this may start a new trend in the Vietnamese wood market.

Non-timber forest products

According to the Ministry of Agriculture and Rural Development (MARD, 2006), Vietnam's natural forests consist of a rich mix of species. Of the 12,000 plant species so far inventoried, around 7,000 have been categorised and their uses described. Among the latter, there are:

- 113 species giving aromatic resins;
- 800 species giving tannins;
- 93 species giving dying materials;
- 458 species giving essential oils;
- 473 species giving fat oils; and
- 1,863 species giving pharmaceutical products.

NTFPs form an integral part of the life of upland communities, particularly the 12 million ethnic minority people in Vietnam. NTFPs are mainly used for domestic purposes such as food (for people) and feed (for livestock), medicine and other daily needs, such as construction materials and woodfuel (Table 19). The range of products people can collect from the forest is large: Pham (2003) found that a rural community gathered 194 NTFPs in a nearby forest, of which around 80 were frequently collected. The most important ones were woodfuel (around 50 per cent of the total value of NTFPs), bamboo shoots, medicinal herbs and forest leaves. NTFPs are also traded locally and even internationally; this aspect will be explored in more detail in the next section. In addition to their material value as an integral part of the forest, NTFPs have cultural value for local communities, particularly the ethnic minorities in Vietnam.

NTFPs are traditionally collected in natural forests but forest degradation and deforestation has led to the depletion of NTFPs in the wild. Plantations of various NTFPs have become increasingly common and their establishment is supported by national programmes (such as the 327 Programme and the 661 Programme – for the latter, see Box 5) and donor-supported projects, an example of which is a project supported by the International Union for Conservation of Nature (IUCN) on the sustainable use of NTFPs, which was completed in 2002. MARD has also issued technical guiding documents to assist the development of NTFPs in the country (MARD, 2006).

Table 19. Examples of NTFPs collected for household use

Uses	Examples
Food and fodder	Nuts, forest fruits, bamboo shoots, leaves, mushrooms, honey
Medicine	*Rauwolfia spp. Maytenus spp. Solanum margilatum* and *Dioscaria bulbifera*
Non-edible	Rattan, bamboo, ornamental plants, extracts, exudates, fibres, woodfuel
Construction materials	Bamboo, rattan, palm and imperata leaves

Source: MARD, 2006; www.cares.org.vn; FAO, 1993

Box 5. Development of NTFPs under 5MHRP

The 661 Programme was launched in 1998 after Prime Minister's Decision 661/QD-TTg. One of the objectives of the programme was to increase forest area from around nine million hectares (28 per cent of the country's land area) to 14.3 million hectares (43 per cent of the land area) by 2010. Another objective was to enhance the contributions of forests to socio-economic development by providing increased employment and income for forest-dwelling people.

The development of NTFPs was therefore an important activity under the 661 Programme. The aim was to develop around 480,000 hectares of NTFPs, including 65,000 hectares of *Cinnamon cassia*, 20,000 hectares of anise star, 140,000 hectares of Pinus kesiya (for resin production), 155,000 hectares of tung-oil trees (*Vernicia fordii*) and 200,000 hectares of bamboo of various species.

Vietnamese NTFPs are exported to around 90 countries, generating revenue of US$200 million per year (mainly from bamboo and rattan handicrafts). However, this export sector is still underdeveloped. NTFP markets are relatively spontaneous and driven by the demands of (international) buyers. There is a great potential to develop new markets for NTFPs.

NTFPs also play an important role in local economies and culture. Almost eight million ethnic minorities in Vietnam spend significant time collecting NTFPs (Sunderlin and Huynh, 2005). It is estimated that NTFPs account for 15-25 per cent of household income of people living in forest areas. While household consumption is the primary objective of NTFP collection, the trading of surplus NTFPs within and between communities is also common (Box 6). For poor and forest-dependent households, NTFPs serve as the main source of subsistence. Such people often live in or near natural forest areas, relying on a wide range of NTFPs for food, fodder, medicines and other daily needs (Sunderlin and Huynh, 2005). The collection of NTFPs for sale also provides 'quick cash' in emergencies. Nevertheless, better-off households are more likely to benefit from the commercialisation of NTFPs because poor households lack the resources to take advantage of market openings.

Box 6. Consumption and trading of NTFPs in Cham B village

In Cham B village in Dak Lak province, local people have traditionally relied on products collected in nearby forests for various purposes. Local people have identified at least 251 NTFPs, comprising food (146 products), household materials (60 products), medicines (40 products) and fodder (5 products). Attached to each product is traditional knowledge and culture that have been passed from generation to generation, including knowledge on traditional healing and cuisine. All households in the village collect different types of NTFPs, almost on a daily basis, with bamboo shoots and forest leaves the most common. All households have also traded NTFPs at different times, and eight collect NTFPs for sale on a regular basis.

Source: Pham, 2003; Nguyen, 2005

Tenure rights in subsector enterprise options for smallholders

In general, tenure rights are a complex issue. For the sake of simplicity, the discussion here separates land tenure from tree/crop tenure, both of which apply to all the options discussed above.

With regard to land, tenure rights can be granted to smallholders provided that the source of acquisition is clear, the farmer has been using the land for sufficiently long, and there is no current conflict. In such cases, a land-use title (known as a Red Book Certificate due to the colour of its cover page) is awarded to the land user. By legal definition, tenure cannot be granted for cropping land if the land has been illegally converted from forestland, for example, in the case of clearing forest for rubber, coffee, pepper or even tree plantations. Nevertheless, high demand for cropping land, along with the expectation that legal land title could be granted in the future, have been strong driving forces for the clearance of degraded forestland for planting cash crops and tree plantations (see later discussion).

Because the legal framework permits land-use titling subject to the land being used for long enough by the same land-user and on which no conflict occurs (perhaps because there is a lack of historical data on land tenure, among other reasons), some landgrabbers

have successfully acquired land-use titles for their illegally converted forestlands. This has set a precedent and raised expectations among rural people that the same thing could happen to their lands.

Land tenure rights, according to the current legal framework in Vietnam, cover the rights to exchange, mortgage, transfer, inherit, lease and use the land as a contribution to joint investments with other actor(s). In other words, a titleholder can exchange her (or his) land with another's, ask a credit institution to take the land as the mortgage for a loan, transfer the title (along with all the tenure rights) to another person, pass the land to her (rightful) heir, lease the land for other persons(s) to use, and use the land commercially with other(s). In short, land tenure rights allow titleholders to use the land for both domestic and commercial purposes.

It is also legally possible for local communities to hold collective tenure rights to land and forest resources. In other words, communities can have legal title to land and forest collectively, according to the current Land Law and Forest Protection and Development Law. But these rights are limited to the protection, management and domestic use of the resource. The Civil Code does not recognise the community as a legal entity and thus the collective commercialisation of forest resources and trees or crops by communities is not legally possible.

Under the statutory laws, those who invest in trees or cash crops have both commercial and use rights to the products derived from those trees or crops. In other words, the products can be used for home consumption or sale. In the latter case, no legal procedure is required for rubber, coffee, pepper or NTFPs. For plantation wood, tree-growers are required to submit an application to the Communal People's Committee. Five days after the application is accepted by the Committee, logging can take place (Table 20).

Customary laws in many regions also have tree tenure provisions. For products in natural forests, the collection of common NTFPs (that is, those not on the prohibited list) for domestic use can be 'informally' open to all, although the legal right remains with the entity that has been authorised by the state. For example, farmers in all surrounding villages may collect NTFPs in a forest area managed by a local forest company or an individual household. Nevertheless, NTFP collection for commercial purposes is generally not allowed under customary law. In many villages, customary laws also prohibit the sale of NTFPs collected in the wild.

Table 20. Legal requirements for commercial production of enterprise options

Enterprise options	Legal requirements
Rubber	No legal procedures needed for commercial production
Coffee	No legal procedures needed for commercial production
Pepper	No legal procedures needed for commercial production
Tree plantations for pulp and construction material	Application to be accepted by Communal People's Committee at least five days before logging
NTFPs	No legal procedures needed for commercial production/collection (not including products prohibited by law – e.g. endangered species)

5.3 Assessment of integrated impacts of subsector options

This section provides an assessment of subsector options against a range of criteria, namely impacts on: gender; food security; energy security; climate change mitigation and adaptation potential; biodiversity within the actual system and in adjacent natural systems; and soil fertility and nitrogen inputs.

Cash crops

Gender. For rubber, coffee and pepper, both women and men are involved in all stages of production – planting, tending, harvesting, processing and trading. Importantly, income generation and spending are often done at the household level. Any gender-based differences in opportunities would be associated with different household structures – for example households headed by widows, who may have fewer (human) resources.

Food security. All three cash crops have high capacity to increase incomes for households and thereby enhance their purchasing power to buy staple foods. These crops therefore make an indirect contribution to improving food security. If prices drop, however, farmers may have difficulty in generating cash income from these crops. The long time frame for rubber counts against it as an option for generating income for smallholders.

Energy security. The three cash crops can make a direct contribution to energy security because households can use dead or old rubber, coffee and pepper trees as woodfuel, and the three cash crops can also make an indirect contribution by increasing the purchasing power of households.

Climate change mitigation and adaptation potential. While the three cash crops can certainly absorb CO_2 through photosynthesis, plantation establishment is often at the expense of natural forests, which usually involves significant greenhouse gas emissions. The intensification of these crops may lead to the (excessive) use and environmental discharge of chemicals such as pesticides and fertilisers and greater vulnerability to soil erosion, which would reduce adaptability to climate change.

Biodiversity. The expansion of rubber, coffee and pepper is assessed as a threat to the conservation of local biodiversity, for the reasons outlined earlier.

Soil fertility and nitrogen inputs. The intensification of the three cash crops often implies the excessive use of nitrogen fertilisers.

Tree plantations for pulp and construction material

Gender. The planting and tending of trees for construction wood involves both women and men. Women are usually involved more than men in tending the trees. Men often undertake harvesting and processing due to the heavy nature of the work.

Food security. Tree plantations can make an indirect contribution to improving food security by increasing income for households and thus their purchasing power for buying staple foods. However, a long period of time is required for this impact to take place.

Energy security. Tree-tops and branches can be used as woodfuel. Income from wood sales can indirectly increase energy security by enhancing household purchasing power.

Climate change mitigation and adaptation. Tree plantations have the potential to mitigate climate change, for example by enhancing carbon stocks as part of REDD+ activities. Mismanaged logging may lead to a reduction in such carbon stocks, however.

Biodiversity. Monocultures of eucalypts and acacias are threatening biodiversity in Vietnam. The expansion of the tree plantation estate is sometimes at the expense of natural forests. On the other hand, the supply of timber and woodfuel from tree plantations can reduce pressure on natural forests for such products.

Soil fertility and nitrogen inputs. Monocultures of eucalypts may have a high risk of soil erosion. Plantations of acacia, however, help fix nitrogen. In general, plantation forests can help improve forest cover.

NTFPs

Gender. There is evidence that women dominate the collection, processing and trading of various NTFPs, such as in the case of cardamom (Dinh, 2004).

Food security. NTFPs serve as food in many households, as fodder for livestock, and as a source of income for local households.

Energy security. Woodfuel is the most common NTFP that local households use on a daily basis.

Climate change mitigation and adaptation. There is evidence that the excessive collection of NTFPs depletes forest resources, thus reducing their climate change mitigation and adaptation potential.

Biodiversity. See climate change mitigation and adaptation above.

Soil fertility and nitrogen inputs. Many NTFPs can be used as natural fertilisers, such as green composting, which reduces the use of chemicals.

Table 21 summarises the overall impacts of the subsector options.

Table 21. Summary of scores for each subsector					
Impact criterion	**Subsector**				
	Rubber	Coffee	Pepper	Plantation wood	NTFPs
Gender	5	5	5	3	4
Food security	2	4	4	2	5
Energy security	5	5	5	5	5
Climate change	2	2	2	4	2
Biodiversity	1	1	1	3	3
Soil fertility/ nitrogen use	1	1	1	3	5
Total	**16**	**18**	**18**	**20**	**24**

Note: Impact criteria are described in the text. Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

5.4 Assessment of support priorities

Based on the points raised above on (among other things): (i) the initial high cost of investing in new crops and the long lag time before some crops generate income; (ii) land tenure versus commercial rights and tenure rights versus illegal land conversions; (iii) price-fixing by stronger actors in the market chain or the lack of negotiating power of producers; and (iv) the limited value added in the country, the following recommendations are made for future support for locally controlled forest enterprise subsectors in Vietnam to best deliver critical outcomes.

- **Secure commercial tenure.** As a precondition for any support, it is important to clarify tenure rights. Interventions should be avoided or suspended in areas where tenure conflicts exist, unless there is a commitment among local authorities to solve such problems, by clarifying rights or forestland allocation. In addition, efforts should be made to ensure that legal rights can officially be allocated to potential beneficiaries. This is an important first step in strengthening the voice of poor ethnic communities.

- **Mix income-generation options.** In future support activities, the enterprise options discussed in this chapter can be combined in sub-groups, such as combining a particular NTFP able to deliver quick income for local people and a cash crop such as coffee or pepper, which may take longer before generating income for smallholders. The NTFPs to be developed should be suitable for the local physical, cultural and market conditions. Rubber and tree plantations may not be ideal in the short run because of the long time it takes for them to generate income, but they could be considered in the longer term, particularly tree plantations, which have greater positive impacts on climate change, biodiversity and soil fertility compared with cash crops.

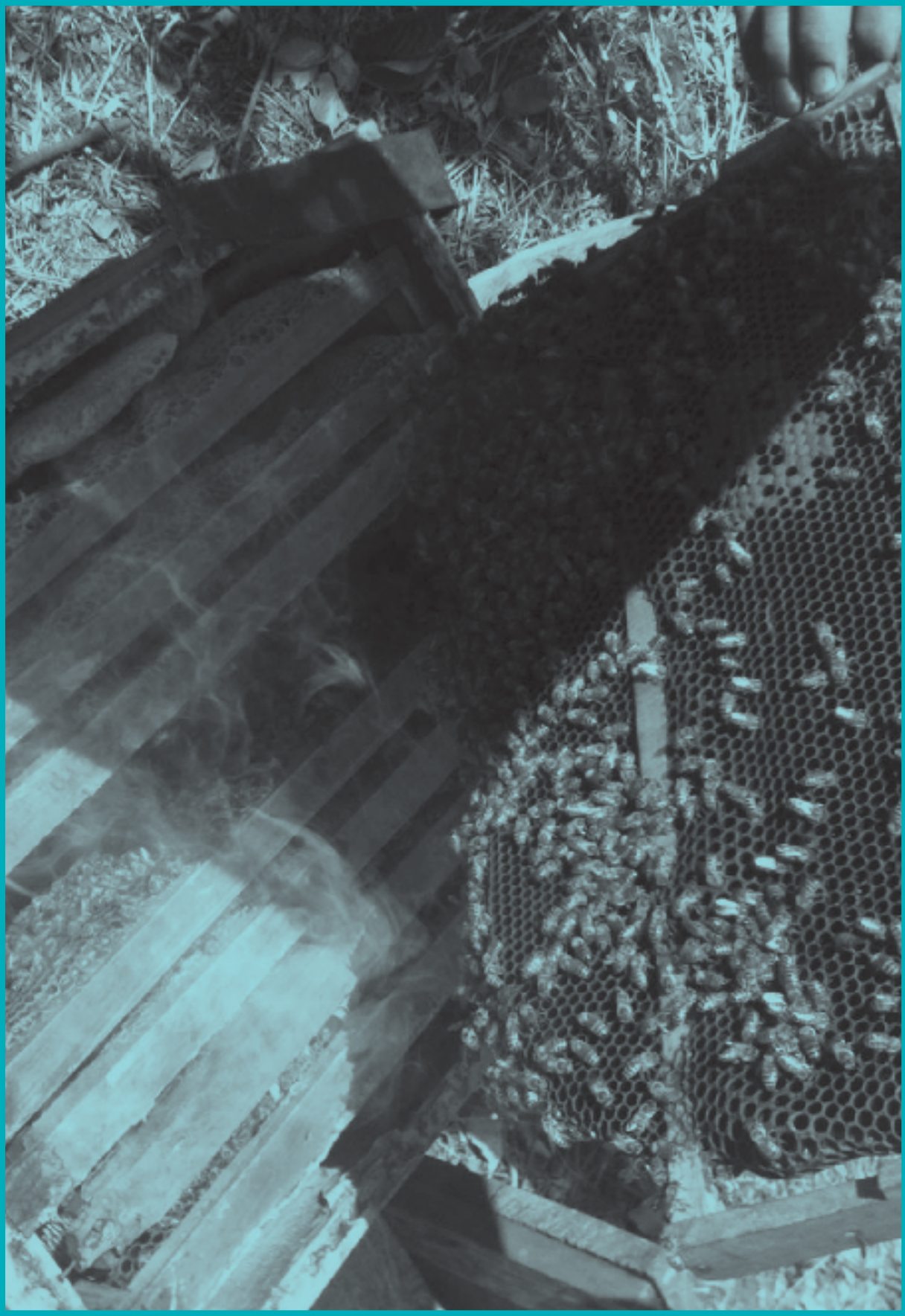
- **Focus on value adding.** Attention needs to be paid to increasing value added to all products, especially at the farm level. Possibilities include introducing post-harvest processing technologies to the farmers and providing technical assistance if they adopt the technologies. In addition, the development of business capacity, such as the formation of associations, organisational skill development (including negotiation skills) and business planning, would also help smallholder farmers gain more benefits from their produce.

- **Work to improve existing management arrangements.** Given that the negative impacts of each subsector can be mitigated and avoided by better planning and management, it is recommended that attention be given to improving existing management practices. For example, future support could focus on mitigating the impacts of cash cropping on biodiversity, such as by sourcing the wooden poles used in pepper-planting from plantations rather than natural forests, or using other materials, such as earthen or brick supports.

- **Build on local knowledge.** It is recommended that external interventions take into account and promote existing local knowledge. Attention needs to be paid to the limited capacity of the poor in terms of time and human and financial resources to ensure that they can benefit from external support. Interventions should aim to improve local governance and empower poor ethnic communities, particularly the in situ minority groups, and they must avoid (indirectly) widening the gap between ethnic minority groups and the Kinh. Investing time in building capacity and readiness for suitable enterprises is key. Given the limited capacity of the very poor to participate in uncertain ventures – without putting short-term livelihoods at risk – strong evidence of the advantages of intended interventions needs to be provided. Types of support include proactive measures to improve assets, such as productive lands, access to finance/ micro-finance; capacity, for example, education, exposure to information and new ideas and networks; and representation, such as through cooperative movements and representation in various bodies.

- **Support enterprise capacity development broadly.** Depending on the availability of suitable and accessible land and access to technical and financial services, particularly in the Central Highlands, interventions should not focus on a single subsector. People's interest and ability to engage in any particular enterprise will be determined by their local livelihoods and often requires them to follow a 'landscape approach', in order to spread investment risks and to ensure both short- and medium-term sources of income.

- **Focus on the poorest regions.** Interventions should be made in the three regions where the poverty rate is highest – Northern Midlands and Mountains, North and South Central Coast, and Central Highlands. There should be particular focus on the Central Highlands if the objective of the intervention is to address poverty among the in situ ethnic minorities (versus those of mainstream Vietnamese and other migrant ethnic groups). Within the region(s), intervention sites should be selected in cooperation with the Vietnamese government and partners, taking into account not only the biophysical and demographic conditions but also the capacity of the human resource, including the leadership, and the existence of ongoing projects and programmes.



Community honey production, Chiapas.

6

Assessing subsectors of locally controlled forest enterprises and support options in Chiapas, Mexico

Mario Bringas

6.1 Introduction

In this chapter, an assessment is made of enterprise options in the municipio (municipality) of Chilón in Chiapas, Mexico. Chilón covers 2,490 km^2 at the limits of the East Mountains in northern Chiapas, Mexico's southernmost state. Of around 2,457 municipios in the country, Chilón is among the bottom 125 in the Human Development Index. With a growing, mostly indigenous (Tseltal) population of 112,000 (population density of 44 inhabitants per km^2), its main economic activity derives from the traditional cultivation of coffee and the main land uses are the cultivation of coffee and maize for local consumption. On average, families own 3.5 hectares of land, and the terrain is rugged. It has been estimated that 92 per cent of Chiapas farmers cultivate fewer than five hectares each (Peeters *et al*., 2003). Other subsectoral activities include honey and soap production.

Chilón's potential for achieving sustainable natural resource management is considerable. As this assessment will show, sufficient economic incentives exist for coffee producers and beekeepers, as well as for timber and firewood, to develop sustainable forest enterprises in place of current unsustainable natural resource management practices.

Spiritual factors also push the Tseltal communities toward sustainable natural resource management. In a *sui generis* process of regional syncretism, priests assign individuals with certain spiritual roles, one of which is to look after the health of the environment. Over the years, these *cuidadores de la madre tierra* (roughly translated as 'protectors of mother earth') have acquired expertise in sustainable and organic farming in Tseltal communities. Some communities, such as the *Bats'il Maya* cooperative, have been able to take advantage of these practices to develop successful businesses for coffee production and export. The Bats'il Maya cooperative is an example of how the organisation of enterprises in a particular subsector can be a powerful way to increase bargaining power in the market and advocate for better rights and incentives for enterprise development. The cooperative is diversifying its production with honey and soap.

All these factors, combined with the high level of poverty in the *municipio*, provide the conditions for the development of enterprise options that deliver poverty reduction and sustainable natural resource management.

Although there is no explicit set of rights and incentives that channels the entrepreneurial energy of the Tseltal people towards the enhancement of biocapacity, certain initiatives at the

federal and state levels and indicators can help illustrate the degree to which *campesinos* (local forest farmers) in Chilón can develop local enterprises and pursue social and environmental aims such as sustainability and employment. Despite the potential illustrated below, however, evidence based on access to credit suggests that the entrepreneurial options of Tseltal *campesinos* are not yet being realised.

Potential subsectors considered in this assessment

Timber. Forests, including rainforests, cover approximately 58 per cent of the territory of Chiapas, accounting for four per cent of the national forest area. Yet the state contributes only two per cent of national timber production. Poverty, low levels of education, a strong agricultural and livestock legacy, a lack of awareness of forest-related activities, insecure tenure rights in some areas, and conflicts between farmers, among other factors, lie behind forest-related problems in the Chiapas highlands.

Peeters *et al.* (2008) divided species that farmers use for timber into three classes: commercial species present in the local timber market; species used locally for making boards or furniture; and species used locally in construction works. Table 22 shows the average market price of these classes.

Table 22. Classes of timber and market price

Timber class	**Market price** (US$ per board foot)
Commercial timbers (e.g. red cedar)	2.10
Timber for planks and furniture	1.53
Timber used in local construction	0.78

Source: Peeters *et al.*, 2008

Many of the *campesinos* in the *municipio* have secure access to timber in coffee plantations (their main livelihood income). It is worth noting, therefore, some of the major differences in the potential of different types of coffee plantation. For example, traditional biodiverse coffee plantations contain more than ten times the amount of timber found in *Inga*-shaded plantations (monocultural coffee plantations), and timber suitable for local uses such as boards or furniture accounts for 90 per cent of the total timber volume in traditional coffee plantations and 79 per cent in *Inga*-shaded plantations. *Inga* and 80 per cent of the tree species used in traditional coffee plantations are considered to be good firewood.

The total monetary value of the present stock of timber, calculated on wholesale and substitution prices, amounts to US$18,009 per hectare in traditional plantations, almost 18 times the estimated monetary value of a year's coffee harvest. However, this rather astounding figure is only to be taken as an indicator. Although farmers have been extracting certain amounts of timber for personal use, the current timber stock has built up over more than 30 years; moreover, the shade requirements of the coffee plants do not allow a high exploitation rate of the shade trees, and some of the trees are either too small for immediate exploitation or too crooked to be suitable for milling. Many native timber species cannot easily be sold into the market, which focuses only on well-known timber species (Peeters *et al.*, 2003).

There is clear potential for traditional coffee plantations to be used in timber production for local planks, furniture and construction. Given that native species cannot easily be sold into higher-value markets, however, the potential is limited. The present stock of timber would need to be harvested over a 30-year cycle, and its sustainable management would require long-term enabling investment and financing frameworks, which Chilón lacks. Furthermore, successful sustainable agroforestry systems that combine timber and coffee production are yet to be established in Chilón.

Firewood. In Chilón, all families depend on firewood for cooking and, with little primary or secondary forest left, sufficient firewood reserves are essential. Indeed, many communities with relatively few coffee plantations have experienced firewood shortages (Peeters *et al*., 2003). Like timber, the production of firewood is highly dependent on the systems used in coffee production. The development of both entrepreneurial options depends to a great extent, therefore, on changes in the coffee subsector rather than in timber or firewood markets.

The potential for improvements in coffee and honey production vis-à-vis other dependent economic subsectoral activities in Chilón is significant enough to focus this study on those two economic activities.

Coffee. In 2012, the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación) and the Mexican Association of Coffee Value Chain (AMECAFE) signed an agreement at the federal level for the creation of a framework that would financially support arabica coffee producers. According to this agreement, funding will help coffee producers gain access to productive support and will reduce the risk for financial intermediaries who give credit to arabica coffee producers (AMECAFE, 2012). In terms of coffee production, Chiapas is the most subsidised state in the country. The 'Fomento al Café' programme subsidised coffee production in Chiapas to the amount of MX$866,001,947 from 2005 to 2009. Of all the municipalities in Chiapas, Chilón received the most coffee subsidies in 2008 and 2009.

Honey. *Chab nichim honey* ('our honey' in Tseltal) is a supplier to Chilón-based *Cooperativa Bats'il Maya*. Thirty-one producers of organic honey and a few technicians and volunteers are involved in the process. An estimated 242 indigenous families obtain benefits from the trade, which amounts to around 1,500 marginalised people (Centro de Derechos Indigenas, AC, 2012). As with coffee, the cooperative enjoys the unique advantage of owning the complete honey production process.

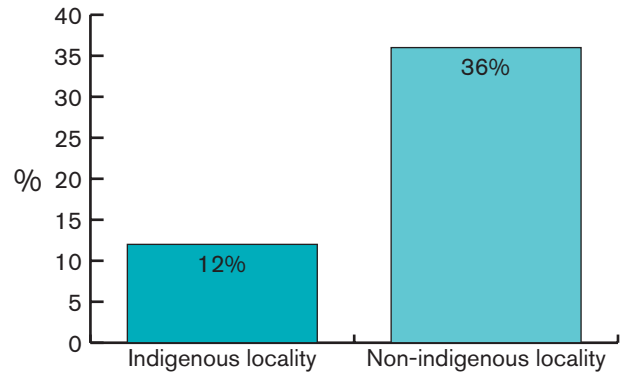
Access to credit as an indicator of enterprise development potential

One indicator of the potential for enterprise development and the quality of the enabling environment is equity in access to credit, and the equity with which the state treats local businesses in this regard is highly questionable. For example, statewide subsidy programmes are highly unequal: roughly ten per cent of coffee producers receive 43 per cent of the total available subsidies. Chilón is no exception to the inequity of subsidy distribution. In 2008 and 2009 there were 12,933 beneficiaries in the *municipio*, with a total distribution of US$2.6 million. The top 1,000 beneficiaries received US$400 or more

and the remaining 11,933 beneficiaries received substantially less. The beneficiary with the biggest subsidy (US$13,650) received 4.8 times more than the next beneficiary and, on average, 33.8 times more than the amount received by the 11,933 lesser beneficiaries. Only 142 beneficiaries (1.19 per cent of the total) received more than US$790 each in the two years (FUNDAR, 2010). Borja-Vega *et al.* (2007) showed that access to credit at the community level is three times lower in indigenous rural localities than in non-indigenous localities (Figure 27).

Borja-Vega *et al.* (2007) argued that access to credit is closely linked to property rights and that a common problem among indigenous communities is the lack of property rights and therefore their lack of collateral. In addition, low endowments of human capital (such as education) in indigenous communities reduce economic opportunities, hinder entrepreneurship and reduce returns to assets. Table 23 shows the difference in access to credit between the poorest and richest percentiles of indigenous groups in Chiapas, by occupational status.

Figure 27. Access to credit at the community level



Note: An indigenous locality is defined an having an indigenous population of more than 70 per cent and a non-indigenous locality is defined as having indigenous population of less than 10 per cent.
Source: Borja-Vega *et al.*, 2007

In addition to the general inequities in access to credit, some social assistance programmes and government subsidies such as Oportunidades, PROCAMPO and CONCAFÉ appear to blunt entrepreneurship (Román-Ruiz and Hernández-Daumas, 2010). In these programmes, some families receive more than half their income from the programme, regardless of their performance. Beneficiaries ultimately have no incentive to work at all.

Table 23. Indigenous access to credit, by occupational status, in rural areas in Chiapas

Occupational status	Access to informal credit (%)		Access to savings (%)	
	Poorest 20%	Richest 20%	Poorest 20%	Richest 20%
Campesino land owner	0.8	14.8	0	28.9
Worker in family business	7.5	0	0	37.8
Employed in non-agricultural sector	9.9	35.6	14.2	71.8
Agricultural worker	6.4	0	0	8.2
Off-farm entrepreneur	0	68.7	0	62.4

6.2 Assessment of market prospects of shortlisted subsectors

The initial selection of four potential enterprise subsectors (timber, firewood, coffee and honey) in the municipality of Chilón was reduced in the subsequent analysis to two. As described above, the prospects for timber and firewood enterprise development depend crucially on the systems used to produce the two main cash crops in the region (coffee and honey) and, for this reason, the remainder of this chapter focuses on these two main income-generating opportunities.

Coffee

Coffee consumption in Mexico has grown significantly. From 2004 to 2008, for example, national consumption rose by 42.9 per cent, from 84,000 tonnes to 120,000 tonnes (Financiera Rural, 2009). Mexico is a net coffee exporter, with exports amounting to 270,000 tonnes in 2008. Most of Mexico's coffee exports consist of unprocessed raw coffee beans (Financiera Rural, 2009). In 2008, Chiapas was the largest coffee-producing state in the country, contributing roughly 34 per cent of the total supply.

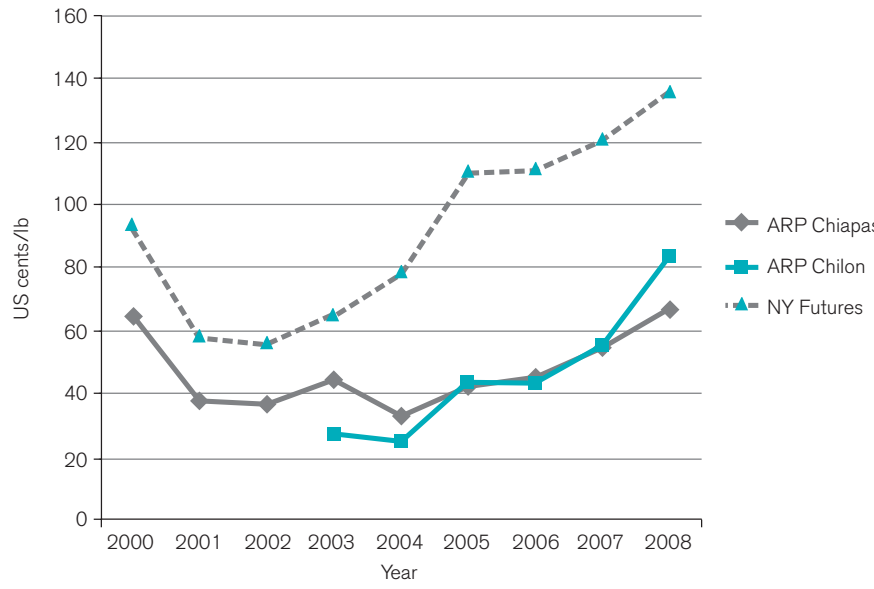
The global coffee market is characterised by the high volatility of its prices and by the fact that most exporters are developing countries and most importers are developed countries. In 2011, global production exceeded 7.8 million tonnes and exports accounted for 75 per cent of total production.

In 2011, Chilón produced 32,499 tonnes of coffee, which was grown in 13,282 hectares of coffee plantation. Chilón was the second-largest producer in Chiapas by production value, just less than the production value earned by the municipality of Tapachula. Chilón sold its coffee at an average rural price of US$670 per tonne, the highest average price in Chiapas (SIAP, 2012). These figures might suggest that Chilón has several competitive advantages compared with other municipalities in Chiapas. Nonetheless, the yield of coffee in Chilón was 2.45 tonnes per hectare, ranking it only 26th among the 85 municipalities. The highest yield, 3.89 tonnes per hectare, was achieved in Amatenango de la Frontera, and the average yield was 2.24 tonnes per hectare. Even though Chilón's yield is above average, its ranking suggests that significant increases in yield may be possible. On the other hand, the high price at which Chilón coffee was sold suggests that the

municipality may have a competitive advantage over others in terms of quality, assuming that labour and capital costs are more or less the same throughout the state.

Given the rugged conditions of the terrain in Chilón and its relative isolation from important urban centres, local merchants – known colloquially as coyotes – take advantage of coffee producers' lack of resources to process or distribute their produce by establishing the sale price, effectively turning the commercial relationship into a monopsony. Coyotes are known to establish prices according to the international price of coffee futures in the Intercontinental Exchange (formerly known as the New York Board of Trade) (Figure 28). However, this gives them the opportunity to speculate, buying *pergamino* coffee (coffee obtained after skin, pulp and pectin layers have been removed – the remaining parchment, or *pergamino*, is removed in the hulling process, but farmers in Chilón do not possess hullers). Since pergamino coffee is the only type of coffee that producers are able to sell because it is the most basic form of production, the coyotes can stock it when prices are low and sell it when prices are high.

Figure 28. Coffee prices in Chilón, Chiapas, and on the New York futures market



Source: SIAP, 2012 and International Coffee Organization, 2012

This suggests that coyotes only buy coffee when prices are low. Coffee producers lack the means to add value to their coffee. They do not benefit when prices are high; on the contrary, at such times they are unable to sell their stocks. *Coyotes* benefit the most from high coffee prices.

Organisation is a key element in overcoming such economic obstacles, such as unreliable intermediaries, as demonstrated by the case of *Cooperativa Bats'il Maya*, a group of more

than 280 coffee producers in Chilón who have organised themselves to break the link with coyotes. Members hand their harvests of organic pergamino coffee to the cooperative's plant in the town of Chilón, where the beans are processed and packed ready to be sold for final consumption. To date, the most important source of income for cooperative members has been exports to Japan.

The vast majority of coffee-growers are located at 1,100-1,200m above sea level. According to UNDP (2011), coffee harvesting is negatively affected by increases in average temperature but mostly by higher maximum temperatures. The realisation of predictions of temperature increases as a result of climate change of 2.1-2.2 °C would mean that, effectively, current conditions at 600m above sea level would relocate to 850-900m, and coffee crops in lower areas would become marginal. Chilón is located at around 900m above sea level, which means that a temperature increase of more than 2 °C would have significant impacts on coffee production.

Furthermore, greater annual variability in climatic conditions and more extreme weather, such as an increase in the frequency or duration of events such as El Niño, would ultimately result in greater fluctuations in the amount and quality of coffee (UNDP, 2011). The degree of resilience of coffee-growing in Chiapas, and specifically in Chilón, in the face of likely climate change is therefore low.

Honey

Mexico is one of the top eight honey-producing countries that, combined, produce 56 per cent of total global honey production; Mexico's contribution is 3.5 per cent. Mexico is also one of the five countries that collectively export more than half of total world exports, contributing 6.6 per cent. Mexico is ranked third in organic honey exports, which exceed the price per unit volume of conventional honey by 30 per cent (Financiera Rural, 2011). Nationally, Chiapas is the fourth-ranked state in honey production.

Mexico is a net honey exporter. Around 80 per cent of Mexico's honey is destined abroad, and the remaining 20 per cent is traded within the country. In 2002, Mexican honey exports peaked at 34,000 tonnes. In 2009, Mexico exported 61.2 per cent of its total honey exports to Germany, 12.7 per cent to the United Kingdom, 7.6 per cent to Switzerland, 6.6 per cent to Saudi Arabia, 6.1 per cent to the United States, 3.1 per cent to Belgium and the rest to countries like China, Spain and Venezuela (Financiera Rural, 2011). Mexico has taken advantage of its free trade agreement with the European Union in its honey exports; it enjoys a preferential quota of 30,000 tonnes annually at a tariff of 8.6 per cent.

Compared with European countries, Mexico's per capita honey consumption is very low. In 2008-2009, national per capita consumption was 270-280gm per inhabitant per year; honey consumption in European countries, on the other hand, is about 700gm per inhabitant (Financiera Rural, 2011).

For most Mexican honey producers, beekeeping is not their main source of income (Financiera Rural, 2011). Therefore, one of the industry's major drawbacks is that production hasn't undergone a modernisation process. The lack of entrepreneurship in the subsector

is also a major issue. In the southeast of the country, beekeeping is linked to sedentary agricultural producers, who mostly rely on traditional technology. Given its tropical climate, the southeast has the advantage of year-long honey production. Honey produced there has worldwide prestige because of its reliance on native floral species such as *dzidzilche* and *tajonal*. Currently, 20 operators are certified as organic (Garibay *et al*., 2011).

The enabling environment in Mexico is quite strong. A large number of institutions and government programmes are oriented specifically towards beekeeping, given that there are approximately 41,000 beekeepers in the country. Strict quality measures can be discouraging for small producers in the short term, but from an exporting perspective they ensure that Mexican honey complies with international standards. According to Garibay *et al*. (2011), 'A big challenge for Mexican, export-oriented, honey producers is compliance with the various "Good Production and Manufacturing Practices", which are required for exportation, especially to the European market'.

Small-scale Tseltal producers might also face a knowledge gap when competing with exporting producers. On the other hand, the relatively small area that beekeeping occupies might be an incentive for territorially constrained communities, where dependence on land use for self-consumption is high or very high.

Local producers consider that climate change poses a major threat to beekeeping. Weather has a very real effect on colony welfare. Dry spells, or long periods of continuous rain, can negatively affect colony productivity. The flow of nectar is never guaranteed but it will be much less so with a change in climate.

The Yucatan Peninsula, especially the area north of Chiapas, is subject to hurricanes and, in the other extreme, drought. While the links between climate change and hurricane frequency and intensity are still the subject of active research, warming seas are unlikely to diminish the risk. Nevertheless, in the foreseeable future, small-scale agriculture, with its low use of pesticides, especially in the southern states of Mexico where there are large indigenous cultures, provides a good ecological foundation for organic beekeeping (Garibay *et al*., 2011).

6.3 Assessment of the integrated impacts of subsector options

Gender

In 2000, 23.4 per cent of economically active indigenous people in Chiapas were women, a percentage that ranked Chiapas 24th out of 32 states nationally in this measure and is below the national average (24.9 per cent). However, the Tseltal population's rate of economic participation is ranked third nationwide, which indicates a relatively high contribution of the Tseltal people to the national economy compared with other ethnicities (INEGI, 2004). Tseltal women's daily life can be depicted in general terms by this interview with horticulture cooperative member Micaela Hernández Gómez, from the community of Aurora Grande, Chilón (Castro, 2003):

> *[In the morning] the first thing I do is get up, wash my face and hands, light my fire, prepare coffee, frijol [beans]. The men wake up afterwards to have breakfast and go to work. Our*

daughters help us make the tortillas. We have a lot of work. After having breakfast, the men go to work, we women stay at home to wash and grind the corn, prepare tortillas and pozol [a traditional maya drink, grinded corn in water]. The men arrive in the afternoon to eat. We have to wash our husband and children's clothes, we have to maintain and take care of them. The girls begin to work harder after 10 or 11 years old. The boys usually have harder work after they are 17 years old. We women after 9 or 10 a.m. go to the cornfield to work, collect firewood, and harvest our beans, that's how we get our food, what we eat. After dinner we have other activities. We usually go to bed at around 10 or 11 pm and we have to get up really early as well. We women have many sicknesses, but we have to keep working because we have don't have any money.

In the community context, Castro (2003) argued that Tseltal women are gradually being empowered and have a growing role in decision-making processes and income-generating activities. Still, he accepted that there are challenges based on social structure and tradition that need to be addressed to improve the empowerment of women: 'Even though they are named by the community to hold a certain "cargo" [role], at times they are looked down upon because they are dedicating less time to their family and household. In the patriarchal community structure, the ultimate role for women is procreation and up to a certain point, being at the service of their families, everything else is secondary' (Castro, 2003).

In coffee production, income-generating opportunities for women are limited. Gender roles in Tseltal communities are quite differentiated, and while men are expected to work their lands, women are expected to take care of the home. In some aspects, however, women also become part of the coffee production process, for example by picking coffee beans, but they hardly earn any direct income through this practice: 'Maintenance of the coffee plot is usually – but not always – in the hands of the men. Women often take charge of the drying process at the household level, and sometimes participate in the picking' (Pérez-Grovas *et al*., 2001). The roles do involve cooperation within the family unit, rather than allowing individuals to act as entrepreneurs. Gender differences are notable in forest management projects and organic crops, like coffee. In coffee production, the representation of women in formal organisations is low and consequently women tend not to be the direct beneficiaries of programmes that support or promote these activities (Mujer y Medio Ambiente, AC, 2008).

Men also mostly carry out honey production in Chiapas. In Chilón, however, there have been outside attempts to empower women through other activities related to beekeeping. For example, soap-making is an income-generating task for Tseltal women derived from organic honey production inside the Bats'il Maya cooperative. Students of the Universidad Iberoamericana in Mexico City brought about the initiative, which has been relatively successful in providing Tseltal women with additional income. On the other hand, while these initiatives have diversified intervention options in resource use in favour of women and developed new sources of income, most women are still based in a domestic environment that maintains differentiated gender roles (Mujer y Medio Ambiente, AC, 2008).

Gender impact score for coffee: 3 – no likely effect
Gender impact score for honey: 4 – moderately likely to have a positive impact

Food security

At the national level, food consumption is higher in households that own their own land (private holdings). Food consumption in indigenous households that own their land is 62 per cent higher than in indigenous households that only have access to communal land (Table 24). Also, food consumption is nearly 1.5 times higher in non-indigenous households that own land than in non-indigenous households that only have access to communal land (Borja-Vega *et al*., 2007).

Farmers in Chilón dedicate a sufficient proportion of their territories to *milpa*, which is an area in which staple foods such as maize, beans and squash are grown; the rest is *acahual* – fallow.

An average family in Chilón owns 3.5 hectares. Such a family will often allocate one part of its land to coffee production, one to *milpa* and one part to *acahual*. The family would therefore be using two-thirds of its land for agriculture at any one time. Table 24 shows the food consumption of and hours worked by indigenous and non-indigenous farmers who use individually allocated land, private land or communal land for subsistence, or who use varying proportions of their land for commercial agriculture.

Table 24. Mean food consumption (measured using a proxy of monthly per capita US$ income equivalent) and working hours by type of land ownership

Category	Indigenous			Non-indigenous		
	Proportion of categories	Mean food consumption	Mean hours worked per day	Proportion of categories	Mean food consumption	Mean hours worked per day
Land used for subsistence agriculture						
Individually allocated land	24%	352	4.6	36%	693	7.8
Privately owned land	70%	217	4.2	51%	281	8.1
Communal land	6%	259	8.7	13%	338	6.5
Land used for commercial agriculture						
Full (100%)	59%	406	5.7	84%	574	8.1
Medium (50-70%)	23%	232	4.0	11%	460	7.5
Low (25-50%)	18%	153	3.7	5%	284	11.0

Source: Borja-Vega *et al*., 2007

Coffee production has an important but indirect impact on food security in Chiapas. In Chilón, 87.3 per cent of the economically active population is categorised as agricultural workers. Of these, 97 per cent of lands dedicated to perennial crops in the *municipio* consist of coffee plantations (13,216 hectares). Of the annual crops, maize accounts for 82 per cent, with 19,420 hectares, and beans for 17.78 per cent, with 4,200 hectares. According to Román-Ruiz and Hernández-Daumas (2010), 'coffee production is part of a totally commercial strategy that generates greater income to that produced by corn;

however, coffee is subject to constant fluctuation of its prices, having a negative impact when the price drops, in the monetary income of families'.

Coffee plantations clearly play an important role in Chilón farmers' subsistence. Coffee production is relatively more profitable for farmers than other crops in the area, even when their produce is bought at low prices. Coffee production is a highly vulnerable commercial strategy, however, given the volatility of the coffee price. Even if *milpas* are used to guarantee food security, indigenous peoples' food consumption nationwide is lower than that of non-indigenous people.

The impact of honey production on food security is also reasonably positive. Since beekeeping is not a land-intensive activity, the area can simultaneously be used for growing crops that can enhance food security. Additionally, organic honey's health benefits are very significant, considering that the variety of staple foods in Chilón is limited. The extra income derived from the trade of honey and soap serves to enhance food security.

Impacts of coffee on food security: 4 – moderately likely to be positive
Impacts of honey on food security: 5 – highly likely to be positive

Energy security

Many traditional shaded coffee plantations were replaced in the 1970s and 1980s by plantations with single-species shade vegetation ('shaded monocultures') or even without shade vegetation ('unshaded monocultures'), with the encouragement of INMECAFE, the former Mexican Coffee Institute. Nestle estimated that 30 per cent of the traditional coffee plantations in Mexico had been converted to shaded monocultures, which despite the name, still include some residual tree species. Moguel and Toledo (1999) estimated that in Chiapas, 60 per cent of current coffee plantations were either shaded or unshaded monocultures. Thus, it can be assumed that approximately 40 per cent of coffee plantations in Chiapas are managed as traditional agroforestry systems (Peeters *et al*., 2003).

Energy security is understood here as the degree to which firewood can be obtained as a direct or indirect result of an economic activity. In Mexico, 89 per cent of coffee is grown beneath the shade of trees – either biodiverse forests or monocultures (Moguel and Toledo, 1999). Peeters *et al*. (2003) studied the impact of the development of *Inga*-shaded coffee plantations (monocultures) on firewood production in Chiapas, compared with traditional biodiverse agroforestry coffee systems and found, on average, no difference in coffee production between traditionally managed plots and *Inga*-shaded plantations (Peeters *et al*., 2003). The question here, however, is whether there are differences in the volume of firewood produced.

There is a strong correlation between the volume of firewood obtained in coffee plots and the amount of biodiversity in them: shaded monocultures produce 39 per cent less firewood than traditional systems (Peeters *et al*., 2003). Traditional biodiverse agroforestry coffee plantations contain more than ten times the total volume of commercially saleable timber found in shaded monocultures. Biodiverse agroforestry plantations have 55 per cent more above-ground dry biomass than shaded monocultures and 60 per cent more

above-ground tree biomass of species suitable for firewood. In communities where all families depend on firewood for cooking, and where little primary or secondary forest is left, sufficient firewood reserves are essential (Diaz *et al.*, 1989, in Peeters *et al.*, 2003).

Trees are grown in coffee plantations to give shade, without which the quality of coffee beans decreases dramatically. Farmers therefore cannot use all the trees in their plantations for their cooking-energy supply (although electricity is scarce, many communities have access to it). The *cuidadores de la madre tierra* encourage people to obtain firewood from trees that have fallen without human intervention. 'Wood-gathering, carried out principally by the women, occurs in land left fallow where young trees are growing, as well as in the forest itself' (Pérez-Grovas *et al.*, 2001). Agroforestry is a system that allows families to obtain both firewood and agricultural products, but firewood production is not the main business of coffee plantations in Chiapas, whether they are traditional agroforestry systems or shaded monocultures. Nevertheless, the potential to obtain firewood and timber from shade trees can enhance energy security, both directly and indirectly (by generating income through wood sales).

Honey production has a much more limited role in energy security. Beeswax is a sub-product of honey production that can be used for making candles and thus can enhance energy security. However, beekeeping in Chilón is limited to honey production by technological and knowledge constraints – beeswax products are not yet developed. The direct contribution of this subsector to energy security is therefore likely to be low.

Impacts of coffee on energy security: 4 – moderately likely to be positive
Impacts of honey on energy security: 2 – unlikely

Climate change mitigation and adaptation potential

Carbon emissions reduction schemes involving Tseltal communities in Chilón already exist. The Scolel Té project, which involved researchers from the University of Edinburgh and El Colegio de la Frontera Sur in Chiapas, received funding from the European Union and Mexican government to conduct an initial appraisal of the technical options for sequestering carbon in agroforestry systems (Tipper, 2002). Scolel Té – which means 'the tree that grows' in Tseltal – is a project to sequester carbon in restoration forests and improved agroforestry systems that enhance the livelihoods of rural communities in Mexico. The project is now affiliated with and certified by the Plan Vivo system. The reforestation and agroforestry systems implemented by the project are designed to capture more carbon than the baseline conditions of pastureland, scrubland, degraded forests and the traditional cropping of corn and beans (Rainforest Alliance, 2009). In this project, which is notable for its strong local participation, around 60 per cent of the carbon sale price goes to farmers, who use that income to cover the costs of establishing forestry and agroforestry activities and to meet livelihood needs (Locatelli *et al.*, 2010).

Coffee production is directly integrated with such carbon sequestration systems. Soto-Pinto *et al.* (2009) acknowledged the potential of organic coffee to reduce emissions from deforestation and forest degradation:

Coffee plantations with densely growing trees resembling the forest structure store high amounts of carbon in above ground biomass and soil. It has to be noted that among the three coffee systems [Inga-shade-organic, polyculture-shade-organic, polyculture-shade-non-organic] the latter [Inga] prototype is the most intensive system, in relation to inputs and labour applied. This supports the suggestion that coffee may be considered as an appropriate practice for reduction emissions by deforestation and degradation ...

Additionally, coffee production, as a perennial system, has a comparative advantage in carbon emissions reduction schemes compared with annual systems, given that carbon sequestration operates over a longer period (Soto-Pinto *et al*., 2009).

Challenges still need to be addressed in the coffee sector to strengthen resilience in the face of climate change. According to the UNDP's strategy for coffee producers in Chiapas to combat climate change, priority actions include: identifying vulnerability among different farms and developing and implementing adaptive measures in them; and diversifying commercial production as a survival strategy.

These priorities indicate, first, that not all stakeholders perceive climate change as a threat, since the vulnerability of farms still has to be identified; and, second, that reliance solely on coffee involves a sufficient amount of risk to encourage diversification in production. These might prove to be significant obstacles for climate change mitigation and adaptation potential, even though frameworks for the reduction of carbon emissions are well advanced in Chiapas.

The climate change mitigation and adaptation potential of honey production can be seen as the extent to which the relative small impacts of this subsector strengthen the viability of tree-growing in carbon emissions reduction schemes such as Scolel Té. Frameworks for achieving carbon emissions reductions through beekeeping have not yet been developed in Mexico.

Impacts of coffee on climate change mitigation and adaptation potential:
4 – Moderately likely to be positive
Impacts of honey on climate change mitigation and adaptation potential:
3 – No likely effect

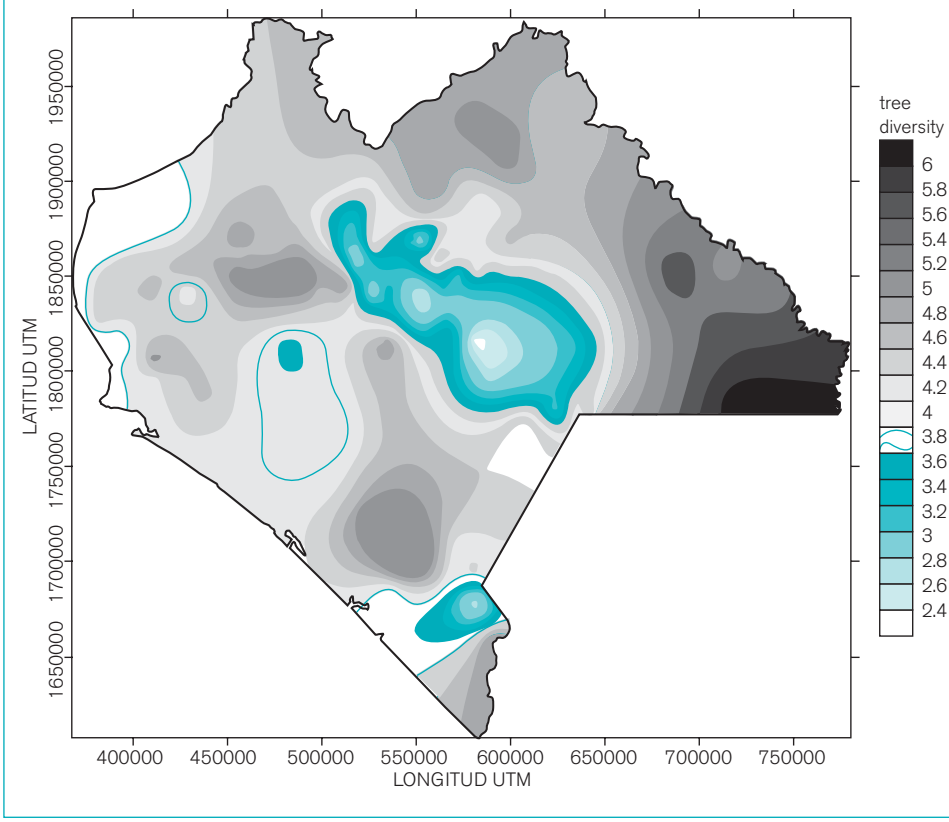
Biodiversity

In Mexico, coffee plots are found at the same altitude as cloud forests (Challenger, 1998). Cloud forests occupy less than one per cent of Mexico's total area but contain 10-12 per cent of its plant and animal species, making them one of country's most diverse ecosystems. Worldwide, cloud forests are greatly endangered. In Mexico, it is estimated that more than 50 per cent of cloud forests have been replaced by other land uses (Challenger, 1998; Manson *et al*., 2008).

Moguel and Toledo (1999) showed that traditional shaded coffee plantations are 'important repositories of biological richness' for various groups of species, as opposed to 'modern' types of plantations such as shaded and unshaded monocultures (Figure 29).

Traditional coffee systems partially displace original forests and thus can be considered humanised forest remnants (Moguel and Toledo, 1999), unlike monocultural plantations.

Figure 29. Spatial map of tree diversity in Chiapas showing high diversity in areas of traditional coffee production (highest diversity in black)



Source: González Espinosa *et al.*, 2009

Coffee plantations are important for bird species diversity because Mexico is the most significant winter destination of certain potentially endangered migrant species and most coffee-growing areas coincide with the habitat of such species (Moguel and Toledo, 1999). The high number of plant and animal species in traditional shaded coffee fields indicates that these agroforests can play a conservation role as protected anthropogenic habitats for species of the original forests (Moguel and Toledo, 1999).

Given the socio-economic conditions, the predominant coffee systems in Chilón are traditional shaded agroforestry and shaded monocultures. Traditional shaded agroforestry promotes biodiversity conservation to a greater extent than do shaded monocultures. Any positive impact that coffee plantations could have on cloud forests in Mexico would have global benefits.

Honey production can also be a positive factor in biodiversity conservation. Bees are the most effective pollination agents in the world (Financiera Rural, 2011), playing an important role in the reproduction of many plant species. 'If the bee disappeared off the surface of the globe then Man would only have four years of life left.' – Albert Einstein

Impacts of coffee on biodiversity: 5 – Highly likely to be positive
Impacts of honey on biodiversity: 5 – Highly likely to be positive

Soil fertility and nitrogen inputs

Grossman (2006) argued that most small-scale farmers in Chiapas have been encouraged to revert to chemical-free coffee production systems as a consequence of reductions in government loans for fertilisers and declining yields, soil quality and personal health. This, in turn, drove farmers to seek organic certification and pursue chemical-free soil management techniques to improve their crops. Farmers engage in many activities to strengthen ecological processes in their agroecosystems. They manage the leguminous Inga shade trees for both their potential to add nitrogen to the soil and the erosion control afforded by their large leaves. Other organic coffee management practices include weeding the coffee plots (two to three times annually), pruning the coffee trees (once annually, between February and May), and pruning the shade trees to regulate the light available to coffee (Grossman, 2006).

Grossman (2006) stressed the importance of understanding the processes behind these techniques as tools for making management decisions and hinted that farmers' knowledge of these processes is quite uneven. Even though farmers can identify processes in their coffee plots, their knowledge of such processes is limited by their lack of conceptual understanding and by the exclusively visual source of their experiences. Moreover, even though farmers expect *Inga* trees to fix nitrogen in the soil, few field experiments have assessed the impact of this service on improving coffee yields (Peeters *et al.*, 2003). As stated above, Peeters *et al.* (2003) reported no significant difference in coffee production between traditionally managed plots and Inga-shaded plantations.

The contribution of coffee production to natural forest management in Chilón is conditioned to a certain extent by the knowledge of soil processes possessed by organic farmers. Insofar as that understanding has conceptual gaps, the knowledge of non-organic farmers will remain even more limited. Knowledge of organic techniques needs to be promoted. Emphasis should be placed on the added value of organic coffee as an incentive for farmers to employ chemical-free coffee production systems.

Impacts of coffee on soil fertility and nitrogen inputs: 4 – Moderately likely to be positive
Impacts of honey on soil fertility and nitrogen inputs: 3 – No likely effect

6.4 Assessment of support priorities

An assessment has been made in this chapter of the impacts of various forest-related subsectors on poverty and climate in Chilón, Chiapas, against a range of criteria. The major subsectoral activities in this *muncipio* are coffee production and honey production, with complementary possibilities for timber and firewood production. Table 25 presents scores assigned by the author for these four subsectors against the criteria.

Table 25. Combined impact assessment of four forest enterprise subsectors in Chiapas, Mexico

Impact criterion	Subsector			
	Coffee production	Honey production	Timber	Firewood
Gender	3	4	2	5
Food security	4	5	4	4
Energy security	4	2	5	5
Climate change mitigation and adaptation	5	3	4	4
Biodiversity	5	5	5	5
Soil fertility without excessive nitrogen inputs	4	3	3	3
Total	**25**	**22**	**23**	**26**

Note: Impact criteria are described in the text.
Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Coffee production's overall score is somewhat higher than that of honey production, scoring higher against three criteria: energy security, climate change mitigation and adaptation potential, and impact on soil fertility. Coffee production's highest score, however, is in its impact on biodiversity. Coffee production's weakest impact is on gender, where it is likely to have no effect. Coffee production's overall contribution to more integrated, intensified and climate-smart land use is moderately positive.

Honey production scored higher than coffee production in two aspects – gender and food security and matched it in its impact on biodiversity. Honey production scored only 2 in energy security, the lowest score of the four subsectors.

Both these core subsectors would be enhanced if they could be integrated with the sustainable commercial production of timber and/or firewood. Firewood (from fallen trees and branches) and, to a lesser extent, sustainable timber production, can provide powerful incentives for maintaining tree cover, particularly in biodiverse agroforestry systems (where the quantities of saleable timber and firewood are highest).

The findings in Table 25 are subject to two important qualifications. First, the academic literature on honey production is still very limited, and arguments are derived mostly through either peer-to-peer discussions or the personal experience of the author. Inevitably, this adds a certain degree of subjectivity to the scoring. This does not mean that the scores for coffee production are entirely objective, but to a certain extent they are less subjective than those for honey production. Second, and most importantly, the body of literature around coffee production, society and environment in Chiapas is remarkable. The fact that local and international organisations have already produced carbon-sequestering frameworks for coffee-growing in indigenous communities indicates the extent of the advancement of these topics in the state. The flow of information can only be expected to grow as a consequence of involving more actors in the processes, and this is a clear advantage that coffee production enjoys vis-à-vis honey production.

Notwithstanding the positive impacts of coffee production, however, honey production and commercial timber and firewood production in Chilón should not be discarded or seen as sub-optimal solutions. National-level data show not only that Mexico has a favourable global commercial position but that Chiapas itself has enormous potential to develop unique value-added enterprises, especially in beekeeping. Perhaps this knowledge could shift the view among Tseltal *campesinos* of beekeeping from simply being an extra source of income to being the main source. Possibly their success in overcoming obstacles such as those posed by *coyotes* gives them the necessary tools to develop successful, independent business ventures and form horizontal clusters of know-how and mutual support.

Much in the way that farmers' understanding of soil processes in Chiapas is derived to a great extent from visual experiences, the understanding of Tseltal *campesinos* of global markets is based on what they can 'see'. Encouraging more integrated, intensified and climate-smart land uses requires the building of human capital and the promotion of an entrepreneurial mentality – which is lacking in many rural areas of the country. Interventions should promote entrepreneurial behaviour that enables *campesinos* to 'see' the full potential of their products to both increase their incomes and safeguard the environment.

Community forest nursery business, Tanzania.

7

Locally controlled forest enterprise subsectors in Tanzania: An assessment of their contribution to integrated, intensified and climate-smart land use

Simon Milledge

7.1 Introduction

Tanzania is the largest country in East Africa. It covers 945,000km^2 and is home to a rich cultural and biological diversity. The estimated total population of 42 million people is growing at 2.8 per cent per year and is 26 percent urbanised, with a rate of urbanisation of 4.2-5.4 per cent annually (President's Office, 2012).

A combination of geopolitical factors underlies Tanzania's strategic position regarding regional connectivity and trade, with potential to grow. As a member of two regional economic groupings (the East African Community – EAC, and the Southern Africa Development Community) and bordering eight countries and the Indian Ocean, Tanzania is well placed to engage in intra-African trade, as well as to act as a conduit for the continent's exports and imports. Tanzania has historically traded commodities from the African continent to the Middle and Far East, a role that has grown in recent decades, given the country's relative peace and social stability, and global shifts in wealth and trade. The ongoing advancement of the EAC towards duty-free trade will enhance enterprise opportunities.

The economy is highly dependent on agriculture, which generates 85 per cent of exports, employs 60 per cent of the labour force and accounts for 25 per cent of GDP (President's Office, 2012). Tanzanian agriculture is in a transition from a command production system to a market-based production system but remains dominated by small-scale subsistence farming (Kawa and Kaitira, 2007).

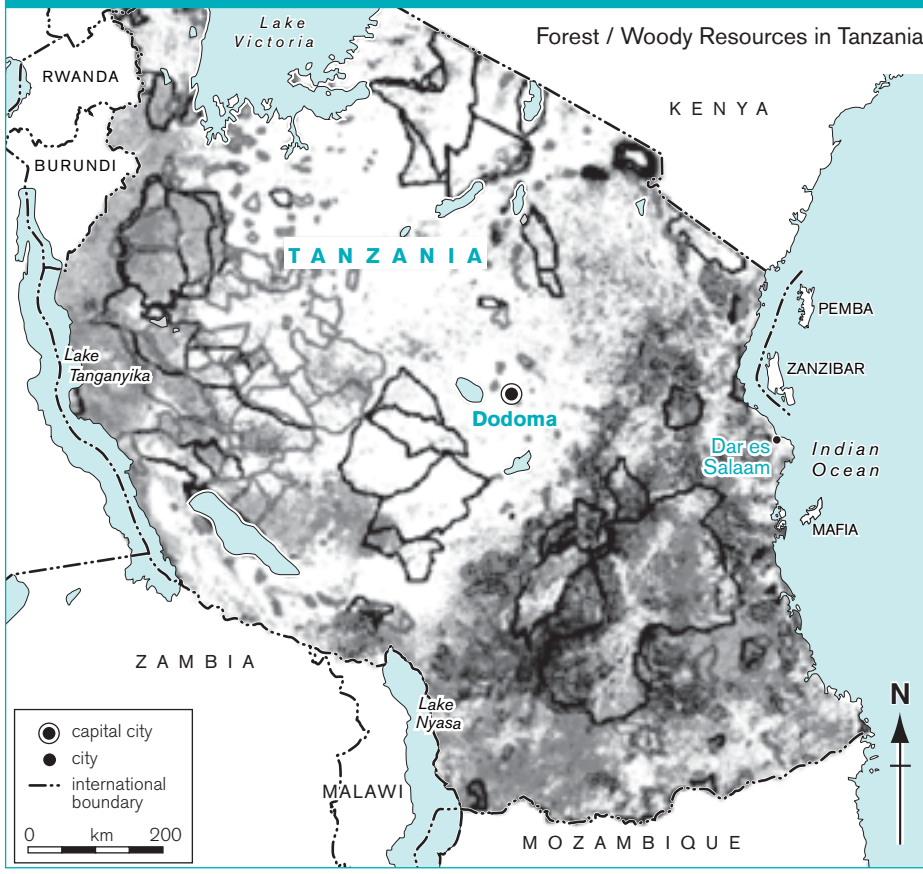
Tanzania had some promising indicators of macroeconomic performance in the period 2000-2010, including annual economic growth averaging seven per cent (Government of Tanzania, 2011). However, growth has not been broad-based and pro-poor (President's Office, 2012). Tanzania remains one of the world's poorest countries: it is listed by the Organisation for Economic Co-operation and Development (OECD) as a least-developed country and a heavily indebted poor country, and is ranked 151 out of 182 countries in UNDP's 2009 Human Development Index.

Forests and woodlands are predominantly miombo woodlands, acacia savannah, highland evergreen forests, and mangroves (Figure 30). Covering around 38 per cent of the land, forests and woodlands provide water catchment for over 80 per cent of Tanzania's water supplies and account for over 60 per cent of Tanzania's generated electricity through hydropower. Forests also

provide essential household products, including 90 per cent of the population's heating and cooking energy, as well as construction materials and a wide variety of NTFPs.

Population growth, urbanisation and integration into regional and global markets means the demand for food and other natural resources is set to continue, but production is based on a finite natural resource base. Signs of degradation are evident in forests, soils and water. Deforestation drivers include charcoal production, the expansion of agricultural land, uncontrolled fires and illegal logging (Indufor, 2011).

Figure 30. Tanzania's forest/woody resources



Source: WDPA, 2010

Approximately 13.5 million hectares of the country's total forest area of 33.4 million hectares are gazetted as national forests or local government forests, with the remaining on village or general land. The policy framework (including the 1995 National Land Policy, the 1998 National Forestry Policy, the 1999 Land Act, the 1999 Village Land Act, the 2002 Forest Act, the 2004 Forest Regulations and various tools for implementation) enables wide participation in managing and benefiting from forest resources, for both the private sector and communities, termed participatory forest management (PFM). PFM takes two forms: community-based

forest management, in which villagers take full ownership and management responsibility for forests within their jurisdiction; and joint forest management, a collaborative management approach between government and forest-adjacent communities. PFM is operating in more than 1,800 villages and covers over 3.6 million hectares of forest. The forest policy framework also enables the participation of the private sector.

Factors affecting the development of locally controlled enterprises engaged in tree-growing, bioenergy and primary and secondary wood processing include forest management plans, the reservation of new forest reserves, forest concessions, tree tenure, training, extension services, permits and licensing and partnership arrangements (Mgoo, 2005). Links between PFM and forest regeneration, biodiversity, forest growth and human well-being have been documented in Tanzania (Blomley *et al.*, 2008).

The geographic area selected for this case study was not based on any physical or natural stratification such as geology, pedology, topology, hydrology, land cover or climate; rather, it is an economic growth corridor known as the Southern Agricultural Growth Corridor of Tanzania (SAGCOT; Figure 31). The Tanzanian government has priorised SAGCOT for public and private investments in agricultural and infrastructural development; it was launched in 2010 and an investment blueprint was produced in 2011. The corridor was chosen due to its comparative advantage in climate, infrastructure and market connectivity. Theoretically, this market-based approach bodes well for enhancing economic growth and reducing poverty, albeit with an identified need to safeguard smaller-scale farmers and the natural environment (ERM, 2012) as well as to develop 'green' opportunities (Milder *et al.*, 2012). By focusing on an area that has been prioritised for investment, this case study can contribute to ensuring that enterprise development within SACGOT considers pro-poor forest-based opportunities.

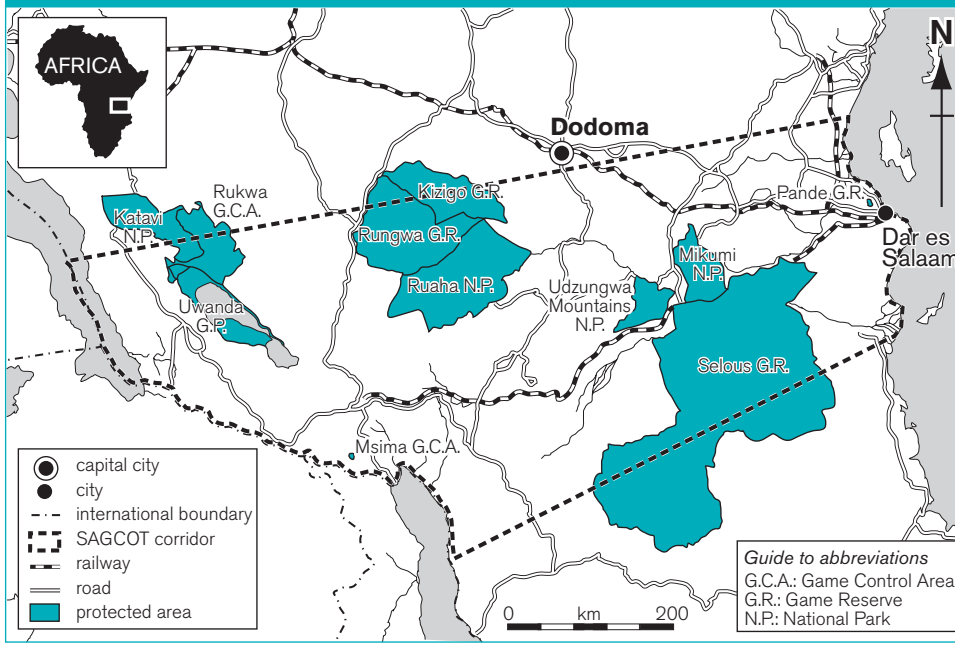
Given the overt focus on agriculture, SAGCOT relies on the productive use of natural resource assets (such as land, water, soil and forests), and it is recognised that a sustainable economic growth trajectory will partly depend on ensuring an integrated landscape approach. Covering around 300,000km^2, SAGCOT covers an area with substantial forest resources and growing market opportunities, and it illustrates issues at the agriculture–forest nexus relevant to all sizes of enterprise throughout sub-Saharan Africa. A central premise of the 'green growth vision' for SAGCOT is that critical natural resources are 'investable assets' that can be a focus of public, private and community investment (Milder *et al.*, 2012). By focusing on a landscape characterised by a mosaic of land uses involving agriculture and forest, this case study can also, therefore, contribute towards optimising contributions to sustainable natural resource management.

The following sections summarise the justification for selecting SAGCOT against various criteria, particularly forest cover and forest-related enterprise options; population density; food-security potential; energy-security potential; climate change mitigation; and biodiversity.

Forests

SAGCOT includes a mixture of highlands (1,000-2,000m) and lowlands (0-1,000m), with large tracts of forest and woodland mixed with croplands. From a national perspective, SAGCOT encompasses key highland water catchment forests and overlaps with some

Figure 31. Map of SAGCOT, including protected areas



Source: SAGCOT Centre Ltd

of the most intact miombo woodlands in the country. A relatively low proportion of forest lying in SAGCOT is unreserved. There are considerable opportunities for sustainable forest management under public, private and community management regimes, which are currently being realised by timber-related investments of varying sizes. SAGCOT has the country's highest expansion potential for fast-growing plantations and smallholder woodlots, and forest products are among targets for investment (Milder *et al.*, 2012).

SAGCOT is suitable for three agroforestry options: biomass transfer (medium-altitude plains and mountain blocks); multi-strata home gardens (high-gradient landscapes); and improved fallow/fertiliser trees (central plateau) (Kitalyi *et al.*, 2008).

Poverty/income-generation

SAGCOT does not rank particularly highly in its levels of poverty, partly as a result of the comparatively good standing of subsistence agriculture, social services and market links. However, specific areas of low income and absolute poverty do exist within the corridor. The investment blueprint places emphasis on ensuring the full engagement of smallholders so that planned agricultural investments improve their socio-economic status.

SAGCOT can be deemed to be of high importance for urban livelihoods given the existence of a chain of highly populated areas within a landscape characterised by high levels of forest carbon. Wards with high population densities stretch in a southwesterly direction from Dar es Salaam to the Zambian border, including the towns of Morogoro, Iringa and Mbeya.

Food security

As evidenced by the extent of political support for it, SAGCOT has been made a national priority for agricultural development to become a 'breadbasket' for food security at the national and regional levels. Rice, sugar and livestock are the initial priorities because of their development impact and attractiveness to investors. Parts of the corridor are priority areas for the production of honey and beeswax.

While SAGCOT does not currently have high levels of food insecurity or malnutrition, improving local food security should help contribute towards reducing the under-five mortality rate (FTF, 2011).

Energy security

Eighty per cent of Tanzania's total hydroelectricity capacity is generated in SAGCOT, including by the Kihansi, Mtera and Kidatu dams, with a number of other large hydro projects under consideration. Forests and woodlands play a central role in energy security by maintaining sufficient water flow for hydroelectric generation and by supplying households with firewood and charcoal, which constitute over 90 per cent of cooking energy in both rural and urban areas.

Climate change mitigation and adaptation potential

Central and western Tanzania are projected to experience the nation's highest increases in temperature as a result of climate change, as well as some changes in rainfall. Farmers in SAGCOT report that they are experiencing more seasonal and annual variability in rainfall, higher temperatures, and less overall climate predictability (Milder *et al.*, 2012). Climate change models suggest that temperatures will rise by 1-3 °C by 2050, leading to mixed impacts on agriculture, for example, declines in maize yields of 20-40 per cent and increases in coffee yields at higher altitudes.

The central plateau drylands (Dodoma, Singida, Tabora, Shinyanga, Kigoma and Mwanza), to the north of SAGCOT, are considered to be most vulnerable to climate change. SAGCOT is an area of national importance with respect to climate change mitigation potential because it has the country's largest carbon stocks, particularly in the Eastern Arc Mountains (Miles *et al.*, 2009). Accordingly, there is potential for the corridor to benefit from future finance streams linked to climate change mitigation, such as REDD+ (ECCM, 2007). Indeed, two REDD+ pilot projects are already underway in Kilosa District and Mbeya Region in SAGCOT.

Biodiversity

SAGCOT encompasses numerous centres of high animal and plant biodiversity and endemism, including large parts of the Eastern Arc Mountains, the southern highlands in the southwest of the corridor, and coastal forests in the east (Miles *et al.*, 2009). The Eastern Arc Mountains are globally recognised for their high plant, mammal, reptile, amphibian and bird species richness (Burgess *et al.*, 2006). To conserve and benefit from this biodiversity, Tanzania has set aside large parts of the areas as formally protected areas, including one World Heritage Site.

Soil fertility

Soil fertility is highly variable within SAGCOT, which supports a range of farming systems and is recognised nationally as having areas of high fertility. For example, there are highly fertile volcanic soils that support banana, coffee and horticulture, and fertile alluvial soils that support rice and sugarcane. The majority of the productive agricultural land is used for shifting cultivation (mostly maize and legumes) and the intensive cultivation of cotton and maize.

An attempt was made to draw up a comprehensive list of subsectors of forest enterprises within SAGCOT. Those that require, as part of their operations, more trees (on- or off-farm) to enhance biocapacity are:

- Construction-material enterprises, where on-farm or natural-forest trees are used for sawnwood, carpentry and thatching:
  1. construction timber produced from natural forests (hardwood), plantations (predominantly softwood), woodlots (as part of agroforestry) and sawmilling and related timber-processing enterprises.
- NTFPs, where on-farm or natural-forest trees are used for medicinal, cosmetic, craft or other purposes:
  2. beekeeping
  3. butterfly farming
- Tree-crop food enterprises, where tree fruits/leaves/stems, or nectar products such as honey, are used directly for food:
  4. indigenous fruit trees
  5. coffee
  6. cocoa
- Agroforestry food-product enterprises, where trees serve to improve soil fertility for conventional agricultural crops:
  7. fertiliser trees
- Biomass energy enterprises, where on-farm or natural-forest wood products are used for energy:
  8. firewood and charcoal produced in natural forests, managed woodlots and agroforestry systems, and briquettes made from agricultural waste.

7.2 Assessment of market prospects of shortlisted subsectors

Construction-material enterprises

1. Construction timber

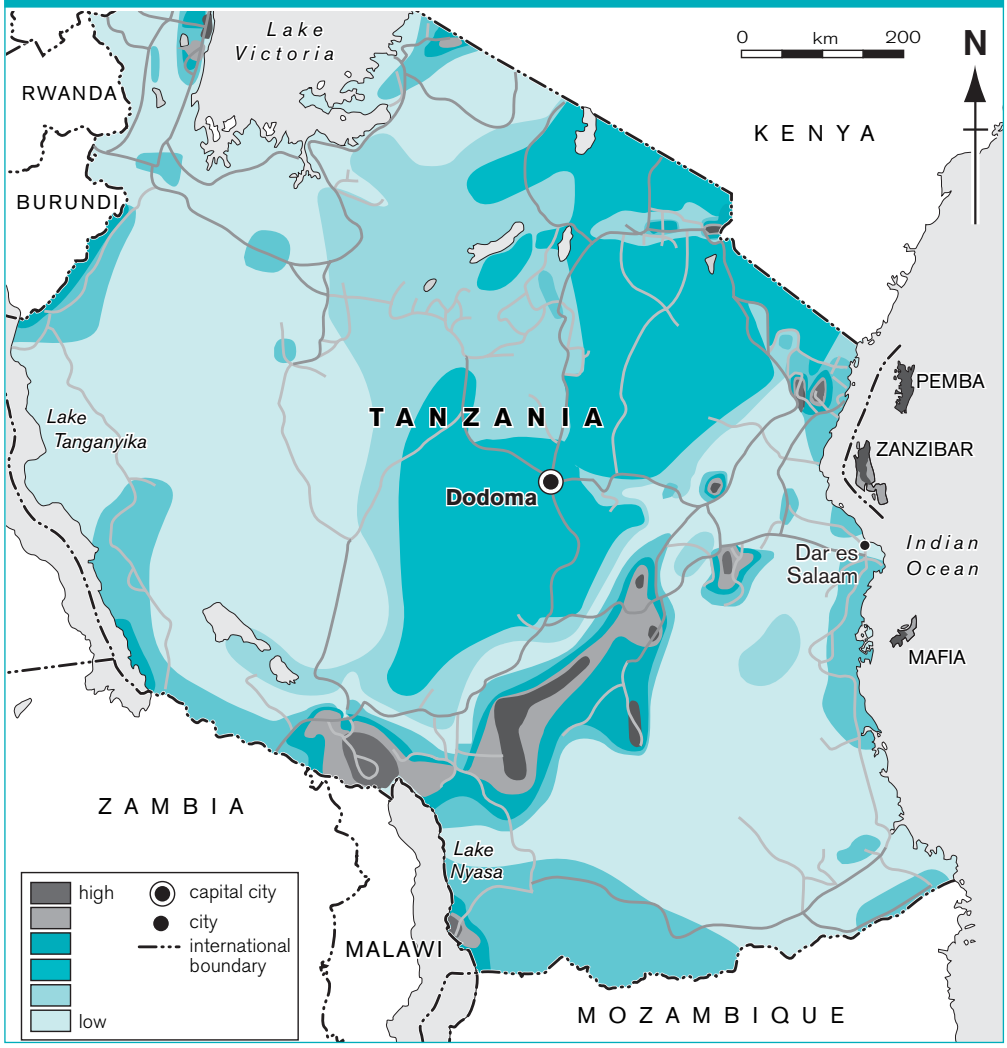
This section examines timber produced in natural forests (hardwood), plantations (predominantly softwood) and agroforestry systems, as well as sawmilling and related timber-processing enterprises. These four enterprise options are assessed separately for their integrated impacts.

Market trends. Roundwood in Tanzania is consumed predominantly by industries engaged in construction (62 per cent), pulp and paper (17 per cent), furniture and joinery (10 per cent), and packaging and utility poles manufacturing (11 per cent) (Indufor, 2011). The construction and infrastructure industries are driving growth in demand, particularly for pine and eucalypt timber and poles, but the use of softwood for furniture is also growing where

the availability of hardwoods has declined. Tanzania is a source of valuable hardwoods, including timber from PFM areas certified under the Forest Stewardship Council.

Total demand for roundwood was estimated at 1.46 million m^3 in 2010, and it was forecast to reach 4.5 million m^3 roundwood equivalent by 2025 (Indufor, 2011). Growth in intraregional timber trade (such as exports to Burundi and Kenya) forms a key part of this forecast demand.

Figure 32. Map of Tanzania showing the expansion potential for fast-growing plantations and smallholder woodlots in the vicinity of present plantations



Source: Indufor Oy (2011)

On the production side, government plantations supply 80 per cent of the nation's roundwood, with the remainder coming from private-sector plantations, including industrial, communal and individual farmers (Indufor, 2011). This situation is projected to reverse by 2025, with private-sector production capacity increasing and production from government plantations declining as a result of overharvesting and a lack of replanting. Overall, however, a severe shortage of roundwood is predicted from 2016, with the supply shortage forecast to reach 2.7 million m^3 by 2025, equivalent to around 10,000 hectares of plantation area annually (Indufor, 2011).

Tanzania's main areas of plantation development to meet construction timber markets lie within SAGCOT, including around 90 per cent of government plantations and four of the five large-scale private industrial plantations covering nearly 40,000 hectares (Indufor, 2011). Small-scale woodlots and medium-sized plantations (owned by local farmers, communities, business people, districts, NGOs, schools, and so on) cover 50,000-100,000 hectares. The involvement of smaller-scale producers in the construction timber industry is made possible partly by the fact that local markets, within Tanzania and in neighbouring countries, demand neither high-quality products nor the implementation of certification standards that require higher levels of investment.

The sawmilling industry has grown markedly, with the number of registered mills increasing from around 140 in 1998 to 367 in 2005, accompanied by a corresponding rise in installed capacity from around 750,000m^2 in 2001 to 2.67 million m^2 in 2005 (Ngaga, 2011). Most sawmills are small-scale (with log input less than 5,000m^3 and employing five to eight people), and total production is less than 50 per cent of installed capacity. Linkages between larger government plantations and smaller industries are significant. For example, small and medium-sized sawmills consume two-thirds of the annual cut at Sao Hill, which itself accounted for 85 per cent of the total wood supply from government plantations in 2009 (Indufor, 2011). SAGCOT is also placed strategically in terms of other processing industries, including the nation's seven largest pole treatment plants in Iringa Region and a pulp and paper mill in Mufindi.

In summary, market trends favouring the expansion of this subsector by small and medium-sized private investors in SAGCOT include: (i) forecasted increase in overall demand, including demand for relatively low-quality products; (ii) ongoing growth in private-sector production; (iii) existing market chains and a significant presence of processing industries as intermediary buyers; and (iv) the presence of a log export ban that favours domestic processing industries.

Comparative advantage. Compared with nearby countries (Ethiopia, Kenya, Rwanda, South Sudan and Uganda), Tanzania has certain comparative advantages in terms of its forest resources (the largest forest area, at 88.7 million hectares), farm forests (the largest area, at 51 million ha) and number of large-scale industries (the second-highest number, at 138), but it has a relatively small area of plantations and low annual timber production (Chamshama, 2011). Given the projected growth in demand in all east and northeastern African markets to 2030, as well as wood deficits of varying magnitudes from 2015 onwards, Tanzania is in a competitive position as the projected leading supplier of wood in eastern and northeastern Africa by 2030 (Chamshama, 2011).

The construction timber subsector is also competitive as a result of relatively well-established supply chains, the organisation of sawmillers, and political support for the development of local timber enterprises. Within SAGCOT, the prioritised development of infrastructure will serve to increase the area's competitiveness for growing and selling construction timber.

Theoretically, the owners of private plantations should have a comparative advantage over government plantations when it comes to negotiating prices, but few individual woodlot owners receive good prices for their trees, resulting in reduced opportunities for profits and reinvestment (Indufor, 2011). Another reason for low prices for woodlot trees is that typically they are harvested at a young age and therefore the yields are low per unit area. On the other hand, industrial plantations have a comparative advantage when it comes to economies of scale, which helps ensure quality and establish strong market links.

Tanzanian timber has doubled in price since 2003, even though quality-control measures have not been fully integrated. Tanzanian producers and processing industries will need to both improve quality (for example, in propagation, silviculture, milling efficiency, grading and storage) and cut costs (such as those associated with transport, taxation and intermediaries) to remain competitive in key regional markets (Indufor, 2011).

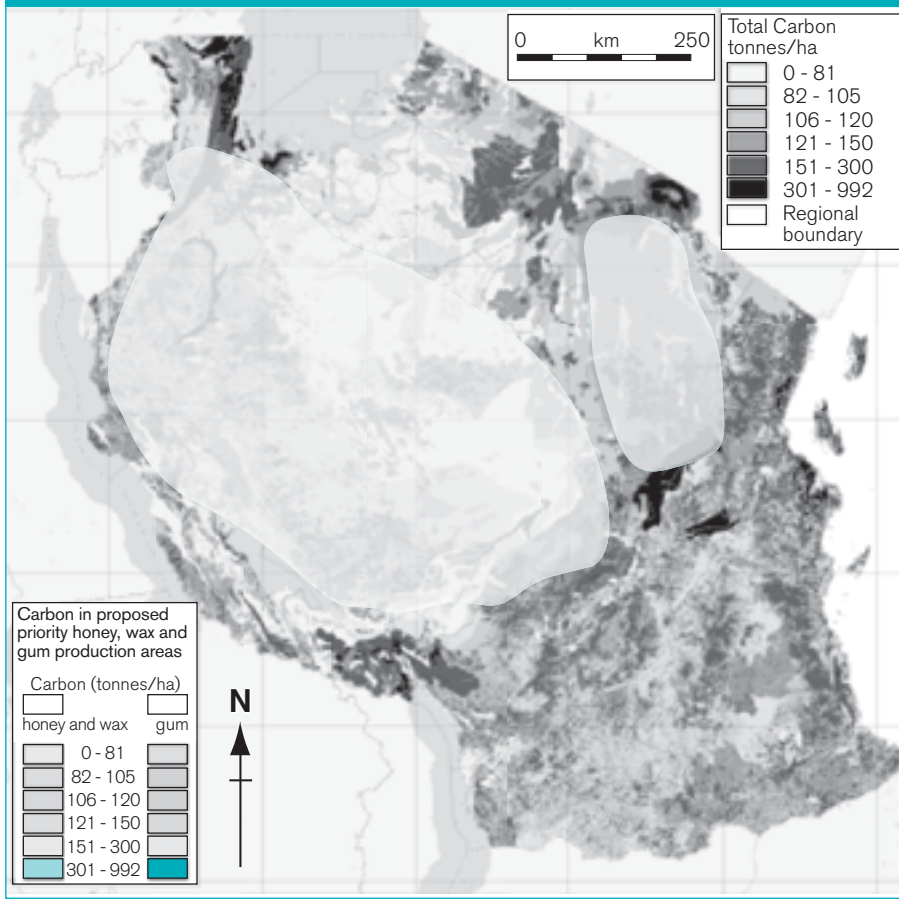
Enabling environment. The national forest policy is supportive of private-sector engagement and wood-based industries (Mgoo, 2005) and, since the establishment of the Tanzania Forest Fund, there has been greater allocation of grants for commercial, private and smallholder forestry. Trade barriers and bureaucracy are among factors affecting the marketing of and trade in construction timber. Others are weak transport infrastructure, poor-quality germplasm, limited extension services and a lack of export financing and appropriate trade policy. Within SAGCOT, timber-based enterprise models have helped drive the wider adoption of agroforestry technologies, and the presence of industrial plantations has catalysed the adoption of similar enterprises by smallholders – for example, the Sao Hill 'spill-over' effect into Njombe.

As evidenced from the general lack of high-quality products in local markets (Indufor, 2011), there appears to be little demand for high domestic quality. However, a lack of quality is reportedly a limiting factor in the development of international markets, thus indicating a need for greater quality control and value-adding processing.

Illegal logging poses a challenge in creating an enabling environment. In the case of natural forests, illegality has been facilitated by governance shortfalls (Milledge, Gelvas and Ahrends, 2007). In the case of plantations, it has been driven partly by perverse incentives caused by the fact that producer prices barely cover production costs (Indufor, 2011). An excessive number of small-scale sawmillers and limited raw materials reduce the attractiveness of this industry to new entrants. The changing trade policy framework in the EAC presents opportunities for gaining further access to regional markets but also brings uncertainty; for example, the possibility that Kenya will impose import tariffs when its logging ban is lifted.

Resilience to climate change. Natural forests have strong resilience to climate change, although some forest types may be more vulnerable than others. To a large extent, the resilience of plantations and woodlots to climate change depends on species selection.

Figure 33. Map of Tanzania showing honey production areas



Source: UNEP-WCMC 2006

NTFP enterprises

2. Beekeeping

Beekeeping enterprises are predominantly undertaken for honey production, although other products include food pollen, brood, medicine, and raw materials for various industrial purposes. Figure 33 shows Tanzania's honey production areas.

Market trends. Tanzania was a leading world exporter of beeswax in the 1960s and has the potential to produce 138,000 tonnes of honey (worth some US$138 million) and 9,200 tonnes of beeswax (worth US$36.8 million) annually (1998 National Beekeeping Policy). The industry today produces only 3.5-7 per cent of its potential. This is despite high global demand for honey and beeswax and a demand specifically for Tanzanian honey and beeswax that exceeds supply (Mwakatobe and Mlingwa, 2006).

Almost all honey in Tanzania is produced by traditional beekeeping methods (Mwakatobe, 2001) and is organic. Over 60 per cent of honey produced is sold locally for food, medicine

and other uses, including the production of traditional alcoholic beverages. Confectioneries and pharmaceutical industries consume a further ten per cent locally (Mapolu, 2005). Internal markets for honey and beeswax are not well established (Mapolu, 2005), although urban markets are rapidly expanding. Research undertaken in Mbeya Region indicates that finding a market for honey is not a problem because demand in urban areas exceeds supply.

Competitive advantage. Honey from Tanzania is a high-potential organic export product. It is ranked among the best-quality honey in the world, having passed the United Kingdom International Quality Test with a rating of 100 per cent for clarity, consistency, low yeast and moisture content (EPOPA, 2005). At the same time, however, the competitiveness of Tanzanian honey is limited by the low usage of modern beekeeping technologies and production methods, a lack of product differentiation and limited quality testing.

With international market prices rising, bee products can compete with the prices of other export crops (Mwakatobe and Mlingwa, 2006). Many rural communities are able to engage in beekeeping given its relatively low investment costs and good returns.

Tanzania has high potential to produce honey and beeswax given the large number of bee colonies and the large area of vegetation suitable for bees, both in forested (especially miombo woodland) and agricultural landscapes (Mwakatobe and Mlingwa, 2006). Moreover, beekeeping does not compete directly with other land uses such as forestry and agriculture (Engh, 2011).

Enabling environment. Beekeeping policies are highly supportive of this sector, although public–private partnerships are reportedly inadequately promoted. While Tanzanian honey (and beeswax) has proved highly competitive in terms of quality (such as from its organic status), access to international markets is hindered by the need to produce sufficient quantities of a high-quality product. Achieving quality in practice has been problematic for many years, largely as a result of insufficient hygiene during collection, processing and storage.

Resilience to climate change. Bees are susceptible to environmental change, although the potential impact of climate change on them remains speculative. Disruption of vital plant–pollinator relationships is potentially the most significant problem.

3. Butterfly farming

Butterfly farming has untapped market potential within SAGCOT given its demonstrated success as a viable venture in the East Usambara Mountains since 2003. Butterfly farming entails the capture of a small number of wild female butterflies (especially large, colourful and active species) to form the captive stock, with the occasional addition of wild males to maintain genetic diversity. Pupae (chrysalis) are collected and sold abroad, mostly for live exhibits in Europe and the United States, with a smaller collectors' market for preserved, dried specimens. Another potential, but as yet unexplored, niche market is the release market (using ubiquitous species) for celebratory events such as weddings.

Market trends. The business of butterfly exhibits is growing and the butterfly market has the potential to significantly expand production and sales, achieve financial self-sufficiency and reduce poverty in participating households (Scurrah-Ehrhart and Blomley, 2006). Sales in the East Usambara Mountains scheme increased more than four-fold between 2004 and 2008, with

the project becoming self-sustaining in 2006. Within SAGCOT, the establishment of a similar butterfly farming scheme to that found in the East Usambara Mountains is being planned in the Kilombero Valley, while the Nguru mountains are another area with high potential.

Direct financial returns to farmers are good, with farmers receiving around 70 per cent of the final sale price (each pupa selling for US$1-US$2.50). In the East Usambara Mountains scheme, average household income grew by 25 per cent with the advent of butterfly farming (see www.amanibutterflyproject.org). However, only a limited number of households in any given village can realistically be engaged in butterfly farming. One documented challenge is securing the engagement of particular segments of communities (Engh, 2011).

Competitive advantage. The global butterfly market for African butterflies remains unsaturated, and Tanzania has the potential to occupy a specific (and valuable) niche in the market given its high diversity of butterfly species. Competitiveness is enhanced by the fact that no other East African producers sell the same species (Scurrah-Ehrhart and Blomley, 2006). The seasonality of Tanzania's butterflies also appears to match seasonal demand in overseas markets, coinciding with butterfly exhibit seasons. This type of enterprise also carries considerable benefits in terms of the ease with which it can be set up in communities living near suitable forests because it requires relatively low levels of capital and land, and can provide favourable returns to farmers within one year.

Enabling environment. The policy environment in Tanzania is supportive of butterfly farming and the experience in the East Usambara Mountains provides the basis for a viable enterprise model. Butterfly pupae exports are subject to changes in export, transit, import and other transport restrictions, however. For example, transport restrictions introduced in 2007 forced a switch from courier services to the more expensive option of air cargo; the net result being lower competitiveness as a result of higher sale prices (Engh, 2011).

Resilience to climate change. Butterflies provide a useful indicator of biodiversity, being a significant predictor of the richness of bird, lichen and plant species (Chris, 2012). They are also known to lack resilience to the impacts of climate change.

Tree-crop food enterprises

4. Indigenous fruit trees

Market trends. Eighty-three indigenous tree species that bear edible fruits and nuts have been identified in the Tanzanian miombo woodland (Oduol, 2005). Most consumption is on a subsistence basis, and trade mostly involves relatively small quantities in local markets. Supply is generally seasonal and only a few enterprises have become truly commercialised. In a pilot study, the World Agroforestry Centre succeeded in achieving commercial production in western Tanzania for the following indigenous fruit species: *Parinari curatellifolia, Strychnos cocculoides, Vitex mombassae, Flacourtia indica, Sclerocarya birrea* and *Syzygium guineense* (Kitalyi *et al*., 2008). However, there is little evidence that such commercial production has continued since the pilot study was completed. Other popular indigenous fruits found within SAGCOT are *Adansonia digitata, Kigelia africana, Uapaca kirkiana, Strychnos cocculoides* and *Brassus ethyopia*.

Competitive advantage. Indigenous wild-harvested fruits have potential for marketing and up-scaling because they are usually preferred to domesticated fruits for their nutritious,

medicinal properties and cultural roles. Competition from domesticated fruits (both raw and processed) remains the main challenge, however. Growers of domesticated fruits benefit from having tried-and-tested propagation techniques, widely available germplasm, reliable quality, and the capacity to produce large quantities.

Enabling environment. The main challenge in creating an enabling environment appears to be the current lack of entrepreneurs to adopt ideas generated in research institutions – because considerable research has been undertaken to highlight the favourable dietary properties of many indigenous fruits.

Resilience to climate change. Indigenous fruit trees in the miombo woodlands are more tolerant of drought and resistant to disease than domesticated fruits, qualities that provide a degree of resilience to future climate change.

5. Coffee

Coffee is included as a forest-linked enterprise because of the importance of forest-based pollinators, which have been found to increase coffee yields by 20 per cent within one km of forest (Ricketts *et al*., 2004).

Market trends. Coffee is Tanzania's largest export crop, with exports accounting for around 20 per cent of Tanzania's foreign exchange earnings, contributing around US$112 million in 2007/2008 (USAID, 2010). The main growing areas for the valuable arabica variety, which comprises approximately 70 per cent of production, are the Mbeya, Iringa and Morogoro regions in SAGCOT (MMAL, 2012). The 2011-2016 Tanzanian Coffee Development Strategy aims to increase coffee production to 100,000 tonnes by 2020 by increasing productivity and expanding the plantation area (Haggar and Schepp, 2012).

The global coffee market is characterised by growing demand, but the price is volatile and in long-term relative decline (Parrish *et al*., 2005). With smallholders (farming an average of 0.5 hectares) responsible for over 90 per cent of the country's production, approximately half a million households engaged in coffee farming are vulnerable to the volatility of the world market (Parrish *et al*., 2005).

Competitive advantage. Tanzania is Africa's fourth-largest coffee producer and has the right environmental conditions to produce speciality arabica coffee that attracts premium prices in world markets. Coffee grown in the south of the country, within SAGCOT, has a comparative advantage over other growing areas, with the highest levels of productivity (937.8kg per hectare; USAID, 2010). Tanzania's coffee sector has witnessed a decline in both production and quality, however, particularly for arabica coffee, as well as in the proportion of the price that accrues to the producer (Mahdi, 2008). Beans of suboptimal quality are more likely to be sold in the highly volatile blended coffee market.

Enabling environment. Extensive reforms since 1994 resulted in private-sector engagement in marketing and processing, albeit with mixed results (USAID, 2010). Areas of the enabling environment requiring attention include husbandry, agronomic management, extension and farmer groups, taxation, access to credit and other inputs, modernised processing facilities and quality inspections. Fair trade and free trade interventions have

been found to be complementary in assisting smallholder farmers: Fairtrade certification has helped with demand-side market creation and TechnoServe business development has increased supply-side production efficiency (Parrish *et al*., 2005). Group dynamics and the underlying political economy of the coffee market are key variables affecting the success of interventions to improve coffee markets in Tanzania (Mahdi, 2008).

Resilience to climate change. Climate modelling indicates changes to rainfall patterns, with some intensification of the dry season in the unimodal southern highlands within SAGCOT and a slight decrease in total rainfall (Haggar and Schepp, 2012). Studies in Kenya and Uganda indicate that climate change would increase the minimum altitude for arabica production by up to 400m, which would have significant socio-economic and environmental impacts.

6. Cocoa

Market trends. Tanzania's cocoa production areas are all located within SAGCOT, mainly Mbeya Region (Kyela and Rungwe districts) and Morogoro Region (Kilombero District). Tanzania has a very small part of the global market share, by quantity, producing 7,000-10,000 tonnes of raw cocoa annually (MMAL, 2012). Production includes certified organic cocoa, demand for which is reportedly growing at 10-15 per cent annually. For example, Rainforest Alliance certification has been granted to 20,000 cocoa farmers in Kyela District within SAGCOT (Milder *et al*., 2012).

Competitive advantage. Although Tanzania is a small player in the world market, the unique flavour profile of its cocoa has been recognised, and limited lines of single-origin Tanzanian chocolate bars already exist (MMAL, 2012). Further competitive advantage comes from the fact that cocoa production presents opportunities for smallholder cocoa farmers who are relatively well organised in cooperatives.

Enabling environment. Despite favourable agronomic conditions, the high-potential cocoa production areas (such as Mbeya Region) do not realise their potential productivity and quality, due largely to poor agronomic practices during production and post-harvest handling (MMAL, 2012).

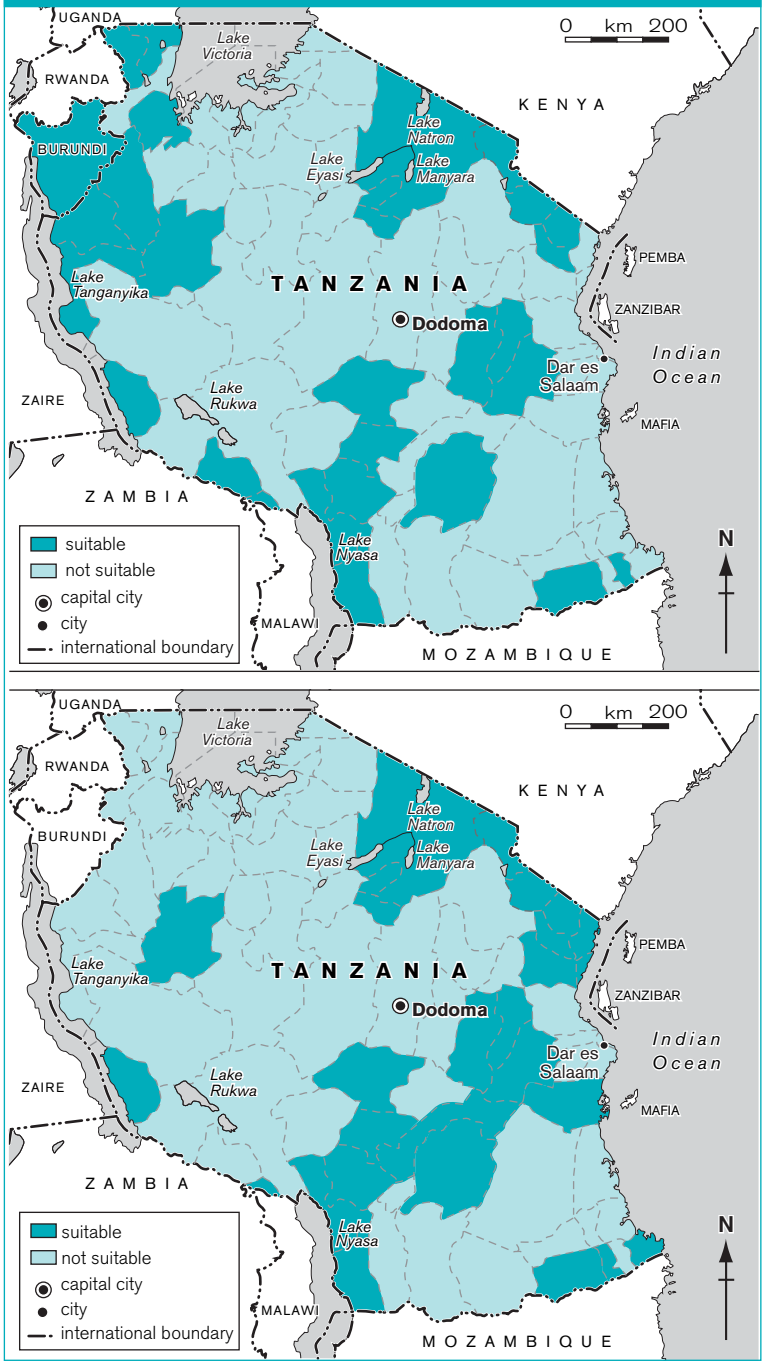
Resilience to climate change. The environmental preferences of cocoa mean that production is restricted to certain areas, making it vulnerable to climate change in SAGCOT, should such areas contract in size.

Agroforestry food-product enterprises

7. Fertiliser trees

Market trends. Four broad options for systems involving nitrogen-fixing fertiliser trees have been adopted in Tanzania: the sequential fallow rotation of nitrogen-fixing trees with cereal crops; fertiliser tree/cereal inter-cropping managed as coppiced fallow; annual relay fallow intercropping of shrubs with cereals; and biomass transfer (Kitalyi *et al*., 2008), Figure 34 shows the areas in Tanzania suitable for three of these options. Biomass transfer, which uses tree-litter mulching, differs from other agroforestry systems in that tree-crop competition is minimised; it is seemingly widespread in SAGCOT (Kitalyi *et al*., 2008). Among the most common species used in agroforestry systems for improving crop yields are *Faidherbia albida, Gliricidia sepium, Leucaena pallida species, Sesbania sesban, Tehprosia vogeli, Tephrosia candida, Acacia angustissima* and *Cajanun cajan* (Oduol, 2005).

Figure 34. Map of Tanzania showing suitability of agroforestry options



Source: World Agroforestry Centre, 2013

In reality, farmers rarely plant trees on their farms purely to improve soil fertility. Usually they do so for multiple purposes and functions that bring a mix of economic, soil and ecological benefits to the farmer. While the use of fertiliser trees is relatively widespread, there are very few examples of commercialisation and viable enterprises involving propagation, the sale of seeds or saplings, and related services. Most initiatives promoting fertiliser trees have been donor-supported and have been unsuccessful in creating sufficient demand from farmers to drive commercialisation. In contrast, enterprises focusing on ornamental and timber species have flourished.

Competitive advantage. The adoption of agroforestry technologies is attractive to smallholders because it does not require a major tradeoff in terms of food production. However, a possible reason why the uptake of agroforestry technologies is lower than hoped is that the break-even point for adoption (when revenue matches cost) is two to three years after establishment, thus requiring farmers to have sufficient working capital during this initial period. Mineral fertilisers are heavily promoted and therefore command a much higher market share than fertiliser trees, a trend that is likely to continue in SAGCOT, given the presence of multinational interests, such as the fertiliser manufacturer Yara International.

Enabling environment. There is a favourable policy environment for agroforestry in Tanzania, although limitations include a lack of management skills, insufficient institutional structure, a lack of private-sector involvement in providing access to high-quality agroforestry tree seeds (unlike in the provision of annual crop seeds), and a lack of capacity to implement agroforestry technologies (Kitalyi *et al*., 2008). A key impediment to creating viable enterprises for fertiliser trees is the high national expenditure on nitrogen mineral fertilisers, which acts as a perverse incentive for what is effectively a competing enterprise.

Soil nutrition is best managed using an integrated approach, not one that relies solely on fertiliser trees. In addition to fixing nitrogen, soil fertility requires an adequate physical soil structure for retaining nutrients and water. As well as the use of fertiliser trees, an integrated approach can include the use of fallow systems, mulching, biomass transfer, boundary planting and conservation agriculture practices. Thus, some practitioners argue that the management of soil fertility is more about optimal farming practices – behavioural and technical elements that can best be promoted through extension services – than the need for market-based enterprises.

8. Charcoal, firewood and agricultural waste briquettes

This section considers charcoal and firewood produced in natural forests, managed woodlots and as part of agroforestry systems, and briquettes made from agricultural waste. The integrated impacts of these three options (charcoal and firewood produced in natural forests, charcoal and firewood produced in woodlots, and agricultural waste briquettes) are assessed separately.

Market trends. Charcoal and firewood provide 92 per cent of Tanzania's total energy demand and are growth markets (Milder *et al*., 2012). Charcoal consumption is the dominant form of cooking energy used in urban areas. In Dar es Salaam, which accounts for approximately half the national consumption, the proportion of households using charcoal

climbed from 47 per cent in 2001 to 71 per cent in 2007. Absolute and relative demand is expected to continue to increase, driven by rapid population growth, continued urbanisation, and the relative price increases of fossil-fuel-based alternative energy sources. Woodfuel is the primary fuel used for drying tea and curing tobacco and in other key agriculture-related processing in SAGCOT (Milder *et al*., 2012). Sustainable bioenergy production for local use and domestic markets is seen as a real opportunity there (Milder *et al*., 2012).

Given the anticipated growth in agricultural investments within SAGCOT, the potential raw-material supply for briquettes made from agricultural residues is predicted to grow enormously.

Competitive advantage. Unlike some other countries in the region, such as Ethiopia, Rwanda and Sudan, Tanzania has few public/private commercial plantations (136 hectares only) for which the management objective is to produce woodfuel (Chamshama, 2011). However, it has 140,000 hectares of woodlots established as outgrowers and other woodlots. Further, Tanzania has by far the highest area of community-owned forest in east and northeastern Africa – 2,485,000 hectares (Chamshama, 2011). This availability of suitable land for the sustainable production of charcoal and firewood gives the country a comparative advantage over its neighbours. Indeed, SAGCOT includes large areas that are suitable for sustainable charcoal production and has reasonable transport links to the main urban markets, including Dar es Salaam.

Charcoal has a comparative advantage over other biomass energy options as a preferred cooking fuel, largely as a result of its perceived low cost, widespread availability and ease of use (Palmula and Beaudin, 2007). A significant challenge for sustainable charcoal production in both natural forests and woodlots, however, is the lower cost in the market of illegally harvested charcoal (which forms the bulk of the market), yet there is no product differentiation from the perspective of the average customer. Some form of subsidy or financial incentive may be necessary in the early stages of adoption to catalyse local-level investments in establishing planted woodlots for charcoal production.

The same market-related challenges face the sale of briquettes made from agricultural waste residues, although SAGCOT has a potential advantage in economies of scale, given the anticipated surge in agricultural activity.

Enabling environment. Weak governance and law enforcement characterise the charcoal trade throughout Tanzania, which is further undermined by the political economy and corruption at road checkpoints. Significant changes are needed to regularise and legalise the currently informal charcoal subsector (World Bank, 2009b). This would require a policy shift to treat charcoal trade as both a current reality and a sustainable business opportunity, as well as changes to the regulatory, fiscal and pricing frameworks. In particular, prices for sustainably produced charcoal need to reflect its true value by incorporating the costs of raw materials, labour, transport and taxes, accompanied by a stepping up of law enforcement against illegal charcoal (World Bank, 2009b).

Resilience to climate change. The bulk of charcoal is produced in miombo woodlands, which are not considered to be seriously threatened by climate change.

7.3 Assessment of integrated impacts of subsector options

Construction-material enterprises

1. Construction timber

Gender. While women are well represented in village-level PFM governance structures, such schemes offer few opportunities for generating income at the household level from construction timber. In the few instances where PFM schemes have developed to the stage of selling timber (such as in Kilwa and Kiteto districts), income is retained at the village level for investing in projects with community-wide benefits, for example, the construction of water wells or classrooms. In a similar way, community-managed woodlots and plantations tend to deliver benefits to the community rather than directly to households. Households derive more direct income-generating opportunities from private/household woodlots and plantations because they are more directly involved in their day-to-day management and in decisions on harvesting and sales. Opportunities for women remain somewhat limited, however, because timber-related businesses tend to be male-dominated. Women also play only a minor role in sawmilling and other wood-based processing enterprises.

Food security. While consumer prices for sawnwood can vary enormously, enterprises based on construction timber can generate substantial revenue in the medium to long term (taking into account the time and capital needed for investments in the management of natural forests, plantations and wood processing), and may therefore contribute indirectly to food security by diversifying and improving income generation. The practice of intercropping helps with short-term food security. Woodlots and trees on farms are becoming more integral parts of agroecosystems and therefore of the lives of many communities (Chamshama, 2011). Where agroforestry practices mix tree species grown for construction timber (and NTFPs) with agricultural crops (and livestock systems), such enterprises have both a direct (for example, enhanced productivity) and indirect (such as diversified income) impact on food security. One challenge is the tendency of smallholders to cut trees prematurely to meet short-term needs.

Energy security. Sustainable hardwood production from PFM areas provides incentives for conserving natural forests, which can then act as a source of woodfuel for household use in neighbouring communities. Plantations and woodlots can also provide a significant source of (mostly softwood) biomass as a by-product of thinning and pruning, which can be used either directly as fuel or converted to charcoal. The use of woodlots in agroforestry provides the most direct and tangible impact on energy security at the household level because households own the woodlots and because some species are selected specifically for their qualities as woodfuel. Sawmilling also produces residues that can be used in the production of biofuel briquettes.

Climate change mitigation and adaptation potential. The sustainable management of forests (both natural and planted) and woodlands contributes to climate change mitigation through the physical process of carbon sequestration, as well as by reducing the pressure that leads to unregulated harvesting. The scale of carbon sequestration depends on historical patterns of land cover but many construction timber enterprises make positive contributions. Natural forests in the highlands have a higher capacity than plantations for sequestering carbon, both above and below ground.

While natural forests have high resilience to environmental change, some provenances of timber plantation species also appear to be well adapted to future climate change scenarios. There is uncertainty on whether natural or exotic timber species have the greatest adaptation potential. Construction timber enterprises can increase the resilience of households to climatic (and economic) shocks because trees can be left standing as a form of capital that can act as buffers against, for example, crop failures. While construction timber, furniture and other wood products store carbon, such stored carbon is not currently part of carbon flux estimates and it is therefore inferred that such industries do not contribute significantly to climate change mitigation.

Biodiversity. Sustainable hardwood production in PFM areas makes the greatest contribution to biodiversity conservation since it involves the management of natural forests. Plantations and woodlots, particularly those based on monocultures, do not directly enhance biodiversity conservation but they can provide an alternative supply of timber, which may reduce the pressure on nearby natural forests (Chamshama, 2011). In addition, monocultural pine plantations have become invasive in parts of the southern highlands, which may have a negative impact on biodiversity. Sawmilling and other processing industries can only plausibly be considered to contribute to biodiversity conservation if they are certified by a relevant body, such as the Forest Stewardship Council.

Soil fertility and nitrogen inputs. Of the four options, sustainable hardwood production in PFM areas has the most positive impacts on soil fertility because it entails the management of natural forests. *Grevillia emetica*, a species commonly planted in woodlots at higher altitudes, is an effective nitrogen-fixer.

NTFP enterprises

2. Beekeeping

Gender. Beekeeping is generally male-dominated and contributes up to 30-50 per cent of household income in southern Tanzania (Ngaga *et al*., 2005). It increasingly provides income-generating opportunities for women, however, because it is reasonably compatible with women's lifestyles, as long as the hives are not located too far from the home. Beekeeping generates supplementary income and many women's groups oversee honey production, both in natural forests and on agricultural land. It is also promoted as a strategy to boost nutrition among women living with HIV/AIDS. Bee products have a wide range of medicinal uses, either alone or in combination with traditional medicines, that further promote well-being (Ngaga *et al*., 2005).

Food security. Bees play a vital role in crop pollination, with around one-third of all plants and plant products eaten by humans depending directly or indirectly on bees for their pollination (FAO, 2009). In addition, beekeeping produces honey and other products that are of high nutritional value and can be stored for use in times of need. It has been estimated that annual sales of honey and beeswax generate about US$1.7 million and that the subsector employs about two million rural people (Mwakatobe and Mlingwa, 2006). It can be assumed, therefore, that beekeeping also contributes indirectly to food security through diversified income generation – partly in the hands of women – for the purchase of staple foods.

Energy security. Beekeeping has no direct or indirect impact on energy security, although it does provide incentives for conserving forests that are household sources of fuel.

Climate change mitigation and adaptation potential. Beekeeping thrives in well-managed natural forests and may therefore contribute to climate change mitigation by increasing incentives to prevent deforestation and forest degradation. The scale of impact is limited, however, given the nature of the drivers of deforestation. The beekeeping subsector is not considered important for adapting or building resilience to climate change.

Biodiversity. Beekeeping plays a major role in pollination, which is important for biodiversity in forested landscapes – including natural forests and agroforestry regimes – and also for increasing crop production. Bees are susceptible to pollution and the overuse of chemical fertilisers, and they require the maintenance of natural ecosystems.

Soil fertility and nitrogen inputs. Beekeeping depends on the deployment of sustainable land-use practices, including the minimal use of chemical fertilisers, herbicides and pesticides, which also improve the prospects of long-term soil fertility.

3. Butterfly farming

Gender. With its flexible labour requirements and by enabling producers to work from home, butterfly farming is broadly compatible with daily household responsibilities and is therefore popular among women as an income-generating opportunity. For example, one study in the East Usambara Mountains found that the ratio of female-to-male participation was 55:45 (Scurrah-Ehrhart and Blomley, 2006).

Food security. In the East Usambara Mountains, a set-up in which 65 per cent of sales goes to farmers, has helped ensure that butterfly farming contributes directly to raising the incomes of member farmers (Scurrah-Ehrhart and Blomley, 2006). On average, the incomes of households engaging in butterfly farming increased by 25 per cent, and it can be assumed that the high level of involvement of women ensures that most of such income is spent buying staple foods. At the same time, only a limited number of households can engage in butterfly farming, with no more than 20 per cent of surveyed households in the East Usambara Mountains participating (Scurrah-Ehrhart and Blomley, 2006).

Energy security. Butterfly farming does not have a direct or indirect impact on energy security, although the subsector provides incentives for conserving forests that are a source of woodfuel for household use.

Climate change mitigation and adaptation potential. As a subsector that depends on good natural forest management, butterfly farming contributes to climate change mitigation by increasing incentives to protect forests. The scale of impact is limited, however, given the nature of the main drivers of deforestation. Butterflies are highly sensitive to environmental change and are likely to be vulnerable to climate change. This subsector, therefore, is considered important for adapting and building resilience to climate change.

Biodiversity. Butterfly farming is entirely dependent on the maintenance of natural ecosystems. Access to natural forest greatly reduces the capital costs of farming butterflies, enabling small-scale farmers to compete with wealthier farmers in other parts of the country and further afield. Access to this 'bank of biodiversity', especially in protected forest areas,

helps create a real link between livelihoods and conservation. Further, butterfly collection has minimal impact on the natural environment (Scurrah-Ehrhart and Blomley, 2006). Butterfly farmers perceive a link between earnings and forest conservation, thus increasing their participation in conservation (Morgan-Brown *et al*., 2010).

Soil fertility and nitrogen inputs. Butterfly farming does not require the use of nitrogen fertilisers. It is an enterprise that depends on good natural forest management, which is positive for long-term soil fertility.

Tree-crop food enterprises

4. Indigenous fruit trees

Gender. Indigenous fruits promoted in western Tanzania have been found to provide income-generating opportunities for women in the form of processing and enterprise development (Kitalyi *et al*., 2008; Oduol *et al*., 2006), such as the marketing of raw fruits, juices, jams, jelly and marmalade to national and international trade fairs and some local supermarkets. The World Agroforestry Centre succeeded in commercialising (in a pilot phase) the following indigenous fruits in western Tanzania: *Parinari curatellifolia, Strychnos cocculoides, Vitex mombassae, Flacourtia indica, Sclerocarya birrea* and *Syzygium guineense* (Kitalyi *et al*., 2008).

Food security. Indigenous fruits provide a direct source of supplementary nutrition and are a seasonal source of income for rural people. Fruit trees exist on many small farms within SAGCOT and provide a food-security 'safety net' of particular importance for women and children (Milder *et al*., 2012).

Energy security. Indigenous fruit enterprises do not provide significant quantities of wood residues and therefore have no direct impact on energy security.

Climate change mitigation and adaptation potential. Many fruit trees sequester considerable quantities of carbon and are more tolerant of drought and resistant to diseases than domesticated fruits, qualities that provide adaptation potential.

Biodiversity. There is little domestication of indigenous fruits, and more than 90 per cent of marketed fruit-tree products are harvested in wild stands (Akinnifesi *et al*., 2008). While this could change with improved propagation and smallholder management, most indigenous fruit enterprises are dependent on the maintenance of biodiversity and natural ecosystems.

Soil fertility and nitrogen inputs. The cultivation of indigenous fruit trees is likely to have a positive impact on soil fertility.

5. Coffee

Gender. Women constitute the bulk of the agricultural workforce, with an estimated two million people employed either directly or indirectly in the coffee industry in Tanzania (USAID, 2010). However, male-headed households frequently exhibit gender disparities in household expenditure decisions.

Food security. Coffee farmers derive an important share of their household income from coffee, which is inevitably used to ensure food security. The share of household income from coffee is projected to increase as a result of world market price rises, improved coffee productivity and quality, and better market links (USAID, 2010).

Energy security. The management of coffee plantations does not produce significant quantities of wood residues and therefore has no direct impact on energy security.

Climate change mitigation and adaptation potential. Coffee production and processing have only a minor effect on greenhouse gas emissions and are unlikely to assist households to adapt and build resilience to climate change.

Biodiversity. In higher-altitude areas in the past, forests have been converted to coffee plantations, although coffee production is no longer considered a serious threat to deforestation in Tanzania. There is some evidence that coffee production benefits from the existence of pollinators in nearby intact forests, suggesting that conservation investments in such landscapes can yield benefits for both biodiversity and agriculture (Ricketts *et al*., 2004).

6. Cocoa

Gender. Women constitute the bulk of the agricultural workforce and would therefore obtain direct income-generation opportunities from cocoa production, although such opportunities may be affected in male-headed households that exhibit gender disparities in household expenditure decisions.

Food security. Household income from cocoa farming would inevitably be used to indirectly ensure food security. Further, cocoa is often planted in a mixed system including other food crops.

Energy security. The management of cocoa plantations does not produce significant quantities of wood residues and therefore has no direct impact on energy security.

Climate change mitigation and adaptation potential. Cocoa production has a minor effect on greenhouse gas emissions reductions and is unlikely to assist households to adapt and build resilience to climate change.

Agroforestry food-product enterprises

7. Fertiliser trees

Gender. The use of fertiliser trees is entirely compatible with women's lifestyles and the creation of income-generating opportunities. Further, improvements to food security come as a result of producing higher-value and nutritious crops, which is beneficial to household diets and well-being. The use of improved fallows using *Sesbania sesban* has important implications for gender, given women's traditional roles in weeding and firewood collection (Nyadzi, 2004).

Food security. Fertiliser tree systems have a positive impact on food security, both directly by producing food for subsistence, and indirectly by increasing income by increasing the yield of cash crops. For example, improved fallow with *Tephrosia vogelii* and *Sesbania sesban* has been found to increase maize yield by 40 and 68 per cent, respectively (Gama *et al*., 2004). As another

example, *Tithonia diversifolia,* is grown in the highlands in the dry season and is used as a fertiliser in the lowlands during the production of diverse and high-value crops, such as ginger, garlic, cabbage and onions, including in the offseason when prices are higher (Kitalyi *et al*., 2008). This system increases overall production because two or three crops are possible per season.

Energy security. Fertiliser trees can provide up to ten tonnes of wood biomass per hectare per year (Nyadzi, 2004). It is reported, however, that in most cases these tree species are retained in order to fulfil their soil fertility function and not harvested to meet energy security needs.

Climate change mitigation and adaptation potential. Fertiliser trees can sequester 2.5-3.6 tonnes of carbon per hectare per year, thereby contributing to climate change mitigation (Nyadzi, 2004).

Biodiversity. Agroforestry offers robust options for improving productivity, achieving environmental sustainability and conserving on-farm biodiversity (Kitalyi *et al*., 2008). The use of fertiliser trees can have a positive impact on biodiversity conservation given the ecological benefits of nitrogen fixation. A significant positive impact of agroforestry on biodiversity conservation in nature reserves has been documented in Tanzania (Huang *et al*., 2002).

Soil fertility and nitrogen inputs. Research conducted in 2003-2005 in Tabora, western Tanzania, confirmed earlier findings that fallows using *Sesbania sesban* have the potential to improve soil fertility and maize production (Matata *et al*., 2011). The study also demonstrated that the application of *Sesbania* green manure after a two-year fallow can reduce infestation of the parasitic weed, *Striga*. Biomass transfer, which uses tree-litter mulching, is a technique to replenish soil nutrients, but it differs from other agroforestry systems in that tree-crop competition is minimised. The technique appears to be widespread in SAGCOT (Kitalyi *et al*., 2008). An example is the use of *Tithonia diversifolia*, described earlier, which is grown in the highlands in the dry season and used as a fertiliser in the lowlands in the production of diverse high-value crops.

Biomass energy enterprises

8. Charcoal, firewood and agricultural waste briquettes

Gender. In the current charcoal trade, both producers and retailers in urban centres (who are often women) receive a very small share of the final market price. The predominance of illegal harvesting further reduces the benefits received by forest-adjacent communities. A sustainable approach to charcoal production would seek to reverse this situation, although in reality this could only be achieved in the long term. Of the various biomass energy production options, charcoal produced in woodlots, and agricultural residue briquettes, arguably have the greatest potential for creating income-generating opportunities for women.

Food security. Tanzania's charcoal sector makes a substantial contribution to employment, rural livelihoods and the wider economy, estimated at US$650 million per year. Competition-related challenges notwithstanding, sustainable charcoal and briquette enterprises that capture even a small market share will boost the purchasing power of urban and rural households, including those of poorer families.

Energy security. Charcoal remains the single largest source of household energy in urban areas: it is cheap and easy to transport, distribute and store. At the same time, however, unregulated tree removal, which supplies the bulk of charcoal production, has negative impacts on water catchments, affecting water and (hydroelectric) energy supplies. The sustainable production of biomass energy (charcoal, firewood and agricultural waste briquettes) would have positive impacts on household energy security.

Climate change mitigation and adaptation potential. Charcoal production is one of the main drivers of deforestation and forest degradation in Tanzania and, therefore, current production dynamics are contributing towards substantial greenhouse emissions in the land-use sector. Improving efficiency in both the production and consumption of biomass-based fuels for domestic cooking could reduce greenhouse gas emissions in Tanzania by 13 million tonnes of CO_2 equivalent per year by 2030 (Anonymous, 2010). While any attempt to promote alternatives to the current unsustainable harvesting of trees for charcoal would help reduce emissions, there is no avoiding the fact that biomass energy production still produces far more emissions than other subsector options. At the same time, the charcoal trade is probably less affected than most agricultural practices by climate change scenarios and could therefore become a preferred income-generating activity in areas that are hard-hit by climatic variability and unpredictability.

Biodiversity. The bioenergy sector is a primary driver of deforestation and a competitor with agriculture for limited land, water and biomass resources (Milder *et al*., 2012). The charcoal trade in particular is perceived as a primary driver of deforestation (VPO, 2012). The bulk of tree-felling for charcoal production takes place in unreserved forest areas on village land, or on farmland being cleared for agriculture. As such, charcoal production has a significant negative impact on biodiversity. The production of charcoal on a sustainable basis in natural forests involves significant disturbance and is also likely to have an impact on biodiversity. Of the three bioenergy options canvassed here, charcoal production in planted woodlots, and agricultural residue briquettes, have the greatest potential to reduce negative impacts on biodiversity.

Soil fertility and nitrogen inputs. The production of charcoal and agricultural waste briquettes removes woody and vegetative material that would otherwise contribute to soil fertility. These subsectors, therefore, are likely to have a negative effect on soil fertility.

7.4 Assessment of support priorities

Tables 26 and 27 summarise the assessments of market prospects and integrated impacts for each potential subsector, with the main findings discussed below. In reviewing market prospects, the assessment focused on two important indicators of market trends: the nature of market growth, and accessibility to smallholders.

Regarding **market prospects**:

- Most subsectors selected for the assessment scored well for market growth because they had strong current or projected demand and could demonstrate profitability. Exceptions were nitrogen-fixing trees and indigenous fruit trees.

Table 26. Summary assessment of market prospects, by potential subsector					
Subsector	**Market trend**		**Competitive advantage**	**Enabling environment**	**Climate change resilience**
	Growth market	**Accessibility to smallholders**			
Construction timber enterprises					
Timber production in plantations	5	2	4	4	3
Timber production in woodlots	5	5	4	5	4
Timber production in natural forests	4	3	4	2	5
Sawmilling and timber enterprises	3	2	3	3	3
NTFP enterprises					
Beekeeping and honey production	4	4	4	3	3
Butterfly farming for export	3	5	4	4	2
Tree-crop enterprises					
Indigenous fruit trees	2	5	3	2	5
Coffee farming for export	5	5	4	3	2
Cocoa farming for export	4	5	4	3	2
Agroforestry food-product enterprises					
Nitrogen-fixing fertiliser trees	1	5	2	3	3
Biomass energy enterprises					
Charcoal and firewood production in natural forests	5	4	2	2	3
Charcoal and firewood production in woodlots	5	4	3	2	3
Briquettes from agricultural residues	5	5	3	2	3

Score: 5 = very positive prospects; 4 = positive prospects; 3 = medium prospects; 2 = low prospects; 1 = very low prospects.

- Several subsectors with indications of a growth market, such as timber production from plantations and sawmilling, are accessible to smallholders, although not exclusively. Several subsectors with low market growth prospects are among the most accessible to smallholders, including nitrogen-fixing trees, indigenous fruit trees and butterfly farming.
- Subsectors with the most favourable overall assessments of market prospects for smallholders are timber production from woodlots (and, to a slightly lesser extent, from natural forests), cocoa and coffee farming, beekeeping and butterfly farming.
- In general, the three options in the biomass energy subsector can be classified as having very favourable market trends, which are somewhat undermined by a lack of competitive advantage and enabling environment.
- Specific entrepreneurial opportunities appear to exist for butterfly farming and cocoa production, both for export markets.

Table 27. Summary assessment of predicted impacts, by potential subsector						
Subsector	**Social impacts**			**Environmental impacts**		
	Gender	**Food security**	**Energy security**	**Climate change**	**Biodiversity**	**Soil fertility**
Construction timber enterprises						
Timber production in plantations	4	5	4	4	3	3
Timber production in woodlots	4	5	5	4	3	3
Timber production in natural forests	3	4	4	5	4	4
Sawmilling and timber enterprises	3	4	4	3	3	3
NTFP enterprises						
Beekeeping and honey production	5	5	3	3	5	4
Butterfly farming for export	5	4	3	3	5	4
Tree-crop enterprises						
Indigenous fruit trees	5	5	3	4	5	4
Coffee farming for export	4	4	3	2	3	3
Cocoa farming for export	4	4	3	3	3	3
Agroforestry food-product enterprises						
Nitrogen-fixing fertiliser trees	5	5	3	4	4	5
Biomass energy enterprises						
Charcoal and firewood production in natural forests	2	4	5	2	1	1
Charcoal and firewood production in woodlots	3	4	5	2	2	1
Briquettes from agricultural residues	3	4	5	2	3	1

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Regarding **integrated impacts**:

- In terms of social impacts, timber production in plantations and woodlots scored highest.
- The biomass energy subsector scored highly for energy security, and the construction timber subsector also ranked relatively highly for this criterion.
- Indigenous fruit trees and fertiliser trees scored highly for food security and were matched by timber production in plantations and woodlots.
- The most positive environmental impacts were predicted for timber production in natural forests, nitrogen-fixing trees and indigenous fruit trees. At other end of spectrum, the biomass energy subsector was considered likely to have the most negative environmental impact.

- The subsectors with the highest overall integrated impacts were indigenous fruit trees and nitrogen-fixing trees; although these two subsectors scored poorly on market prospects because they lacked competitive advantage and a growth market.

Potential subsectors differ in relation to three important variables, each of which raises important considerations when determining a portfolio of subsector support:

- **Private (household) and communal (village) gain.** Most of the subsectors assessed in this chapter are viable at the household level, usually with a certain level of organisation to serve the collective needs of individual households. Therefore they tend to involve financial flows that go directly to households/families as income. Enterprises such as timber and charcoal production in natural forests, and in most cases beekeeping, are run at the village or community level (mostly through PFM arrangements), however, and most experience to date shows that financial benefits from successful enterprises tend to be used to address community-wide development needs. This is not universally true, with one sub-national REDD project piloting the transfer of carbon credit payments to the individual level via a village cooperative mechanism. One model is not necessarily better than the other, and indeed it may be preferable to promote both in tandem so that the shortcomings of each is balanced by the other, where possible linked through the efficient use of associations/third-party services.

- **Shorter-term and longer-term returns.** Several enterprise subsectors require an investment of time (and inputs) before realising income and, ultimately, a return on investment. This includes almost any enterprise in which the trees have to be planted, such as in construction timber plantations/woodlots and cocoa and coffee plantations. Such longer-term investments are needed to help subsectors reach economies of scale that can transform markets as well as the socio-economic status of producers. For most locally controlled enterprises, some shorter-term returns are needed to tide producers over until the longer-term investments mature. Some subsectors do indeed offer shorter-term returns, such as those involving beekeeping and the production of briquettes from agricultural waste. Agroforestry technologies such as intercropping with annual cash/food crops during the initial years also offer the potential for short-term cash flows.

- **Geographic locality.** While some of the potential subsectors could be applied in most parts of SAGCOT (such as woodlots, beekeeping and fertiliser trees), others have more refined needs that preclude certain areas. For example: timber production in natural forests can only take place where PFM arrangements exist; the production of agricultural residue briquettes is a viable enterprise only where there is a sufficient concentration of agricultural activity; and other subsectors, such as butterfly farming and cocoa production, may be limited to specific forests or hills because of their specialised environmental requirements.

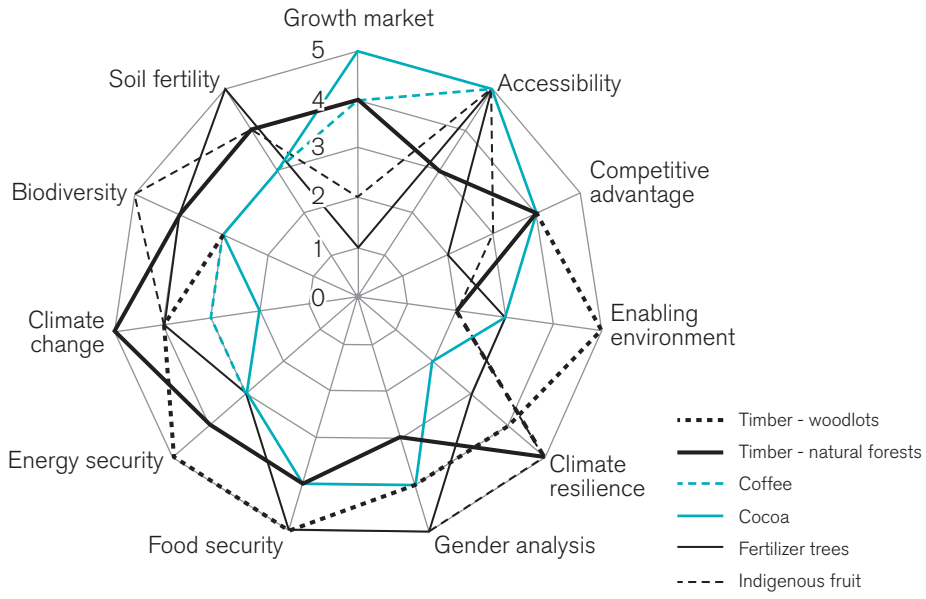
In light of these findings, it is recommended that a manageable portfolio of subsector support activities should focus on timber (and woodfuel) production in woodlots, augmented by the production of briquettes from agricultural waste. These two subsectors, particularly timber production in woodlots, are deemed to have both positive market prospects and mostly positive social and environmental impacts (in the case of timber production, especially if a combination of indigenous and exotic species is promoted).

As part of an integrated approach, however, it is recommended that support packages also promote fertiliser trees and indigenous fruit trees – both of which have very positive social and environmental impacts undermined by low market prospects. An integrated approach would encourage the adoption of wider agroforestry technologies to support forests, agriculture and livelihoods, make linkages with PFM, strengthen land tenure, and provide agricultural extension support that provides smallholders with options and understanding of tradeoffs through a supply-chain approach. Given their relatively poor market prospects, including fertiliser trees and indigenous fruit trees would not necessarily be to promote commercialisation but in recognition of the real need for them, because of their positive social and environmental impacts. There is a need to further develop market opportunities for fertiliser trees and indigenous fruits.

This portfolio of subsectors shares a range of characteristics. They:

- are adequately accessible to poorer smallholders;
- are feasible over the entire landscape, despite varying agroecological conditions;
- contain a mix of shorter- and longer-term returns;
- provide an integrated approach to help reduce risk;
- interface with agriculture, which is the main economic activity and political priority;
- provide opportunities for both private and communal financial gain;
- enable potential linkages with larger-scale commercial actors; and
- reflect global priorities relating to social and environmental impacts.

Figure 35. The complementary benefits of a Tanzanian portfolio of forest subsector support aimed at delivering positive benefits across multiple impact criteria



Vendor selling non-timber forest products in Cambodian market, Phnom Penh.

8

Assessing options for support to community NTFP enterprises in the eastern plains of Cambodia

Emmanuelle Andaya, Femy Pinto, Thibault Ledecq and Amalia Maling

8.1 Introduction

Cambodia has around ten million hectares of forest, which is approximately 57 per cent of the land area. Rather than assessing all potential forest subsectors, in this chapter we restrict our analysis to NTFP subsector options available to community groups. This decision was made in part because current policies and practices in Cambodia favour government, the military and concessionaires in the appropriation of timber rents and exclude people living in or near forests from obtaining access to these rents (Sunderlin, 2006). In addition, a national logging ban is in place, and the development of community timber enterprises is in a very early stage and is limited to managed forests with protected or conservation status, such as the Seima Protected Forest. Some pilot projects have commenced, but they fall outside the scope of this chapter.

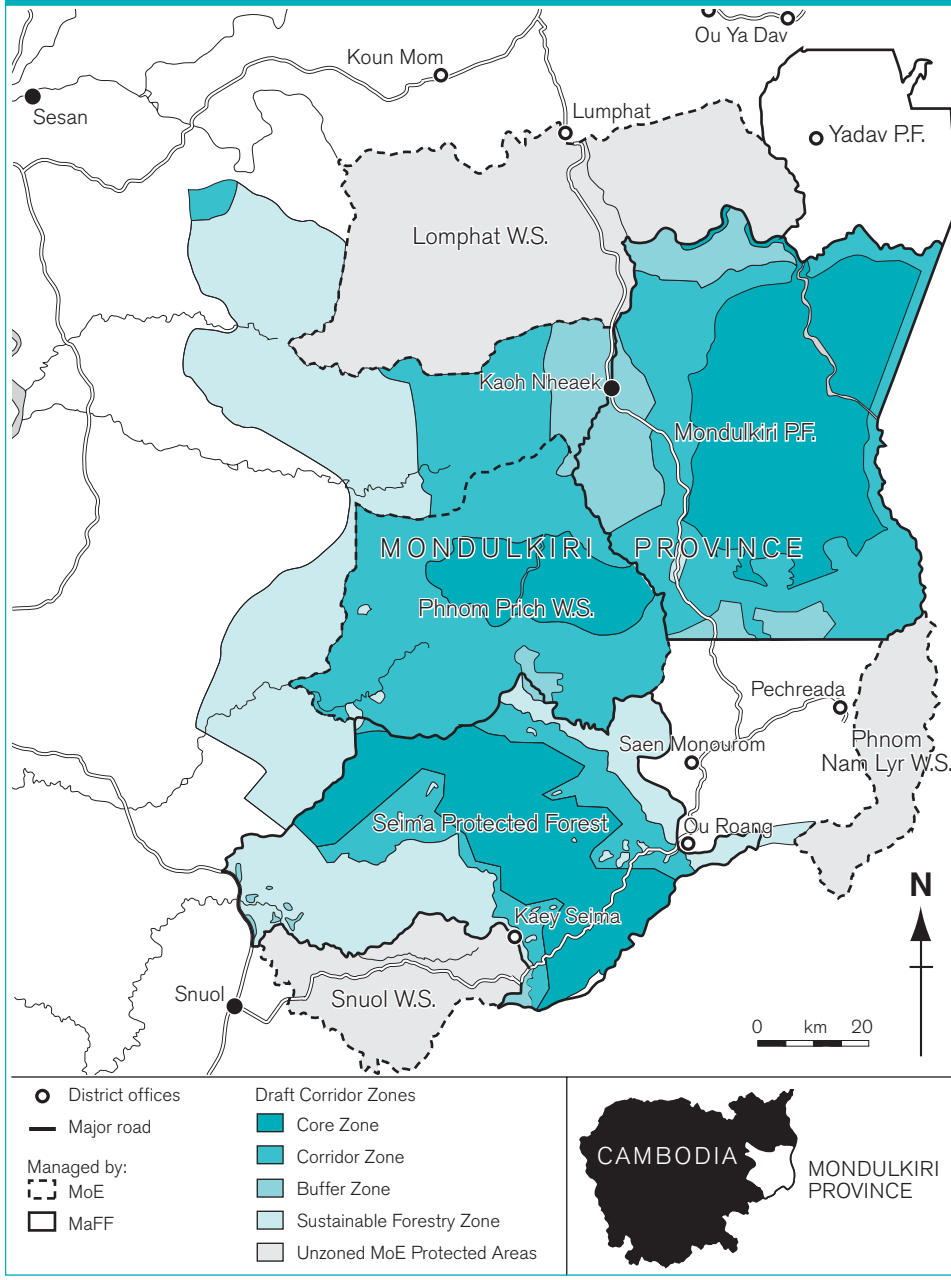
Cambodia has a population of over 15 million people, 80.5 per cent of whom live in rural areas. Most rural communities depend on agriculture and natural resources for their livelihoods. We selected the eastern part of Cambodia, called the eastern plains landscape (EPL), as the geographical focus of our study (see Figure 36) because it is:

- one of the most remarkable biodiversity hotspots in Southeast Asia, featuring a wide variety of flora and fauna (WWF, 2012); and
- one of the most lightly populated provinces in Cambodia, which offers a unique opportunity to conserve the region's biodiversity while also supporting livelihood development for its people.

The EPL is part of the lower Mekong dry forest ecoregion and comprises a mosaic of deciduous dipterocarp, mixed deciduous, semi-evergreen and evergreen forests. This chapter focuses on Mondulkiri province, which accounts for more than 70 per cent of the EPL; more than 65 per cent of the province's forests are designated either as protected areas or protected forests. The one million hectares of protected forest constitutes one of the largest intact tropical dry forest ecosystems in Southeast Asia and also serves as a major catchment basin for various tributaries that drain to the Mekong River system (Maling, 2007). The forests, and the NTFPs within them, have profound cultural significance for local communities. Some 65,000 people live in Mondulkiri province, at an average density of three persons per km^2, over 70 per cent of whom are indigenous. The Bunong, the majority (60 per cent) ethnic group, have their own language, culture and traditions. They live close to or in the forests, sustaining themselves through rotational agriculture (*chamkar*) and the harvest of natural products in the wild.

Population growth is very high in the region as a result of migration and a high fertility rate. The EPL is also considered to be one of the most vulnerable landscapes in the region to climate change (Yusuf and Francisco, 2009), with flooding and drought likely to have increasing impacts (UNDP, 2011).

Figure 36. The draft biodiversity corridor in Mondulkiri province, which forms more than 70 per cent of the EPL



Prevented by law from commercially exploiting timber, communities rely on NTFPs as an important traditional source of livelihoods in Mondulkiri province to complement their livelihoods, which are based mainly on rain-fed agriculture and/or fishing (Maling, 2007). Recently, there have also been ecotourism and REDD+ opportunities in the Seima Protected Forest. Deciduous dipterocarp forests, for example, provide oleoresin and solid resin, which the local communities tap for commercial use, and produce abundant floral resources for honeybees to forage and produce wild honey, which people collect for food, medicine and cash. Indigenous communities also collect food and medicines from shrubs and herbs in the understories of evergreen and semi-evergreen forests. NTFPs are used for either household consumption, for example, wild vegetables, fruits, construction timber and bamboo, woodfuel and grasses; or cash income, such as resin, honey, orchids, *sleng* seeds and wildlife (Maling, 2007). Within the NTFP sector, there are particularly good data on the resin and wild honey subsectors because their value chains and market links are the most established in Mondulkiri. Nevertheless, each of the following options offers potential business opportunities for local communities.

1. Oleoresin (liquid resin)

Tapped from *Dipterocarpus alatus* and *D. intricatus*, oleoresin is one of the most commercially important NTFPs collected in Cambodia and is used in varnishes, soaps, leather-making, sealing wax and perfumes (Maling, 2007; NTFP-EP, 2011a). Oleoresin is used locally for boat caulking and for lighting torches but is mostly traded to bordering countries (Vietnam, Laos) as a raw product. Around the EPL, resin-tapping is an important income source. In three villages bordering the Mondulkiri Protected Forest (MPF), 74-100 per cent of community members tap oleoresin trees for income. A traditional tenure system governs these resources; the first person to mark a resin tree is recognised by the community as the owner, which enables the sale and inheritance of the tree. The market value of oleoresin rose from US$7.50-US$10 per 23-kg container in 2007 to US$15-US$20 in 2012 (NTFP-EP, 2012 forthcoming).

The market for oleoresin has long been established through a chain of wholesalers, traders and exporters. Traders generally finance the collection trips of tappers on condition that the latter sells to the former. Tappers sell individually to traders, who transport the oleoresin to three main wholesalers/exporters in the provincial capital, Sen Monorom. The oleoresin is repacked into large sacks and transported to the Vietnamese border through Dak Dam (Mondulkiri) or Memot (Kampong Cham) and sold to wholesalers on the Vietnamese side of the border, who transport it to Ho Chi Minh City for processing and re-export (NTFP-EP, 2012 forthcoming). Land conversion, unsustainable tapping and illegal logging are the main threats to the resin subsector in the EPL.

2. Wild honey

Wild honey is collected in the southern parts of the EPL in the major evergreen and semi-evergreen forests. The practice requires specific skills, usually passed on by elders to the young, which limit this livelihood activity to a relatively few families. A 2012 study in the Krangties and Puchrey communes estimated that 20-30 per cent of the community collects wild honey (NTFP-EP, 2012 forthcoming). For these village-level

collectors, honey collection ranks as the second most important source of household income, after agriculture.

Traditionally collected for medicinal purposes and household use, wild honey is now collected for commercial sale, due to increases in demand and selling price (Maling, 2007; NTFP-EP, 2012 forthcoming). Less than ten per cent of the harvest is kept for personal consumption. The rest is sold to traders in the village, Sen Monorom or the provincial market. Traders include household-based small enterprises (less than 1,000 litres per year) and company traders (more than 1,000 litres per year). Company traders are based mainly in Phnom Penh. They repackage honey for further wholesale distribution and/or sell the honey at retail (CEDAC, 2012). Honey enterprise groups began to form in the EPL in 2007. The national-level Cambodian Federation for Bee Conservation and Community-based Honey Enterprises (CBHE) was established in 2010; it is a registered community business association and has 570 members. The CBHE has enabled collectors to sell directly to large retailers nationally and also directly to consumers and tourists at the local and provincial levels. The CBHE has played an important role in bridging the gap between community collectors and more distant markets.

The market value of wild honey grew from US$2-US$3.75 per kg in 2007 to US$5-US$8 per kg for community-level wholesale and to US$15 per kg for retail in 2012. In addition, beeswax is starting to be commercially traded through the CBHE as a by-product (NTFP-EP, 2012 forthcoming). Unsecured land tenure and access to forests/resources, deforestation, unsustainable harvesting, and sub-standard post-harvest processing practices are the main threats to the wild-honey subsector.

3. Solid resin (dry resin)

Falling from branches of *Shorea, Vatica* and *Hopea* trees, which thrive in deciduous forests, solid resin's market value was 1,500-2,234 riel per kg in 2008 according to a study commissioned by the Community Forestry Office in 2008-2010 in four villages (Pou Kroch, Pou Radet, Pou Loung and Pou Kreng) (Cengel and Sorn, 2010). The estimated collection volume was 6,000-40,000kg, with an estimated value of US$2,000-US$15,000 in 2008 (Cengel and Sorn, 2010). Where oleoresin tapping is the main activity, however, such as in the villages bordering the MPF, the market value for solid resin of 500 riel per kg in 2007 was lower than the market value of oleoresin, and therefore not people many participated in its collection (Evans *et al*., 2003; Maling, 2007).

According to a study by Cengel and Sorn (2010), collectors are generally not aware of the marketing chain. They mainly sell to local or regional traders/wholesalers, who in turn sell to end-users in Cambodia and Vietnam. There is market demand for dry resin, but poor-quality resin and the old age of trees are the main threats to supply. Trade in solid resin contributed an estimated US$130-US$240 to the annual income of harvesting households in villages surveyed by Cengel and Sorn (2010).

4. Strychnine seeds

Seeds of *Strychnos nux-vomica*, locally known as *sleng*, are mainly collected in the northern, flatter areas of the MPF and exported to Vietnam for use as medicine; other known markets are India, Sri Lanka and China. *Sleng* seeds are also used to make poison, tonicums and bitter flavouring for medicinal purposes, and they are used in muscle-relaxant drugs (Maling, 2007). The commercial collection of sleng seeds started in the MPF in 2004, initiated by non-community members with knowledge of the market demand. Meynell *et al.* (2012) reported that the estimated annual trade of *sleng* was 214 tonnes. High market demand for the seeds has turned it into a major source of cash income for villagers and outsiders who collect this NTFP. The price at the village level increased from 300-500 riel per kg in 2004 to 2,500-3,800 riel per kg in 2009. High demand has put great pressure on this NTFP because it has mostly been harvested unsustainably, whereby the trees are felled to collect the seeds (WWF, 2011). Market actors include collectors, immediate traders, traders and wholesalers/exporters.

5. Orchids

Orchids are high-value and high-demand products that are sold to local traders and wholesalers by collectors representing 12-30 per cent of households of the two villages surveyed (Cengel and Sorn, 2010). The volume traded by the two villages was estimated at 4,000-7,500kg in 2008, with a market value of 2,900-4,100 riel per kg.

6. Bamboo poles and shoots

Bamboo poles are gathered mainly for household use as building materials, utensils, farm equipment, and, in some cases, in cultural ceremonies. Despite new international markets for bamboo, the subsector is not yet developed in the region. In some villages, like O'Rona, bamboo, specifically *Reusei thngor*, is harvested in the Seima Protected Forest to make bamboo incense sticks. Only 9.7 per cent of surveyed bamboo-harvesting families cultivate bamboo on private farms. In the period 2002-2008, 184 hectares of bamboo forest were cleared for the manufacture of incense sticks (Mann, 2009). In O'Rona, bamboo provided at least 44 per cent of household income, an average annual income of US$880. Good roads and easy market access facilitates the livelihoods of the bamboo incense stick-makers. Conversion to agricultural lands and the unsustainable clearcutting of bamboo are the main challenges to the subsector.

Bamboo shoots are also collected in the region, mainly for household consumption. In one village of around 65 families, an estimated 1,710kg of bamboo shoots were collected in 2008, contributing more than US$8 of implied value to the annual income of each household in the village. But this NTFP can offer benefits beyond subsistence (Cengel and Sorn, 2010). As a commercial product, bamboo shoots are a high-value food that can be grown in parallel with culms used for handicraft production or construction materials. Bamboos shoots are one of the three most important product groups in the growing global bamboo industry. However, it is highly seasonal in its production and demand cycles, and there is high price volatility (Marsh and Smith, 2007).

7. Mushrooms

Mushrooms in the region are largely used for household consumption. Combined with rattan and bamboo shoots, mushrooms contribute US$3.50-US$6 to annual household income (Cengel and Sorn, 2010). Outside the province, specifically in Kampong Chnnang province, markets for mushrooms decreased in volume but increased in price, from 5,900 riel per kg in 2006 to around 9,900 riel per kg in 2008. In other provinces, the average price was estimated at 3,000 riel per kg in 2010 (Cengel and Sorn, 2010). Cengel and Sorn (2010) indicated that the mushroom value chain is characterised by the absence of middlemen, traders and wholesalers, which they attributed to the perishability of the product.

8. Other options

Mondulkiri is a biodiverse province that contains many medicinal plants that people use to treat diseases and ailments, although deforestation now threatens these natural resources (Laval *et al*., 2011). Nomad, a local NGO, showed that the Bunong people used a large diversity of plants in their everyday lives and identified 28 plant species collected for medicinal and food security, comprising bamboos, lianas, rattans, palms, ferns, gingers, tree leaves and roots. Other valuable NTFPs, such as false cardamom (*Alpinia nutans*), paper mulberry, malva nut (local name *samrong*) and *Scaphium macropodum beaum*, are also present in the province (Meynell *et al*., 2012). Wild vegetables and fruits are collected for household use and traded in low volumes in local markets.

8.2 Assessment of market prospects of shortlisted subsectors

Market trends

Regional and national market demand for various NTFP resources is steady, if not increasing. Market values are also increasing, as in the case of high-value, high-demand products such as resin (liquid and solid), wild honey, orchids, *sleng* seeds and bamboo shoots (Cengel and Sorn, 2010; Marsh and Smith, 2007; NTFP-EP 2012 forthcoming). Steady demand but declining supplies may be one of the reasons for this. Economic growth in the main traditional markets for these products, such as China and Vietnam, may also be driving the increase in demand and prices. The general trend in the global market towards natural and sustainable products, combined with new processing technologies, is also opening up new opportunities. For example, the bamboo industry is not yet developed on a large scale in Cambodia, but new opportunities are emerging. The market for sustainably and legally sourced products, although still a niche, is driving companies to look for direct contact with community suppliers, which encourages communities to harvest sustainably while increasing their benefits (NTFP-EP, 2012, forthcoming). Growing industries in Southeast Asia, such as tourism, may also open up new market segments and generate demand. Accessibility to processing and packaging technologies can allow community suppliers to reach new markets for perishable products that are usually only traded in local markets and are seasonally based.

Oleoresin value-chain studies in Cambodia conducted by the NTFP Exchange Programme for South and Southeast Asia (NTFP-EP) in 2009 estimated the annual resin market value (export and domestic) at US$4-7.6 million (Prom, 2009). According to the same

studies, the local boating and fishing industries absorb 20-30 per cent of the total annual national resin collection, estimated at 11,000-18,000 tonnes. The majority of the harvest is exported, primarily to Laos, Thailand and Vietnam, where it is processed and re-exported to countries such as France and Germany, where it is further re-exported or processed for different industries, such as the essential oil and perfume industries (NTFP-EP, 2011a). The world market for resin remains steady, but decreasing supplies worldwide are influencing prices and increasing pressure on community suppliers. A niche market for natural paints and varnishes in Europe, albeit small at the moment, is growing and is providing opportunities for communities that employ sustainable harvesting techniques. Technological developments that enable new uses for NTFPs and their components are also opening up new industries for resin. For example, biotechnology advancement and organic markets offer an opportunity for essential oils extracted from dipterocarp oleoresin to be used as a bio-pesticide (NTFP-EP, 2011a). Taking advantage of these niches, however, will require further research and product development support, as well as capacity building at the community and national levels.

Little information is available on markets for wild honey in Cambodia. The CBHE had an annual sales turnover of US$44,000 (including beeswax) in 2012 (NTFP-EP, 2012, forthcoming), but the estimated full value of Cambodia's wild-honey market of US$4 million 'farm-gate value' per year (Meang and McNaughton, 2009) is based on anecdotal and seasonal information. Collection is said to have decreased due to the conversion of lands by individuals and land concession companies, and the price is increasing due to limited supplies and increased demand (CEDAC, 2012). Price competition among traders and high demand have led to reports of adulteration, further driving the demand and price for pure and good-quality honey. Improved processing and packaging have also increased the price for some communities. Commercial users in Cambodia, such as restaurants, hotels, spas/massage centres and salons, constitute a growing market for Cambodian wild honey. According to a study by the Centre d'Etude et de Développement Agricole Cambodgien (CEDAC, 2012), the number of consumers of honey in urban areas will increase over the next ten years from 72 per cent to 86 per cent of the urban population and the average use of two litres per household per year will increase to 2.6 litres. There are also indications of increased demand in the international market for pure, wild honey. A partnership between the CBHE and ARUN, a Japanese social investment firm, is exploring the Japanese market for Cambodian wild honey. Honey is also one of the top ten products being promoted by Cambodia's Trade Promotions Office (Trade Promotions Department, 2013).

Bamboo is another strong growth market. The value of the global market is predicted to reach US$15 billion by 2017 (Marsh and Smith, 2007), opening up opportunities for new actors. The main product groups are handicrafts, processed bamboo shoots for food, and varied industrial materials, such as furniture, fashion accessories and even thread and garments. China is a leader in such industrial development but markets for sustainable, traceable sources may provide niches for smaller players too. Bamboo shoots are a high-demand food product, either fresh or preserved (steamed, deep-frozen or dried); the global export value rose from US$190 million in 2009 to over US$250 million in 2011. Bamboo shoots represent 18 per cent of the global bamboo market (Jonkhart, 2012); they are a source of many nutrients and active materials that are extracted for use in pharmaceutical

and food-processing industries in, for example, beverages, medicines, additives and health foods (Choudhury *et al*., 2012).

Orchids, medicinal plants and wild foods continue to be traded in traditional markets locally and across borders and with minimal processing. The growing economies of China and Vietnam – the traditional markets of such NTFPs – are driving demand for these products. Their value chains need to be studied further with a view to expanding markets through product processing, marketing and promotion (NTFP-EP, 2012 forthcoming). The growing ecotourism/nature-based industry in Cambodia and the region may also offer new opportunities for such products.

Competitive advantage

The main competitive advantage of local communities in Cambodia is their access to a variety of NTFP species for which there is high market demand. Local communities have traditional knowledge on the location of NTFPs and traditional rights to collect them. For some products, communities have traditional knowledge on uses and management that are not yet known to the market. In most cases, however, the market is dictating demand for the raw materials. As for the main currently traded NTFPs, such as resin, honey and bamboo, communities have access but lack awareness of the value-chain steps, end-market uses and demand, as well as of their rights and capacities for commercialisation. A lack of knowledge, technology and equipment to undertake value-adding activities is reducing financial benefits.

Knowledge of local markets for orchids, mushrooms, bamboo shoots and sleng seeds is providing some community collectors with immediate benefits, but an insufficient understanding of national, regional and international demand and market chains prevents them from making informed decisions on pricing and distribution. For orchids, for example, wholesalers are able to mark up products by 100 per cent (Cengel and Sorn, 2010). The cost of oleoresin is US$0.86 per kg at the community level, compared with the ex-works price of US$7 per kg (in Indonesia) (NTFP-EP, 2011a). A lack of skills in processing and packaging prevents bamboo-shoot collectors from selling beyond their local markets and taking a share in a multi-million-dollar world market.

The experience of a honey project in the area funded by the World Wide Fund for Nature (WWF) and the NTFP-EP showed, however, that the establishment of NTFP community enterprises with a strong sustainable management component, as well as network development, can provide communities with new competitive advantages for sustainable quality. The CBHE network of honey collectors is able to access a large source of guaranteed pure and sustainably harvested wild honey to consolidate supplies, meet market demand and increase benefits for members. Continued market research, combined with product development, equipment upgrades – such as the installation of a storage and dryer facility by the CBHE – and private partnerships are helping to increase the communities' competitive advantage beyond their traditional access to resources.

Local resin-tappers have been supported to form a resin association with the aim of reducing the monopoly of wholesalers and increasing returns. Information on market

prices has also helped resin collectors increase their negotiating power. However, limited collective marketing is preventing the group from reaching bigger markets and increasing their benefits by moving up the value chain.

On the other hand, O Rana village has found a market niche in incense stick-making through a combination of skills, proximity to bamboo resources and roads, and access to market, which give it a competitive advantage (Mann, 2009).

The enabling environment

Local communities may have traditional rights to access and harvest NTFPs but they face many hurdles to commercialisation – for example, they are required to secure permits and pay fees to trade in volume and to store, transport and sell beyond their community areas. Limited capitalisation and administrative and entrepreneurial capacities also prevent many communities from becoming major actors in the value chain.

The designation of certain forests as protected areas and the allocation of other forests as economic concessions has reduced local communities' access to forests resources and thus their livelihood options. There are legal frameworks that could enable communities to gain tenure and legal rights to the use and management of natural resources, such as the Community Forestry Programme, the Indigenous People's Policy, and the Communal Land Titling Policy (IOM, 2009). The application and approval processes, however, usually take two to three years or more (NTFP-EP, 2012 forthcoming). In the EPL, the high cost of Community Conservation Forest applications has prevented communities from going through the process if they do not have external assistance and funding. Illegal logging, land encroachment, the lack of approved management plans for protected areas and buffer zones, and weak law enforcement have led to significant forest destruction in the landscape and the reduced availability (and sustainability) of NTFP resources. The decrease in resin production (despite price increases) in Mondulkiri, for example, has been attributed to the expansion of economic land concessions that restrict the access of villagers to resin-tapping areas (NTFP-EP, 2012 forthcoming).

Commercialisation policies are also a key issue. The prevailing rules and procedures for the commercialisation of NTFPs are contained in the following key policy documents: articles 25 and 26 of the 2002 Forestry Law; articles 12 and 13 of the 2003 Sub-decree on Community Forestry; *Prakas* No. 132 (Guidelines) on Non-Timber Forest Products (2005); and the Administrative Circular No. 430 on Formal Fee Rate Determination for Non-Timber Forest Products.

Orchids, mushrooms, sleng seeds and other NTFPs are mostly traded in local markets or sold to traders who come to the village. This is considered to be 'customary use or traditional practice' and thus does not require a permit. When community collectors transport NTFPs outside the village, or conduct commercial activities outside the framework of the Community Forestry Programme, however, the community is required to secure permits and pay transportation and royalty fees. Formal processes to procure licences and commercialisation permits from the Forestry Administration continue to pose a barrier to small-scale resin traders at border gates (Evans *et al*., 2003; Prom, 2009). An

enterprise wanting to commercialise NTFPs beyond the community or village level would require the following permits (issued by various offices of the Ministry of Agriculture, Forestry and Fisheries), as listed in Article 25 of the 2002 Forestry Law:

- permit to set annual harvest quota;
- permit to harvest timber products and NTFPs;
- permit to set quota for transport;
- permit to transport timber products and NTFPs;
- permit for use of forest as defined in Article 28 of the law;
- *prakas* to establish an industrial forest centre, a sawmill or another facility to process timber or NTFPs;
- processing facility;
- permit to enter coupe for preparation;
- permit to establish a storage place to sell or distribute timber products and/or NTFPs;
- permit to establish all types of kilns that use timber products and/or NTFPs as raw material;
- export quota for timber products and/or NTFPs;
- export and import licence for timber products and/or NTFPs; and
- other types of permits that may be required according to provisions of the law.

Certain fee and permit waivers are available to facilitate the development of livelihoods among community members but they are contingent on the approval of the community forestry application. Community enterprises following official processes face price competition from other actors who evade official fees. The cost of official and unofficial fees/royalties, conbined with high transport costs, usually makes business unviable for community enterprise start-ups.

Support for NTFP subsector development is weak. There is still an institutional predisposition to treat NTFPs as traditional and subsistence resources rather than as a subsector that can contribute to economic development. There is limited knowledge of markets, no NTFP market access support, and inadequate awareness of technology for value adding. Trade is consequently focused on raw materials instead of semi-processed or finished products. NTFP support actions tend to occur on a product-by-product basis instead of as an overall approach to strengthening local entrepreneurial capacity. This focus on single products leads to booms and busts that undermine the overall potential of the subsector.

Despite these hurdles, NGOs, communities and relevant local and national institutions have started working together to clear the obstacles to commercialisation for communities. Local Forestry Administration offices are demonstrating support for community livelihood development-oriented initiatives. Some pilot projects are building capacity: WWF and the Forestry Administration successfully carried out a pilot project to lower rattan royalty fees and facilitate its exportation. The same project had a value-chain development approach that built capacity – in the community and among collectors, processors, exporters and the Forestry Administration Cantonment – and strengthened local markets. Communities and NGOs are also finding other ways to legalise their commercial activities. For example,

the CBHE worked towards establishing a legal entity by registering with the Ministry of Commerce; the CBHE is now recognised by legal institutions, facilitating market access. Partnerships with private companies are emerging to fill gaps in product development, market research and market access.

Resilience in the face of likely climate change

Mondulkiri province has become increasingly vulnerable to flood, drought, insect infestation and climate variation. Over 90 per cent of surveyed villages in the province were found to be at either medium or high risk of flooding (IOM, 2009). The mean annual temperature is expected to increase by 0.7-2.7 °C by 2060, and by 1.4-4.3 °C by 2090 (McSweeney *et al.*, 2008). The frequency of hot days and hot nights has increased by 13 per cent and 17 per cent, respectively, since the 1960s (FAO, 2009). Rising temperatures and changes in rainfall patterns will also alter forest fire regimes.

A recent study showed that NTFPs have varying resilience and vulnerability to climate change. Resin trees (*dipterocarps*) and orchids are highly vulnerable. Rattans and mushrooms (*Russula spp.*) are moderately vulnerable, and climbers such as bitter yam (*Dioscorea hispida*) have low vulnerability (Meynell *et al.*, 2012). Experience in other countries and among some CBHE members indicates that climate change will have impacts on the pollen and floral cycles of plants, which will affect honey production.

Despite these vulnerabilities, the development of NTFP resources is also expected to enhance climate change mitigation and adaptation. NTFP enterprises that involve complementary activities such as income diversification alongside carbon sequestration can increase resilience by reducing reliance on single cash crops. Engagement in community-based enterprises also provides opportunities for community savings that can be accessed in emergencies. This can be useful in coping with livelihood shocks, thereby contributing to livelihood resilience in communities.

8.3 Assessment of integrated impacts of subsector options

The following broad discussion of the impacts of NTFP options is not product-specific but it draws on examples, mainly of resin and honey. Where data are available, other NTFPs are also discussed.

Gender

Overall, NTFP enterprises are moderately likely to have a positive impact on income-generating opportunities for women if this aspect is consciously integrated into the design of enterprises.

NTFP collection is traditionally important for women, who have always been involved in the collection and marketing of products such as wild yams, mushrooms, orchids, fruits and other food products (Sloth *et al.*, 2005). In the case of honey, women traditionally participate in quality control, packaging, marketing and retailing in local markets and deal with traders and finances (Bradley and McNaughton, 2007).

The initial experience of the CBHE in establishing and managing an enterprise reflects the importance of consciously incorporating gender-equality objectives. In Mondulkiri, while women continue to participate in the processing of honey, especially for local markets, they have become marginalised. The CBHE is mostly run by men, who have tended to take over women's traditional roles in processing, marketing and finance and reduced the participation of women in decision-making on prices and the volume to be sold (Kusakabe *et al*., 2012). There remains a traditional view that honey and resin collection is too difficult for women, although there are instances where, in women-headed households, women have harvested resin and honey, accompanied by male family members for protection (Blomley *et al*., 2010). Moreover, the participation of women is highly suited to processing, packaging, the production of by-products, marketing, finance and administration. An initial social impact evaluation of the wild-honey business in Mondulkiri found that women felt there was weak recognition of their contributions at the village level (Kusakabe *et al*., 2012). On the other hand, the same evaluation noted a sense of improvement in income and self-confidence among women. Greater access to markets and improved prices have helped increase income, and involvement in meetings, training and community forestry and enterprise development have contributed to uplifting self-confidence (Kusakabe *et al*., 2012).

The production of handicrafts, for example, bamboo and rattan, and by-products from honey and beeswax, such as soap and balms; and the processing of bamboo shoots, mushrooms and by-products, should be explored to further provide employment opportunities for women. A conscious effort is needed to involve women, to strengthen their traditional roles in enterprises, and to provide new skills that will allow them to participate in other ways as new markets are reached. It is also important to include gender indicators in the monitoring of enterprise development and to ensure the participation of women in evaluations.

Food security

Agricultural practices in the EPL have traditionally produced low yields, and an increase in the incidence of pests, drought and extreme rainfall have contributed to an increase in crop failures. The collection of forest products, specifically NTFPs, either for consumption or cash, has traditionally – and increasingly – been filling this gap.

NTFPs provide food directly for household consumption. Mushrooms, bamboo/rattan shoots, wild vegetables and fruits are collected to be eaten. A 2012 survey of resin collectors in Mondulkiri indicated that at least 20 per cent of household food is derived from NTFP collection (NTFP-EP, 2012 forthcoming). The collection of mushrooms, bamboo shoots and rattan for household use contributes an estimated US$3.50-US$8 of implied market value to each household annually (Cengel and Sorn, 2010).

Indirectly, but significantly, income generated by the commercialisation of NTFPs helps meet the overall needs of the household, including for food. This income forms an important part of combined livelihood strategies that also involve income derived from other sources, such as agriculture, fishing and labour.

A 2012 study showed that 92 per cent of members of a honey association considered income from honey to be important, including for food security, with up to eight per cent

of members earning more than 40 per cent of their income from honey (Kusakabe *et al*., 2012). In addition to income earned from the sale of honey, each association member received a profit share of US$10-US$20 annually, depending on their participation in the enterprise and the volume of honey they sold to the association. The same study reported that income had improved for honey association members in Mondulkiri and there was a sense of improvement in social aspects among members. The benefits of association membership were also reaching the poorer members of the community, who were able to obtain better prices for their products (Kusakabe *et al*., 2012).

A 2012 study in two communes in Mondulkiri province, Krangties and Puchrey, found that around 80 per cent of people, the majority of whom were Bunong, were dependent on liquid resin for at least 50-80 per cent of their livelihoods, contributing US$400-US$1,000 annually (NTFP-EP, 2012 forthcoming). Table 28 shows the average contribution of NTFPs to annual household income in Mondulkiri.

Table 28. Income from NTFPs in Mondulkiri

NTFP	Amount contributed annually (US$)	Conditions/source
Oleoresin (liquid resin)	476-1,050	Household (average number of trees = 30-50/household) (NTFP-EP, 2012)
Wild honey	125-280	Household (surveyed households) (NTFP-EP, 2012)
Dry resin	115-240	Household (estimated distributed average) (Cengel and Sorn, 2010)
Combination of orchids/bamboo shoots/rattan/mushrooms	85-115	Household (estimated distributed average) (Cengel and Sorn, 2010)

Note that data for other products were unavailable.

In Mondulkiri, community-based enterprises for resin and honey production, in combination with other NTFPs collected for consumption, are moderately likely to contribute to increased food security. The contribution to food security could be strengthened by increases in the monetary benefits and through savings that would allow households to diversify livelihood activities and to reconstruct livelihoods after shocks. Market access and value-adding skills would enable communities to increase the monetary benefits derived from the NTFP sector.

Energy security

In rural areas in Mondulkiri, the main energy source is firewood, which is used mostly for cooking, while kerosene is used for lighting (Maling, 2007). The wood is collected from nearby forests or in community conservation forest areas. There are currently no restrictions on access to firewood but this could change in the near future as the population increases (through in-migration and natural increases). Innovation and new sources of low-cost energy are needed. For example, peelings and other waste from the use of NTFPs for food or its processing for commercialisation generates biomass that communities could use for energy, although they do not currently do so. Energy-security planning should be part of EPL management plans.

Resin is collected mainly for cash income in Mondulkiri, with very few households using it to fuel wick lamps (Maling, 2007). Lessons can be learned from other areas, where a very small part of the resin harvest (less than ten per cent) is retained for use in household lighting and as a fire-starter (Sloth *et al*., 2005). Some communities have developed this use into an entrepreneurial activity in which they manufacture torches for sale to neighbours and the local community. An increase in prices of petroleum products has created this demand (Prom, 2009). In some communities, therefore, resin collection has increased energy security in small households by providing an affordable energy source, as well as alternative entrepreneurial opportunities for resin collectors.

Indirectly, cash income generated through NTFP enterprises is also used to purchase kerosene, which is used by most people for lighting, as well as to buy diesel for generators and to pay for battery charging (Maling, 2007).

Overall, NTFP community-based enterprises (resin, honey, and so on) in the EPL are moderately likely to contribute to energy security.

Climate mitigation and adaption potential

Community-based natural resource management (focused on NTFP production) in the region assists farmers in coping with drought and other shocks by providing the option of harvesting NTFPs (Senyavong, 2010). This coping mechanism, made possible by NTFP commercialisation, serves as an initial, short-term means of climate change adaptation for communities that are experiencing low agricultural production, exacerbated by the impacts of changing climatic conditions. While NTFP commercialisation cannot fully replace the incomes and food supplied by agriculture and industrial crops, it can be one of the important pillars of livelihood strategies in the EPL because NTFPs and their source, forest ecosystems, are more resilient to climate change than are agricultural crops such as rice and rubber. Resin trees (*dipterocarp spp.*), bitter yams (*dioscorea hispida*) and rattan, for example, are more resistant to drought and flood (Meynell *et al*., 2012). The NTFP subsector also complements agricultural income and provides for livelihood diversity. The combination of the NTFP subsector and a multiple-livelihood approach, comprising enrichment planting and the sustainable management of various products with high resilience to climate change, can be a long-term strategy for climate change adaptation in communities. The adaptation capacity of the different NTFPs in the face of climate change needs to be further studied and incorporated in forest management plans, however. An initial study of some NTFPs in Mondulkiri in 2012 showed varied responses to climate change (Meynell *et al*., 2012).

The conservation of forest ecosystems is one strategy for forest climate change adaptation (Locatelli *et al*., 2010). NTFP resource management activities that can contribute to such adaptation include establishing firebreaks and identifying mother trees as good seed sources. The management of NTFP collection areas is being piloted in the EPL with the aim of improving regeneration and seedling growth rates for resin-producing plants and *Strychnos species*. The NTFP subsector approach, in contrast with monocultural plantations, allows for natural regeneration and contributes to conserving genetic diversity in natural forests. Enrichment planting and the domestication of climate

change-resilient NTFPs, both for sustainable forest management and as part of increasing biocapacity for the purposes of commercialisation and meeting local needs, may also contribute to forest climate change adaptation.

The increased economic returns of NTFP commercialisation provide incentives for local communities to conserve forests (that is, to avoid the conversion of forests to other land uses) and to apply sustainable forest management, including forest protection and monitoring and fire protection. Such actions by local communities contribute to climate change mitigation and complement other mitigation strategies, such as REDD+, in which sustainable forest management is an eligible activity. Established sustainable NTFP enterprises – specifically honey and resin – in Mondulkiri demonstrate strong and clear links with the conservation of biodiversity hotspots and forest ecosystems. These links are reflected in the application of sustainable harvesting methods and the allotment of ten per cent of the CBHE's profit to the Community Forestry Committee for forest patrolling. Patrolling is done to prevent logging, poaching and other unsustainable and illegal activities within the area of responsibility of the community. Such community participation can also be mobilised for climate change mitigation actions. As for climate change adaptation, the sustainable management of NTFP resources, sustainable harvesting methods, enrichment planting and the domestication of NTFPs contribute to climate change mitigation by facilitating resource regeneration and increasing forest and other vegetation cover.

The potential contributions of communities to mitigation and adaptation activities are hampered, however, by limited access to forest resources and markets. Mounting pressure on forests, particularly from agricultural conversion and mining, constitutes another challenge, even inside protected areas, particularly where there is a lack of management plans, enforcement capacity and economic arguments for their protection. The current rate of forest conversion is so high that there is a real risk of losing the entire forest estate, which would result in insufficient access to, and insufficient quantities of, natural resources to support forest-dependent communities. The integrity of the landscape and the continued existence of the biodiversity it supports could be undermined, and ecosystem services – watershed protection, disaster reduction and climate change resilience – could be destroyed, to the extent that the benefits to broader society are lost. As a result of current deforestation, various species, including more than 50 per cent of native medicinal plants and 14 per cent of the known flora of Mondulkiri province, which exhibit 'a significant level of endemism, relatively narrow ecological amplitude and/or are dense forest species' (Ashwell and Walston, 2008), could be under threat in the long term (IOM, 2009). The traditional knowledge and learning of older generations has to be taken into consideration when adaptation and mitigation measures are developed.

Overall, the NTFP subsector and its community enterprises in the EPL are moderately likely to contribute positively to climate change mitigation and adaptation and the reduction of greenhouse gas emissions. This assumes, however, that enterprises generate sufficient economic incentives to encourage forest conservation and that they comply with sustainable harvesting and management protocols.

Biodiversity

NTFPs and their sustainable management for biodiversity conservation constitute and support multi-faceted, complex ecosystems with cultural significance. The EPL – the largest (17,000km^2) complex of protected areas in Southeast Asia – is a critical habitat for tiger conservation and host to globally significant populations of Asian elephant (the largest in the ecoregion), wild cattle (particularly banteng and wild water buffalo), the Siamese crocodile and primates (including the likely largest global populations of yellow-cheeked crested gibbon, black-shanked douc and Indochinese silvered langur). The EPL also sustains the livelihoods of the country's poorest communities and is integral to keeping their rich culture alive; its forests include indigenous communities' sacred grounds and lands that are the foundation of their traditional way of life.

The sustainable commercialisation of NTFP resources provides a strategy to reduce pressure on threatened forest resources and wildlife while meeting the livelihood needs of the communities. However, training is required on sustainable harvesting methods for producers, resource management, including replenishment or regeneration plans, for example, the protection of resin-tree saplings and the partial collection of honeycombs, and forest patrolling. Ideally, such training should be incorporated in community-based enterprise plans to ensure positive impacts on the NTFP resources as well as on wildlife in the province. A heavy reliance on only one NTFP species for income may lead to over-extraction or unsustainable harvesting and cause negative impacts on the species. The use of bamboo (*Reusei thngor*) in O Rana for incense sticks, and clearcutting from clumps and harvesting without consideration of the three- to four-year regeneration, have resulted in the poor regeneration of the species (Mann, 2009). Lastly, limitations on market access and unrealised financial benefits may lessen the interest of communities in sustainable resource management practices (RECOFTC, 2012). If community-based entrepreneurs are to become important actors in biodiversity conservation, therefore, it is important that enabling conditions are in place, markets are accessible, and sustainable collection principles and protocols are adopted. In such circumstances, the NTFP subsector can maintain a level of biodiversity that keeps forests intact and supports the preservation of ecosystem functions – the regulatory, production, supporting and reservoir functions. The subsector will also have positive impacts on livelihoods, with its sustainability depending on the maintenance of the existing biodiverse ecosystem and its biocapacity.

Below are some examples of how NTFP-based livelihoods and traditional use are helping to maintain ecosystems and sustain the resource base:

- Resin collectors need healthy trees (*dipterocarp spp.*). A recent survey by WWF found at least 7,000 trees belonging to 225 families in their survey area. These trees can provide livelihoods over many decades using sustainable tapping methods (Baird, 2005), and families are bound to protect them and keep them intact. In so doing, they help maintain the forest ecosystem and keep the NTFP harvest stable. To grow the subsector, families need to multiply their resin sources, which requires that they protect saplings and carry out enrichment planting.
- A rich and diverse flora and a canopy of trees provide a conducive environment for the hives of honeybees. Large, tall trees, which are more frequent in unlogged, conserved forests, are the most suitable nesting sites for *Apis dorsata* bees to ensure protection

from predators. The loss of tall trees through logging or other activities would limit the density of *A. dorsata* nests in the wild and also reduce the survival of bee colonies. Thus, forest conservation and management at a landscape scale is critical for the sustainability of wild-honey enterprises (Sumin *et al.*, 2009).

- Traditional knowledge dictates that a forested area is maintained inside or at the edge of swidden fields to ensure that medicinal plants grow in the wild. It is not the villagers' practice to domesticate these types of plants. Also, some medicinal plants with specialised ecological requirements, such as lianas, are difficult to grow away from their natural forest habitats. Farmers therefore need to actively conserve some natural plants and forested areas to ensure the continued availability of medicinal plants.

NTFP community-based enterprises (resin, honey, and so on) in the EPL are moderately likely to contribute to biodiversity conservation because such enterprises contribute to maintaining forest ecosystems that host wildlife biodiversity. They also emphasise the application of NTFP harvest protocols and sustainable NTFP management practices in their operations, which complements biodiversity conservation in the EPL.

Impact scores

Each impact area was scored according to the following scale: highly likely, moderately likely, no likely effect or not applicable, unlikely or small adverse impacts, and strong adverse impacts. Table 29 shows that, overall, the NTFP subsectors were assessed as having a moderate effect in each of the impact areas (except soil fertility and nitrogen, which was not assessed).

8.4 Assessment of support priorities

The positive impacts of the NTFP subsector (resin, wild honey and others) are clear but dependent on conditions. The following support actions would help provide the necessary structures to enable the subsector to maximise its positive impacts in the EPL.

Adopt integrated landscape approaches and land-use and ecosystem services mapping
In the EPL, this action would support a better-adapted development strategy that addresses socio-economic, environmental and climate change needs and their incorporation in the provincial/landscape development plan.

A landscape encompasses a mosaic of land uses, including cultivated and wild lands, over a large geographic area that has been shaped and influenced by human interaction over time (Brown *et al.*, 2005). This multidimensional and dynamic definition of a landscape is the basis for the development of a sustainable and integrated approach, in order to manage and develop the multiple functions and ecosystem services of an area and to enhance biodiversity and biocapacities.

A landscape approach incorporates security of access to livelihood resources for communities and balances this access with the sustainable management of natural resources. Such an approach also cultivates human aspects and recognises and mobilises the valuable role and potential contributions of community members to forest management and climate

Table 29. Summary of NTFP impacts		
Impact area	**Impact**	**Basis**
Gender	Moderately positive (4)	Women have traditionally participated in the harvest and/or trade of NTFPs. The different functions in NTFP enterprises, as well as the different by-products that can be produced from NTFPs, offer opportunities for the employment of women.
Food security	Moderately positive (4)	Some NTFPs are used directly for food consumption. In addition, the commercialisation of NTFPs generates income that contributes to household income and therefore supports food security.
Energy security	Moderately positive (4)	NTFPs can be used directly for energy (biomass, resin). Indirectly, income from NTFP commercialisation allows the purchase of energy resources such as kerosene and gasoline and the re-charging of batteries.
Climate mitigation and adaption potential	Moderately positive (4)	The NTFP subsector contributes to keeping forest ecosystems and genetic diversity intact. It also adds to forest regeneration and revegetation through enrichment planting. The NTFP subsector is relatively resilient to current climate change impacts such as drought and floods, and it provides alternative livelihoods that can increase community resilience to climate change.
Biodiversity	Moderately positive (4)	A sustainable NTFP sector relieves pressure on threatened forest resources and wildlife, helping maintain the integrity of ecosystems and biodiversity habitats.
Soil fertility and nitrogen	Not assessed	

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

change mitigation and adaptation. The approach also supports the development of an integrated, diversified livelihood strategy (agriculture, NTFPs, ecotourism and so on). This integrated livelihood approach means that NTFP resource use and management should also be integrated into the provincial land-use map and socio-economic plan. Mapping and recognising NTFP resources can strengthen the arguments of local communities for greater community resource access, the allocation of community forests, the role of NTFPs in forest ecosystem-based adaptation, and the reduction of economic land concessions. Mapping NTFP resources in the landscape and increasing knowledge and understanding of the characteristics of those resources, for example, sustainable maximum yield, regeneration capacity, market demand and seasonality, and their contributions to the impact areas assessed in this study (gender, food security, and so on) can also be useful in planning a multi-NTFP enterprise. Multi-NTFP enterprises are recommended because they reduce dependence on a single product, distribute the pressure of use to several species, and broaden opportunities for income generation to several markets. Established enterprise systems and networks and existing human resources can be used to help commercialise

various products originating in the same geographic area. Therefore, the private sector – business, business development services and small and medium-sized forest enterprises (SMFEs) – should be strongly involved in such landscape development.

Build capacity for enterprise development with strong resource management and social components

Enterprises need to be financially viable and successful to meet the livelihood needs of a community. Clear links with forest conservation and management are also needed to support conservation goals. To achieve both, community members and support institutions need the capacity to establish and manage NTFP enterprises and have a strong understanding and commitment to sustainable forest management and social development. The following activities are recommended:

- Integrated support should be provided, comprising (1) enterprise development and management training; (2) market access facilitation; and (3) natural resource management training.
- Enabling conditions for commercialisation should be created for those enterprises practising sustainable resource management and contributing to social development.
- Actions in value-chain development should be balanced with resource monitoring and resource regeneration activities.
- Climate change adaptive enrichment planting and NTFP domestication should be incorporated in the resource management plans of community-based NTFP enterprises.
- To ensure social justice, mechanisms to ensure the inclusion of vulnerable members of the community and mechanisms that will have positive gender impacts should be consciously integrated into the goals and operations of enterprises.

Focus on broad NTFP subsector development (including markets, technologies and capabilities)

A strategy to promote and develop the NTFP subsector should be pursued. It would include the following activities:

- **NTFP market research and technology-based product development.** Understanding of the value chains and knowledge of demand in existing markets for the various NTFPs will help communities make informed decision on pricing, selling and distribution. Further research and development, including on new technologies for processing NTFPs and new applications and uses for them, should aim to find new market opportunities and develop higher-value products.
- **NTFP value adding and the advancement of community members in value chains by upgrading technology and equipment and building capacity.** Benefits above subsistence are derived through value adding and gaining access to markets beyond the community level. Value adding and accessing new markets can increase revenue without increasing harvesting volumes. The provision of training to community members in processing and value adding will increase economic benefits and provide employment to a larger number of community members. Support activities should also include upgrading production skills; product design; and increasing quality through training, market research and product development. Support should be given to technology research and equipment acquisitions that will increase productivity and competitiveness.

- **NTFP industry and trade promotion.** Domestic industries that process local NTFPs for both local and international markets should be developed. NTFP value chains should be strengthened based on research on markets, technologies and resource sustainability. Finally, market links should be facilitated. This means providing venues for promoting NTFP products, developing trade partnerships and, most importantly, minimising market barriers to new products, such as high taxes, long processes for obtaining commercialisation permits, and high transportation costs.

Conclusion

The EPL in Mondulkiri province is one of world's biodiversity hotspots and the home of diverse cultural communities. Its forests augment the livelihoods of some of the poorest people in the country, whose subsistence is mainly agriculture-based. These people are highly vulnerable to the impacts of climate change and are being affected by increased drought, floods and insect infestation. Deforestation, caused by illegal logging and economic land concessions, and poorly planned infrastructure development and agricultural development pose immediate threats to both the people and the biodiversity of the EPL.

NTFP subsectors piloted in the EPL, especially honey and resin, have resulted in increased income for local communities, supported food security, and demonstrated an important approach to community-based socio-economic development in the province. Support for NTFP subsectors in the EPL has enabled an increase in the benefits derived from the NTFP resource and engaged local communities in improving the management and protection of forest ecosystems. Competition from agri-business development (rubber and cassava plantations) is high. NTFP community enterprises are significant actors in rural socio-economic development but, to have bigger impacts, they must be better integrated into agricultural and, more generally, socio-economic development as well as land-use planning at the provincial and national levels.

Enabling conditions also need to be created to optimise the NTFP subsector's contribution to priority impact areas such as gender, food security, energy security, biodiversity and climate change mitigation and adaptation. Within this context, the next step in the EPL is to support: (1) landscape approaches and the mapping of land uses and ecosystem services to help secure community access to resources and sustainable resource management, integrate the NTFP subsector into the overall socio-economic planning of the province and the region, and enable the sustainable and efficient use of the natural resource capital and the better integration of human activities in their future development. (2) NTFP subsector development that increases and develops know-how in the value chains, production and markets of NTFPs. This will involve research, technology-based value adding, capacity building and market development. Finally, (3) community-based multi-NTFP enterprises anchored in sustainable resource management and social goals. These will provide benefits that meet the multiple needs of community members and create economic incentives for resource management and climate change mitigation and adaptation.

Artisanal fisherman next to rainforest, near Kisangani, DRC.

9

Critical evaluation of locally controlled forest enterprise subsectors likely to contribute to more integrated, intensive and climate-friendly land use in the Democratic Republic of the Congo

Tabin Lissendja, Samuêl Begaa and Alphonse Maindo

9.1 Introduction

The Democratic Republic of the Congo (DRC) has 154 million hectares of forest, which is the second-largest area of tropical forest globally after Brazil. Since the post-conflict reform agenda was launched in 2002, pressure on forestland for economic development has grown, both from external sources and from the 70 per cent of DRC's total population of 60 million people who live in rural areas.

Forests are the main source of subsistence for many rural people in DRC. It is estimated that locally controlled forest enterprises in many low- and middle-income countries account for 80-90 per cent of forestry activities in the forest sector (Macqueen, 2008). Locally controlled enterprises generate local wealth, secure community rights to resources, help create social capital through professional associations, encourage greater local environmental responsibility, help preserve cultural identity, and play an important role in poverty reduction. Yet in countries like DRC – and in Kisangani in the east of the country, the focus of this chapter – such SMFEs also face complex problems.

Kisangani was selected for the study because growing demand in the local market there has led to an upsurge in artisanal logging. When political activities returned to normal and functional road networks helped revive the local economy after the official end of the war, city-dwellers responded to the lack of state support by starting up numerous income-generating and self-help initiatives. Kisangani has been opened up by six main roads serving the agricultural areas of Bafwasende, Banalia, Lubutu, Ubundu, Isangi and Opala, making it easier to transport forest products into urban areas and encouraging artisanal operators and local communities to intensify production to satisfy the growing demands of the urban market. The race to build new houses with durable materials has direct implications for the forests in which timber, woodfuel and rattan are produced, increasing pressure on them from artisanal operators and local communities.

Kisangani is the main city in Eastern Province (Figure 37). It is made up of six administrative communes: Lubunga, Makiso, Tshopo, Kabondo, Mangobo and Kisangani. The city has 1,186,479 inhabitants, of which 600,998 (50.7 per cent) are men and 585,481 (49.3 per cent) are women, according to the Institut National des Statistiques. The city has an area of 1,910km² and is located in the eastern part of the central Congolese basin, at 0°31' latitude North and 25°11' longitude East, some 396m above sea level.

Figure 37. Map of DRC showing Kisangani, Eastern (Orientale) Province

Congolese legislation characterises SMFEs as economic initiatives that aim to make a profit through forest-related activities, employ 10-100 full-time staff, have an annual turnover between US$10,000 and US$30 million, or consume 3,000-20,000m³ of roundwood per year (Mayers, 2006).[4] For the purposes of this chapter, any activity undertaken by a natural or legal person in order to produce and market forest products and generate an income is regarded as an SMFE.

Articles 7 and 9 of the Forest Code stipulate that forests are the property of the state. The provisions of this law and its implementing measures regulate the private and public exploitation and use of forests by natural or legal persons. Natural or planted forests on land ordinarily granted under land legislation belong to the party to whom they are assigned. For example, trees located in a village or its immediate surroundings or in a collective or individual field are the collective property of the village or the person to whom the field belongs.[5] Article 112 of the Forestry Code specifies that, in addition to rights of

4. Ministerial Decree No. 020/CAB/MIN/FINANCES/2010 of 25 March 2010, modifying certain provisions of Ministerial Decree No. 015/CAB/MIN-FINANCES/2008 of 21 August 2008 regarding the implementing measure for Law No. 06/004 of 27 February 2006 on the tax regime applicable to small and medium-sized enterprises (income and turnover taxes).
5. Law No. 011/2002 of 29 August 2002 regarding the Forestry Code, articles 7, 8 and 9.

use, local communities have the right to exploit their forests themselves or through the intermediary of private artisanal operators working under a written agreement. Private artisanal operators may only operate in local community forests if they are authorised to do so by the governor of the province, as proposed by the local forest administration.

Artisanal operations in Congolese forests are also regulated by Decree 035 regarding forest use. Article 8 of this decree states that artisanal logging permits are issued to authorised natural persons operating pit saws or chainsaws. Permit-holders are only authorised to cut wood in one local community forest. Artisanal logging permits may not cover an area exceeding 50 hectares.[6] They are valid for a period of one year, running from 1 January to 31 December, and are issued by the governor of the province in which the forest is located, at the proposal of the provincial administration responsible for forests. Artisanal loggers must be Congolese nationals and may not hold more than two permits in the same year, meaning that they cannot work more than 100 hectares in a single year.

Various researchers have studied forest use by locally controlled enterprises, including timber and other products, in the Kisangani region to determine the activities involved, how such activities are carried out, and what effect they have on the environment and local communities. Tshimpanga (2011) looked at the woodfuel subsector and its implications for forest management in the region. Talinabopato (2011) studied the strategies used by brickmakers to reduce the distance between the points of production and end use, which has a significant effect on the price of baked bricks in Kisangani. Kahindo (2011) analysed the rattan supply chain from production to transport, marketing and consumption. Manirakiza *et al.* (2009) concentrated on the *fumbwa* (*Gnetum spp.*) supply chain in DRC, especially in Equateur and Eastern Province through to Kinshasa. Finally, a study by Benneker *et al.* (2012) centred on forest use and its consequences for all the actors concerned and the interaction between economic and political interests and forest governance policies.

This aim of this chapter is to determine the possible correlation between locally controlled forest enterprises and community development and environmental issues in the Kisangani region. Locally controlled forest enterprises there can be divided into several subsectors. Given constraints on time and space and our desire to produce an accurate and succinct analysis, we restrict our research to six subsectors: timber, oil palm, baked bricks, biomass energy, rubber, and NTFPs such as *fumbwa* and rattan.

Most of the timber produced by industrial logging in the Kisangani region is exported but almost all the timber consumed in the region comes from artisanal logging. It seemed logical to study this subsector, given the large number of operators in the chain, its structure and impacts on local livelihoods, the scale of local demand and the attention it receives in forest governance mechanisms.

Oil palm merited inclusion in the study because of the wide variety of products derived from this type of tree. Palm oil is the most widely consumed oil in the region, and palm

6. Decree No. 035/CAB/MIN/ ECN-EF/006 of 5 October 2006 regarding forest use.

kernels provide feed for livestock, especially pigs. Additionally, palm oil is used to make artisanal soap and fuel. Finally, large quantities of palm wine are consumed in makeshift bars across Kisangani.

Although baked bricks are not a forest product in the strict sense of the term, we wanted to look at the role that locally controlled enterprises play in the structure of the baked-brick supply chain, its impact on local livelihoods, and the environmental effects of brick baking, especially through woodfuel consumption.

The people in the region mainly rely on biomass energy (charcoal and firewood) to meet basic energy needs because of the scarcity or lack of alternative sources of energy, such as electricity and fossil fuels. This subsector was selected because we wanted to investigate the systematic use of both charcoal and firewood, and the pressure this places on the forest.

Rubber production helps households in and around production sites balance their budgets, and it slightly reduces the pressure on forests by providing an alternative to crop production. Old rubber plantations are essentially artificial forests, however, and burning them to produce charcoal and firewood or to clear the land for cultivation could threaten certain ecosystems.

We decided to include the NTFPs *fumbwa* and rattan in the study because of their contributions to household incomes in the Kisangani region, the ways in which their supply chains are organised by artisanal producers, and the scale of demand for these products in local markets.

Information in this chapter has been derived from extensive interviews with: (i) various state services in the province responsible for locally controlled enterprises, environment, nature conservation, energy and agriculture, as well as the Eastern Province Directorate of Revenue and the National Forestry Fund; (ii) NGOs (Organisation Concertée des Ecologistes et Amis de la Nature – OCEAN; SOS Nature; the Association for the Promotion of Local Initiatives in the Forested Areas of Africa – APILAF; and Action for the Integral Development of Kisangani and the Congolese Central Basin – ADIKIS); (iii) bilateral cooperation agencies (the Belgian Technical Cooperation Support Program for Community Development Initiatives); and (iv) artisanal operators themselves. Most of the interviews with state actors and NGOs were held in their offices with the people responsible for the sector concerned; the artisanal operators interviewed came from every part of the production chain (producers, hauliers, vendors, traders and consumers).

A total of 74 surveys were conducted for the study, including with each of the eight state services concerned (environment and nature conservation, energy, locally controlled enterprises, agriculture, the National Forestry Fund, the Eastern Province Directorate of Revenue, the General Directorate of Taxes and the National Institute for Social Security). We interviewed one staff member each in ADIKIS, APILAF and SOS Nature and two staff members at OCEAN, making a total of five respondents from the NGOs operating in Kisangani region. We also interviewed five people in higher-education establishments and universities: two from the University of Kinsagani (UNIKIS), two from the Yangambi

Institute of Agricultural Sciences (Institut Facultaire des Sciences Agronomique de Yangambi – IFA), and one from the Bengamisa Advanced Institute of Agricultural Studies (Institut Supérieur d'Etudes Agronomiques de Bengamisa). A total of 56 artisanal operators from across the production chains were interviewed: eight from the timber subsector, nine from the oil-palm subsector, eight from the baked-brick subsector, ten from the charcoal and firewood subsector, six from the rubber subsector and 15 from the *fumbwa* and rattan subsector.

The information obtained from these surveys was supplemented by existing documentation on forest use in the Kisangani region and elsewhere, provided by research institutions such as UNIKIS, IFA and the National Institute of Agricultural Studies and Research (Institut National Pour l'Etude et la Recherche Agronomiques – INERA). Statistical analysis methods were used to process the quantitative data, and the information generated by the surveys and interviews was subjected to a qualitative analysis.

9.2 Assessment of market prospects of shortlisted subsectors

The city of Kisangani is situated in rainforest, and its citizens still depend on forest products to meet many of their daily needs. The artisanal exploitation of forest products is not well structured or well regulated in DRC. The Forestry Code is geared more to industrial logging and forest use, while artisanal forest operations tend to be informal activities by individuals who negotiate directly with the communities living in or around the sites concerned. The public services are mainly involved in taxing forest products when they come into public markets, predominantly by collecting business tax.

The Small and Medium Enterprise (SME) Division in Kisangani uses a 1990 law[7] to determine which forest products should be taxed. Article 5 of this law stipulates that small-scale farmers and herders who occasionally – on days determined by the local authority – go to public markets to sell produce from their food crops, fishing, livestock rearing or wild harvesting are exempt from business tax. All forest products not cited in this law are subject to business tax, which is collected by urban SME Division inspectors, who monitor sites where products are usually sold or may be displayed for sale.

We now analyse each of the six subsectors, describing their characteristics and production chains. The subsequent section assesses the impacts of the subsectors on poverty reduction, household well-being, gender equity, food and energy security, climate change mitigation and adaptation, biodiversity, and soil fertility without nitrogen-based inputs.

1. Timber

Authorisation from the relevant public administration, in the form of logging permits, is normally required to cut timber, although some operators run clandestine operations without logging permits, and artisanal operators tend to negotiate directly with local communities to obtain rights to access forest resources. Timber is used for domestic roof frames and numerous other products needed to construct and renovate houses. To make

7. Ordinance-Law No. 90-046 of 8 August 1990 regarding the regulation of small business in the Republic of Zaire.

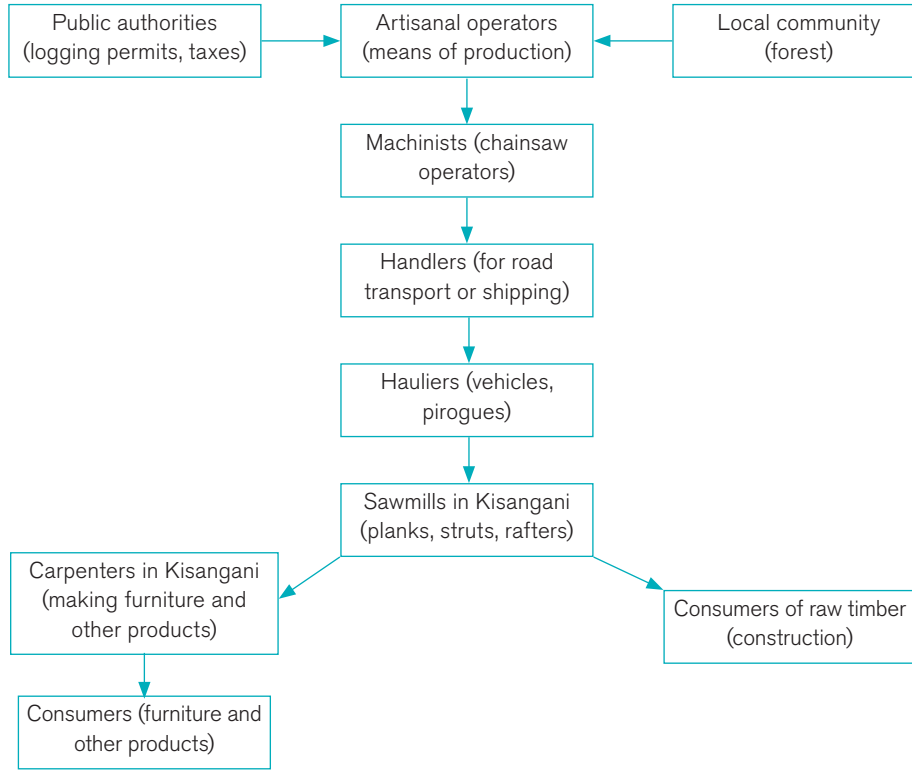
them easier to transport, logs are sawn and cut into planks and struts before they are removed from the forest.[8]

The term 'timber' applies to wood that is used for purposes other than heating and cooking (domestic or otherwise). Timber can be divided into two categories: timber for building, which is used in civil construction and shipbuilding; and timber for carpentry, which is used for joinery, furniture-making and the manufacture of wheels, barrels, and so on. (Ngoy, 2012).

Illegal logging and the trade in illegally sourced timber are complex problems that have wide-ranging environmental, social and economic repercussions (FAO *et al.*, 2006). Forestry could be an important economic sector in DRC but it only accounts for 0.7 per cent of GDP (Greenpeace, 2007).

Various actors are involved in the timber production chain[9] in the Kisangani region (Figure 38): public authorities, artisanal operators (owners of the means of production), local communities, machinists, handlers, hauliers, dealers, carpenters and consumers.

Figure 38. Timber production chain in the Kisangani region



8. www.cecobois.com/les-produits-du-bois/bois-oeuvre/classe-visuelle, accessed 18 December 2012.
9. http://fr.wikipedia.org/wiki/Cha%C3%AEne_de_production, accessed 27 January 2013.

Artisanal operators use their financial capital to acquire the means of production, for example, chainsaws, fuel, lubricants and money. Two or more people can do this by pooling their resources in the production process. They need to obtain logging permits and licences from the environment and nature conservation service, negotiate with the local community, pay for the trees they fell, and get the timber transported to Kisangani to be sawn up and sold. The local communities that live in and around the sites where logging operations take place, sell trees to loggers. Artisanal loggers may buy directly from individual villagers selling trees near their homes or in their fields, or from representatives of the community (village chiefs), who sell trees in community forests 5km or more from the village.

Chainsaws are usually operated by two people, a machinist and an assistant, who fell and saw trees bought from the community by artisanal loggers into boards that can be taken to their point of use. Artisanal loggers pay the sawyers piece rates. Depending on the amount of work involved, teams of six to eight local handlers move the timber from the logging site to road or river depots so that hauliers can transport it to Kisangani. Handlers and hauliers are paid by the operator, who then has the timber cut to the desired shapes and sizes and sells it in the Kisangani market, where furniture-makers and housebuilders buy it.

This production process is shaped by two factors: the artisanal operators' preferred species and the diameter of the trees that are felled. Artisanal loggers in the Kisangani region mainly use afrormosia (known as *mogoya* in the local language) and other hardwoods such as sipo, kossipo, essia, tola, iroko and sapelli. The highest-quality wood is afrormosia, which is also the most popular timber on national and international markets: 51 per cent of the operators we interviewed said it is their preferred timber. It is attractive, very strong and hardwearing, and it is suitable for furniture, marquetry and joinery because it does not shrink much. It makes excellent timber frames and can be used for pit props, in shipbuilding and as railway sleepers (Assumani, 2009). Sipo, kossipo, essia, tola, iroko and sapelli are mainly used in general construction, for example, planks, ties, rafters, and external and internal coverings, and water works, such as bridges. They were the species of choice for 35 per cent of the artisanal operators interviewed for this study.

Forestry regulations in DRC stipulate that no trees of any species should be felled if their diameter is less than 60cm but this rule is widely ignored because the state services rarely monitor logging sites. The environment and nature conservation service intervenes upstream of the logging process, issuing 'logging permits and licences' that cost artisanal operators US$250 per quarter; the Eastern Province Revenue Department and National Forestry Fund intervene downstream, collecting 'business taxes and receipts' when the timber comes onto the public market.[10]

2. Oil palm

The oil palm (*Elaeis guineensis*) originated in Africa, probably along the Gulf of Guinea, where it still grows in natural groves. The other main species of *Elaeis* is *E. oleifera*, which is found in South America, often in the wild. The fruit and kernels of the oil palm provide oil with a high fat content that is a key ingredient in Congolese cuisine in general and in dishes in the Kisangani region in particular.

10. Interviews with individuals at the Eastern Province Revenue services office in Kisangani, and the National Forest Fund office in Kisangani.

Various actors are involved in oil-palm production (Figure 39). Men are responsible for cutting the fruit and maintaining plantations, while women and children collect the fruit and take it to be stored and processed. On mixing days, women carry the fruit to the presses and usually take the extracted oil to market. Tools used in the plantations before mixing include machetes, axes, files and baskets to transport the fruit. Local presses known as *loko*, which are hand-operated by men, are used to extract the oil, which is stored in cans and barrels.

The city of Kisangani consumes large quantities of palm oil produced by traditional artisanal methods that use loko or pound fruit cooked in a barrel or pot. After the palm oil has been extracted, the nuts are crushed to free the kernels and a special press (which requires electricity) is used to produce palm kernel oil. Another sub-product of the oil palm is 'palm wine'.[11] Although the sap from which this is made can be obtained from living trees, it is becoming increasingly common to simply cut down the trees to obtain the wine. The palm-wine supply chain involves producers who extract the sap and make the wine, usually from trees growing in the wild, the dealers who own drinking establishments, and their customers, the end consumers, who are often regular patrons. Over time, some of these drinking dens have become public meeting places that people visit to discuss current affairs and daily life as well as to drink palm wine.

3. Baked bricks

Baked bricks are solid blocks of clayey earth that are formed into regular geometric shapes and baked in an oven at 600-1,200 °C. They are used in construction and are classified as a durable building material. As people in Kisangani strive to meet the basic human need for shelter and protection, they want to improve their housing by constructing their homes out of durable materials. The fact that baked bricks are cheaper than concrete blocks has helped revive an activity that was common during the colonial period.

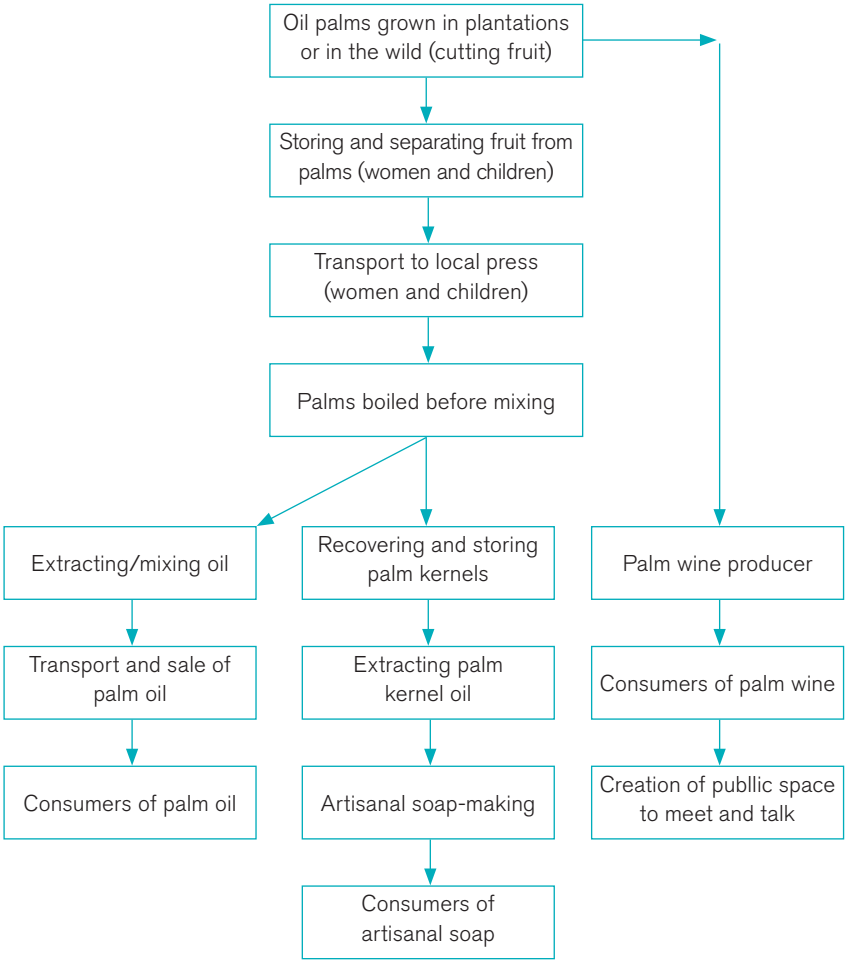
The resurgence of artisanal baked-brick making began in the 1990s, when the socio-economic effects of the country's growing political instability started to bite. As the economic crisis gathered momentum, the price of cement soared in Kisangani, and unemployment in various sectors rose across the nation. People had to find new ways to earn a living, and brick making gradually emerged as an important income-generating activity for households.

Various actors are involved in the production of baked bricks: the entrepreneurs who set up one or two brickmaking machines on pre-selected sites; the small teams of one or two people who use these machines to make the bricks; the suppliers and hauliers who provide the woodfuel to bake the bricks; and the end users who buy the bricks to build durable housing. The baked-brick production chain has several stages:

- The producer chooses a site with good-quality soil that meets a number of criteria.
- A shed is built near the brickmaking site.

11. 'Palm wine' is a traditional drink derived from standing or felled oil palms. It is popular among people with limited purchasing power on the outskirts of the city of Kisangani. It is not wine in the usual sense of the word because no grapes are used in its production.

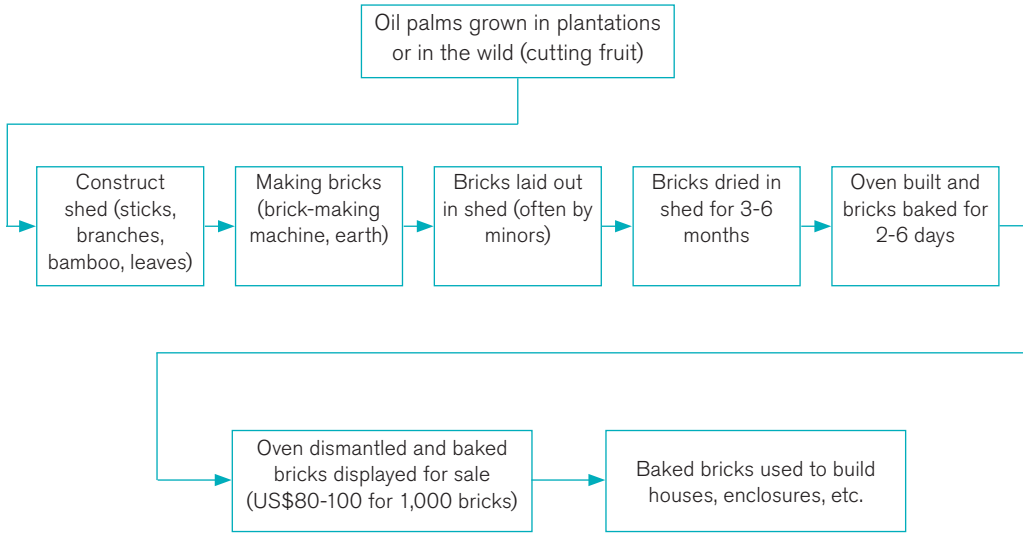
Figure 39. Production chain for oil palm and its sub-products in the Kisangani region



- The brick mixture is prepared using sand and clay if the soil on the site requires it.
- The mixture is pressed into hollow moulds that give the bricks their final shape.
- The bricks are laid out on dry ground in a purpose-built shed (to avoid overdrying), arranged so that air can circulate between the bricks.
- Bricks can be used for construction once they have dried out, although they will be more durable if they are baked for four to six days at 600-1,200 °C.
- When the baking is finished, the oven is dismantled and the bricks are displayed for sale to end-users. They sell for US$80-US$100 per 1,000 units, depending on the location and accessibility of the production site.

Figure 40 illustrates the production and marketing chain.

Figure 40. Baked-brick supply chain in the Kisangani region



4. Biomass energy (charcoal and firewood)

Firewood is procured by gathering dead wood or cutting dead or green wood. It does not involve any particular technical processes, and it can be obtained from all wood-producing plant species whatever their value, height or diameter. Large-diameter timber is difficult to cut and transport and is either split or burned on site. Although the forest service frowns on the removal of green wood to meet energy needs, this practice is common in the Kisangani region.

A number of actors are involved in charcoal production (Figure 41). Small-scale producers tend to be individuals who live in the vicinity of Kisangani and make small charcoal stacks or pits that produce two or three sacks of charcoal to cover their basic needs. These producers often take sacks of charcoal to sell in Kisangani on bicycles. At this level, the supply chain includes charcoal burners, buyers-hauliers-dealers and consumers.

Private entrepreneurs work with local communities to produce charcoal on a slightly larger scale (20 sacks or more). They negotiate with village chiefs and buy the trees to be felled, recruit charcoal-burners to produce the charcoal, and find someone to take the sacks of charcoal to the city by vehicle, pirogue or raft. The two main methods that individuals and entrepreneurs in Kisangani region use to produce charcoal are covered stacks and traditional pits.

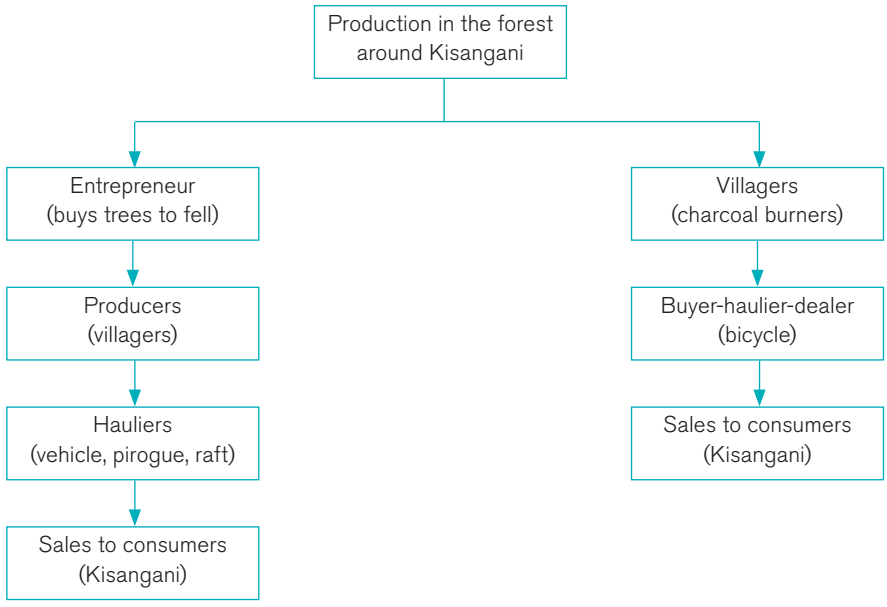
- **Covered stacks** consist of a pile of one to seven steres of wood, whose shape and size vary according to the charcoal-burner. The wood is covered with fresh leaves and earth, with vents left at the base of the stack to allow and control the entry of air. It can take three or more days to produce charcoal in this way, depending on the size of the stack.

- **Traditional pits** are usually rectangular, measuring about 3m long, 1.5m wide and 2m deep. They can accommodate one to four steres of wood, which are covered with fresh leaves and earth. It can take between several hours and several days to produce charcoal in this way. Pits are more stable than stacks because they do not collapse, but they are rarely used in the rainy season because of the risk of flooding.

Whichever technology is used – stacks or pits – traditional charcoal-making can be seen as a wasteful use of resources because it takes 5-7kg of wood to produce 1kg of charcoal. It can take one stere of wood to produce 33kg of charcoal in a covered stack (a 14 per cent yield) and 52kg of charcoal in a traditional pit (21 per cent yield) (Tshimpanga, 2011).

In the Kisangani region, the entire charcoal production process – from cutting the timber to the finished product – takes about 16 days and involves around seven people. Workers sometimes specialise in one stage or another, such as felling trees or weaving sack extensions from branches and leaves. They are paid daily rates or given food and drink, working in a rotation system known as a *tontine*.[12]

Figure 41. Charcoal supply chain in the Kisangani region

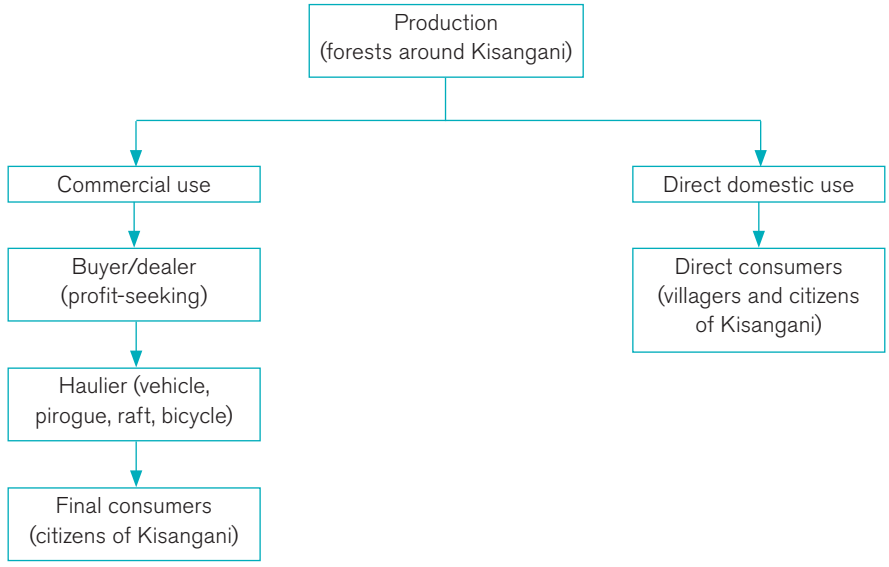


12. In the *tontine* system, each member of the group takes it in turn to provide food and drink for other members. Many producers do not take the unpaid elements of the production process – such as family labour and the rations given to members of the group – into account when estimating their production costs.

Woodfuel provides over 80 per cent of DRC's energy needs and is particularly important in the Kisangani region because of the under-development of the industrial sector, a lack of transport and the high cost of electricity and fossil fuel. Wood is one of the main sources of energy for most rural families and for about 70 per cent of urban families (Tshimpanga, 2011). Woodfuel in the Kisangani region mainly comes from natural vegetation and trees felled to clear land for crops.

Numerous actors are involved in the firewood supply chain: producers, buyers/dealers, hauliers and consumers (Figure 42). Producers are usually rural people who obtain and sell the wood from medium-sized trees in various sites in secondary forests within 80km of Kisangani. Buyers/dealers are men and women who travel to surrounding villages to buy firewood for resale in Kisangani. They pay hauliers to transport it from the production site to the city by vehicle, bicycle, pirogue or raft. Rural people who produce firewood for domestic consumption often carry it home on their heads or backs. Firewood is used for domestic and semi-industrial purposes, such as cooking food, producing alcoholic beverages and baking bricks. Firewood is also used by industries that operate in Kisangani, such as the Société Textile de Kisangani (SOTEXKI). SOTEXKI is not directly involved in logging activities, however; it buys firewood from villagers, who fell the trees and sell it in steres on roadsides. At the time of writing, a stere of firewood was selling for 2,000 Congolese francs in villages near Kisangani.

Figure 42. Firewood supply chain in the Kisangani region



5. Rubber

In its natural setting, the rubber tree (*Hevea brasiliensis*) can grow up to 30m high, with trunks measuring up to 1m in circumference. It has greeny-grey bark and alternate, palmate leaves with three leaflets at the end of a petiole. Lactiferous tissue occurs all over the tree, from the roots to the leaves and the bark of the trunk, where latex is extracted. Latex vessels spiral up the tree in a continuous network within each axial duct. They contain living cells with all the organelles (nucleus, mitochondria and plastids) they need to function.

Latex is different from sap, because sap carries water, minerals and sugar around the tree, while latex is more involved in the tree's natural defence mechanisms and circulates in a distinct network of vessels, or latex canals. Like resin, it oozes from wounds and forms a protective barrier as it dries. The latex that is harvested by tapping is the cytoplasm, or liquid content of the latex cells, composed of a suspension of rubber particles and organelles such as lutoids. Because the nuclei and mitochondria remain attached to the cell walls, the latex is replenished after harvesting, making it a renewable resource. Rubber particles represent about 25-45 per cent of the volume of latex and 90 per cent of the dry matter. Trees can start producing latex when they are five years old and remain productive for about 30 years, after which time they are cut down and replaced.

Latex is harvested by cutting the bark on the trunk of the tree and collecting the liquid that drains from these cuts. Harvesting usually starts when the circumference of the trunk 1m above the ground measures 50cm. Rubber-tappers use special knives to make a light spiral incision downwards on one-third to one-half of the trunk, starting about 1.5m above the ground. Incisions are usually made every two days but may be made as little as once a week, depending on the intensity of harvesting. When the incision (known as the panel) has yielded all its latex, another one is made on the other side of the tree. The liquid gathered just after the incision is known as the latex harvest, while latex that has been allowed to coagulate in the collecting cup is known as the cup lump.[13]

The different stages in latex production and marketing are:

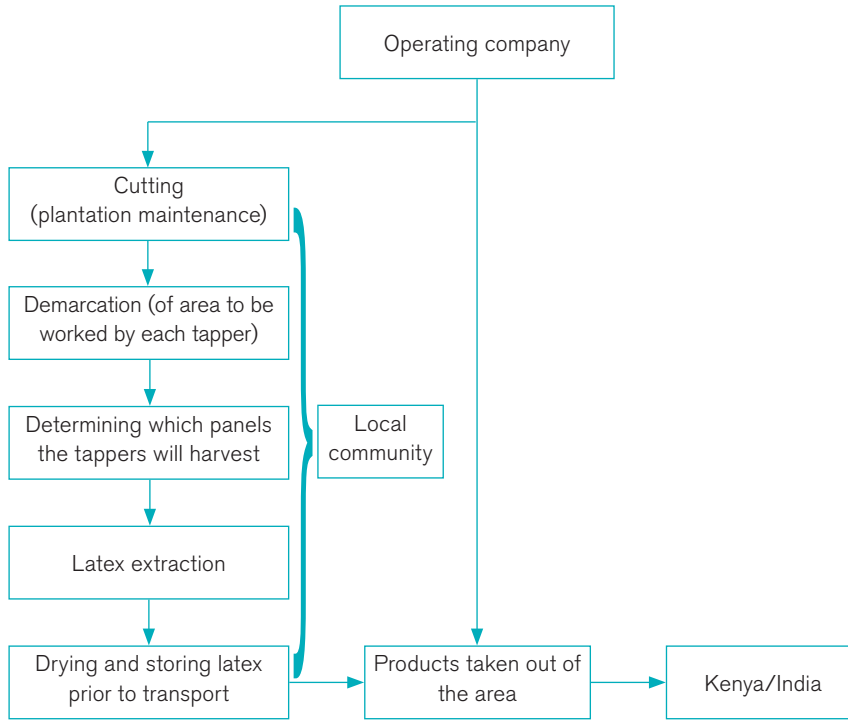
- cutting in order to maintain the plantation;
- marking out the land parcels or area to be allocated to each rubber-tapper;
- determining which panels will be harvested;
- placing the cup carrier and the cup; and
- cutting the preparatory groove using a special rubber-tapping knife. A 15-day pre-tapping period is factored in to establish a good flow of latex for harvesting.

Each operator has to sign a contract with the rightsholders of existing plantations in the area and another contract regarding use rights. These two contracts are not the same for all operators, although the Ministry of Environment, Nature Conservation and Tourism has introduced standard contracts, as for industrial logging (see the cases of the company Congo Relai d'Exploitation et d'Exportation – COREX – and the Tanzanian company

13. Information provided by the supervisor of the Lobby Congo plantation in Pk 36 on the Kisangani–Banalia road. When we visited the site we followed the latex production process from the plantation to the packaging factory.

Lobby Congo).[14] The actors involved in rubber production include national and foreign owners who fund operations, such as COREX, Lobby Congo and Indian-owned companies, and local labourers, who are predominantly male due to the physically demanding nature of the work. Women who are involved in the production process mainly work on the administrative side. None of the latex produced in the Kisangani region is consumed locally (there are no processing companies); it is all taken to the city or exported. Lobby Congo trucks its products to Nairobi, Kenya, via Uganda, while COREX takes its latex products to the port of Dar-es-Salam, where they are processed before being exported to India. Figure 43 depicts the rubber production chain.

Figure 43. Rubber production chain in the Kisangani region



14. COREX has not signed a contract with local communities because it uses old rubber plantations and INERA's buildings and factory and pays INERA a percentage after the latex has been produced. Unlike COREX, Lobby Congo has signed a contract with local people (agreeing to build two schools, a hospital and several houses and provide childcare for rightsholders at the university). However, at the time of writing, Lobby Congo was yet to fulfil its side of the contract, leading to tensions between the company and local community members.

6. Non-timber forest products: fumbwa and rattan

The most commonly used NTFPs in the Kisangani region are rattan, *fumbwa*, caterpillars, game, tree bark, honey, cola nuts, the leaves of *Leucosperma species* (for wrapping) and mushrooms. This study examines the scale and impacts of the use of rattan and *fumbwa* on local sites and markets.

Rattan is one of the main NTFPs used by local people in the Kisangani region. It is a major source of income and the basis of a very active informal sector that supplies the city of Kisangani with untreated and processed rattan. Countries in Central Africa are now waking up to the economic potential of the rattan sub-sector, some three decades after it took off in Asia (Kahindo, 2011).

Rattan is a climbing palm that is used in the manufacture of furniture and wickerwork. Wild rattan plants can grow up to 200m in length, attaching their grey thorny stems to trees. Varieties of rattan are named according to their provenance, giving us malacca (pale yellow), manila (brown), tohiti, sarawak, sampit and pasir rattans. Manila and malacca rattans are solid enough to be used to make chair frames and furniture, while more flexible varieties such as tohiti are used for wickerwork.[15]

Fumbwa (*Gnetum spp.*) is found mainly in the tropical regions of Asia, South America and Central Africa. It includes about 30 species, mainly lianas but also a few shrubs and trees. In Africa, and especially in DRC, two species of *fumbwa* are harvested: *G. africanum* and *G. bucholzianum* (Lomba, 1997). Both of these species are dioecious climbing vines with branching stems, which are often full of nodes, and broad-bladed, opposing leaves of oval or elliptical shape. They have no resin ducts (Flore du Congo Belge et du Ruanda-Urundi, 1948).

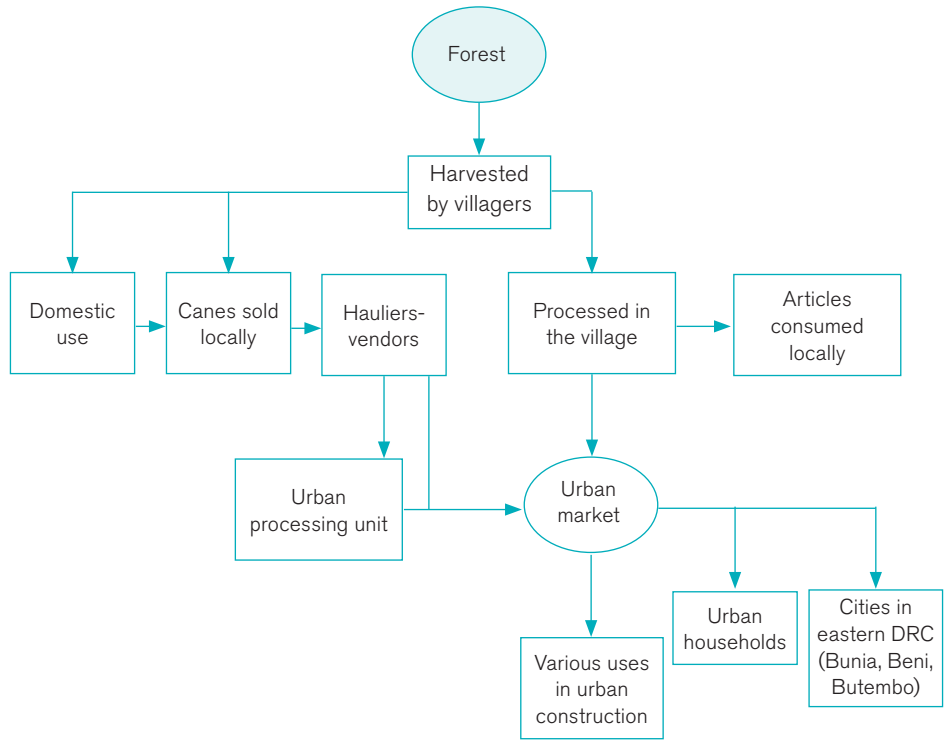
It is not easy to distinguish between the two species without looking closely at their flowers and anatomical structure (Manirakiza *et al*., 2009). The male flowers of *G. africanum* are closely and evenly spaced along a straight narrow spike, while those of *G. buchholzianum* are more widely spaced along a tapering spike. While the efficacy of treatment is unknown, the literature shows that the leaves are mainly used for food and to treat medical conditions such as enlarged spleens and sore throats, to alleviate labour pains, and as an antidote to various types of poison and snake bite. The seeds are used as a fungicide on fresh or infected wounds and are traditionally chewed raw to manage excessive urination in diabetic children (Mialoundama, 1993).

The traditional rules and modes of regulating NTFPs in DRC focus on the legal conditions for their exploitation (harvesting, gathering and marketing). The exploitation of plant-based NTFPs is based on use rights that allow forest communities to meet their individual domestic and collective needs, although permits are needed to remove some products. The Forest Code is unclear on the exploitation of NTFPs in general and *fumbwa* in particular, which seems to be one of the most profitable forest products. The Forest Code places certain limits on use rights relating to local customs, agricultural use and the protection of classified forests and requires several types of authorisation for the harvest of NTFPs – regular harvesting permits when the product is covered by a particular measure, and special permits for protected products. Such permits give holders the right to harvest and sell products such as rattan and the bark, roots and branches of trees (Mpoyi, 2006).

15. en.wikipedia.org/wiki/Rattan.

Figure 44 shows the rattan supply chain in Kisangani and the surrounding area, from the forest to the end-user. It shows that the chain functions at three levels – the forest, village and city – and involves the following actors: rural people (primary collectors), hauliers-vendors, rural and urban artisans, travelling salespersons and traders, and households (consumers of raw and processed rattan).[16] Our interviews and field studies showed that rattan goods in the Kisangani region normally go through six stages of production: soaking, cleaning, splitting (for basketwork), dividing or sizing canes, making frames and, finally, assembling the finished items.

Figure 44. Rattan supply chain in the Kisangani region



Producers use some of the rattan they remove from the forest for domestic purposes, making it into mats, trays, baskets, furniture, beds, shelves and other goods that are sold locally or sent to the market in Kisangani. Raw rattan is also taken to Kisangani, where it is sold for construction (houses, fencing), and small amounts of raw and processed rattan are sent to meet consumer demand in cities in the east of the country (mainly Bunia, Beni and Butembo).

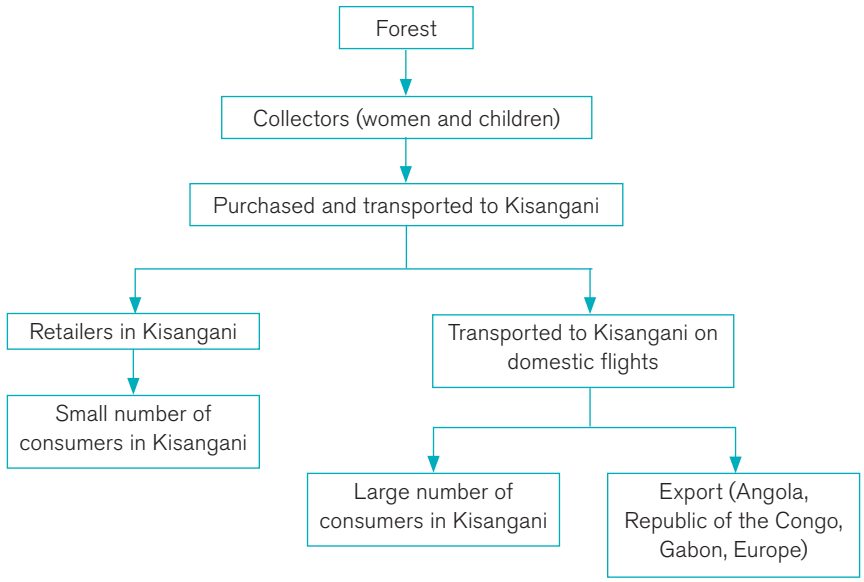
Large quantities of *fumbwa* are sent from Kisangani to traders in Kinshasa and the interior. The two main *fumbwa* trade routes in DRC are the Kisangani–Kinshasa and

16. Interviews with rattan producers on the Kisangani–Yangambi axis, who take their goods to Kisangani market by pirogue.

Mbandaka–Kinshasa runs used by the airlines that operate in the region. All the *fumbwa* from Kisangani comes from the forest and is mainly gathered by children and women, who tend to know more about where and how to harvest it. As people in Eastern Province do not tend to eat much *fumbwa*, villagers harvest it to order and pack it into bags or baskets to be transported to Kisangani.

In Kisangani, *fumbwa* is sold to retailers, who cut it up before offering it for sale. Wholesalers also buy large quantities and on-sell it to traders in Kinshasa. These wholesalers rarely transport the goods themselves, and few have contracts with their associates. Most transactions are based on trust and family links between traders in Kisangani and the villages.[17] One wholesaler in Kisangani told us, 'I've never met my business partner in Kinshasa. I send her my package; she confirms that it has arrived and transfers the money to me when it has been sold. Everything is done on the basis of mutual trust'.[18] *Fumbwa* is harvested the day before the flights leave and taken to Kisangani by bicycle, motorbike or pirogue. The collectors buy on credit and pay when the goods reach their final destination in Kinshasa. If there are no freight planes, the consignment is thrown away and the harvesters receive no money. Figure 45 shows the *fumbwa* supply chain in the Kisangani region.

Figure 45. The *fumbwa* supply chain in the Kisangani region



17. Wholesalers in Kisangani told us that they do not have sufficient capital to fly to Kinshasa and sell their goods there themselves. Therefore, they have to rely on someone in Kinshasa who is prepared to receive the merchandise, sell it and send them the money via one of the financial messaging systems in Kisangani (such as Soficom, Semence or Western).
18. Conversation with *fumbwa* wholesaler in Kisangani, who collects merchandise on the Kisangani–Banalia road.

9.3 Assessment of integrated impacts of subsector options

In the following section we assess, for each of the six identified subsectors, the main impacts associated with production and processing. For each subsector, we comment on their income-generation potential, their impacts on gender equity and food and energy security, and their contributions to mitigating climate change, protecting biodiversity and improving soil fertility without nitrogen-based inputs.

1. Timber

Artisanal timber production has various impacts in the Kisangani region. It helps meet local demand because most of the output from industrial logging is exported, and it contributes to the creation of jobs in sawmills and joineries. This employment has a knock-on effect on living standards and, to a certain extent, poverty reduction, at a time when the government is increasingly shedding its primary responsibilities. Operators use their profits to cover their basic needs and provide a degree of food security for their families. Because the early stages of timber production involve heavy labour and require a certain level of physical strength, the role of women in the production process is limited to that of employers or vendors. Table 30 shows the number of jobs created by sawmills and joineries in the city of Kisangani, by commune. Each sawmill employs eight to twelve people, with an average of ten people per outfit; joineries employ three to five people, with an average of four employees.

Table 30. Number of jobs in sawmills and joineries, by commune, in the city of Kisangani

Commune	No. of sawmills	No. of jobs in sawmills	No. of joineries	No. of jobs in joineries
Mangobo	12	120	102	408
Makiso	19	190	68	272
Tshopo	9	90	49	196
Kabondo	7	70	39	156
Kisangani	5	50	36	144
Total	**52**	**520**	**294**	**1,176**

Source: Field data collected by the authors in 2012.

Table 30 shows that the sawmills and joineries in the communes of Mangobo and Makiso provide the most jobs, followed by those in Tshopo, Kabondo and Kisangani. Mangobo employs more workers than any of the other communes (12 sawmills and 102 joineries), so it can be considered most active in the emergence and development of this type of locally controlled enterprise in the city. Two factors – location and taxation – explain why this commune has the most joineries. The River Tshopo, which is used to transport large quantities of timber, is the main entry point to the commune. This makes it a good location for sawmills and joineries that want to cut the cost of transporting timber from the docks to their premises and also have easy access to the market. SMEs in the centre of Kisangani, and especially in Makiso, have to pay higher rates of tax than those in other communes; certain operators prefer to run their businesses in outlying communes to avoid the exorbitant taxes or, if possible, not pay any tax at all.

Despite its high taxes, some entrepreneurs prefer Makiso because it provides important enabling conditions – such as reliable electricity supplies, as well as good accessibility and proximity to clientele. Makiso therefore has the most sawmills and the second highest number of joineries in the city. These workshops provide employment and thus contribute to the domestic well-being of sawyers, vendors, agents, handlers, hauliers, carpenters, joiners and security guards. Sawyers use varying types of machinery and are paid piece rates by sawmill owners. Vendors are usually family members who are recruited to take care of the daily sales of goods (for example, rafters, struts and planks); they are paid a flat rate in cash or in kind.

Agents work on behalf of the timber merchants or joiners, finding clients and helping gain access to the market. They are well-known in the supply chain, arranging transactions and business deals on behalf of their employers. They do not have their own capital and are paid a percentage, which is agreed in verbal contracts. Handlers in sawmills arrange for the timber to be moved from the point of sale to the point of transport and oversee its loading; they are paid by the purchaser. Timber that is transported by cart or bicycle is handled by the transporter. Hauliers move timber from sawmills to the point of consumption (carpenters' workshops) or processing (joineries). This is usually done by vehicle, cart or bicycle. Carpenters use rafters, struts and planks for domestic construction and roofing, and joiners process the timber bought from sawmills into furniture, such as tables, chairs, wardrobes and closets or into doors, windows, shop windows, coffins, and so on. Watchmen keep guard over the sawmills and workshops to ensure that goods are kept secure until they are sold.

The jobs created in Kisangani sawmills and joineries do not necessarily improve domestic well-being directly because the money does not always reach the households concerned to help balance their budgets. According to one artisanal timber operator, 'some agents, handlers and carters are not organised and their situation does not improve, even though they earn money here every day'.[19]

Our surveys show that very little is being done to mitigate climate change in the Kisangani region. Although artisanal operators pay business taxes,[20] the authorities that are supposed to use this money for reforestation do not seem to be in a hurry to do so. In addition to the business tax, artisanal operators must pay numerous other taxes for which no official proof of payment is given.[21] Consequently, many prefer to work clandestinely because they are fed up with seeing their money used for purposes other than the

19. Interview with an artisanal timber operator in the sawmill opposite the municipal offices in Mongobo.
20. The operators we interviewed reported that they paid two kinds of tax: official taxes (for which they receive a signed document), and unofficial taxes (for which no papers are issued). Unofficial taxes include taxes on information (charged by the National Intelligence Agency), migration (charged by the immigration office), customs (charged by the General Directorate of Administrative and State Revenue), local taxes (charged by decentralised local government bodies), and docking fees (charged by the commune). Taxes are also levied by the provincial environment and nature conservation service, such as the SME business tax, the forest tax and the loading and service tax. Listed official taxes include taxes on statistics, surface area and licences levied by the governorate; and charges, felling and forest use permits, reforestation, volume, income, clearance for crops, rights of access to resources, licences to buy and sell levied by the provincial environment and nature conservation service.
21. Interview with an artisanal operator whose wood is sold in a sawmill in the commune of Makiso.

intended reforestation. Because they cannot be sure that their taxes will reach their rightful destination, many give wine to the tax agents instead. The State technical service responsible for reforestation is eagerly awaiting the National Forestry Fund, the objective of which is to 'contribute, by funding conservation operations, to the reconstitution of forest capital as part of the national effort for sustainable forest resource management and poverty reduction and the global effort to combat climate change resulting from deforestation and the degradation of forested lands'.[22]

The lack of reforestation means that the Kisangani region is gradually losing its forest cover, which will reduce its capacity to capture carbon and mitigate climate change in areas where logging takes place. Although the forest is extremely resilient, there is reason to fear that the rate of deforestation in the Kisangani region is exceeding the pace of reforestation in areas damaged by artisanal logging. Biodiversity in the region is also affected by artisanal forestry operations. Selective woodcutting (skimming) that targets valuable timbers creates a risk that certain species and NTFPs that depend on these trees could disappear. The consumer preference for afrormosia and other hardwoods is contributing to an upsurge in selective logging.[23]

While felling old trees creates space in the canopy for recruits, it takes many years for the new trees to reach maturity, reconstitute the forest and enable it to fulfil its environmental role. Unregulated logging also displaces certain animal and plant species. Nowadays, for example, people have to travel 50-100km to find plant and animal species that used to be common within a 15-20km radius of the city. Some organisations in the region, such as OCEAN, APILAF and ADIKIS, have run awareness-raising and training sessions for state actors, artisanal operators and local communities, but selective logging continues, with no regard for the mechanisms that are supposed to protect biodiversity in Kisangani.

Given that it is difficult – if not impossible – to stop artisanal logging in the region without creating social imbalances and depriving households of their main source of income, the state services and national and international environmental organisations need to do more to regulate the sector and to educate the actors concerned in order to safeguard the region's forest capital, which constitutes a crucial element of global forest reserves.

Reforestation projects could be established in logging zones, and local communities could be educated on the need to replace trees that they fell or sell to artisanal operators to ensure the long-term protection of the forests. National and international organisations could sensitise the state services, which are the principal protectors of national forests, to ensure that existing forestry regulations are respected and to formulate other regulations that are adapted to national realities, and which encourage and develop reforestation activities in logging zones. Artisanal operators should be monitored and controlled by the state services and local communities to prevent the unauthorised logging of old and young trees and to clamp down on the clandestine operations that are rife in the timber-supply chain. Priority should be given to setting up training and awareness-raising projects for all actors involved in the timber production chain so that they understand the ecological roles played by the forest.

22. Kisangani provincial service information on the National Forestry Fund.
23. Interview with a researcher for OCEAN, conducted in the Kisangani office on 22 November 2012.

2. Oil palm

Palm oil is widely used for cooking, such as for frying, margarine and vegetable oils, and its sub-products of stalks, pulp fibres, liquid and solid waste, cakes, and so on, provide various forms of bioenergy, fertilisers and livestock feed. In 2010, palm oil was regarded as the most widely consumed vegetable oil in the world (25 per cent of the world market).[24] The palm nuts are crushed and the kernels extracted, and the waste products are used as an alternative source of energy for cooking; kernels that are not used for oil are fed to livestock, especially pigs. Palm oil is only produced in low- and middle-income countries, where it is the primary vegetable oil in terms of production and trade. It is also the least expensive of all the vegetable oils available on the market in Kisangani (in late 2012, a 20-litre can of palm oil cost US$20 in Kisangani, while five litres of olive oil and other types of oil cost US$15). The labour-intensive production of palm oil involves few mechanised processes and generates 30 times more jobs per unit area than other major agricultural outputs such as soya (Thomas *et al.*, 2009).

To a certain extent, the production and marketing of palm oil and palm kernel oil contributes to household well-being and gender equity in the Kisangani region because women participate in the supply chain – collecting the fruit and taking it from the plantation to the storage site, drawing water when the oil is extracted, and selling the oil and other products. In the production of palm kernel oil, women buy the palm nuts, crush them in local presses, take them to have the kernel oil extracted, and sell the oil on the market. To improve the quality of palm oil, PAIDECO (Projet d'Appui aux Initiatives de Développement Communautaire dans la Tshopo) intends to run a palm-oil training and support project in and around Kisangani.[25]

Small artisanal soap manufacturers use much of the palm kernel oil produced in the Kisangani region; these manufacturers are officially recognised by the public administration (the SME Division). Various types of artisanal soap, such as Tembo, Peto, Benita and Tembe, are available on the local market. These soaps helped fill the gap created by the absence of brands such as Le Coq, Monganga and Give when Kisangani was occupied by rebel forces and cut off from the rest of the country between 1998 and 2003. The popularity of locally produced soaps has waned since the old favourites reappeared on the market after the official end of the war and reunification of the country, but they are still bought by poorer people who cannot afford to purchase imported soap on a regular basis.

Most of the 22 ordinary oil-palm plantations in the region lie between Kisangani and Yangambi. Oil palms also grow in the wild, providing easily accessible fruit that local people use to produce palm oil for their own consumption or to generate additional income. However, many of these trees are being felled for palm wine made from their fermented sap, which is sweet when newly harvested but which soon sours during the rapid fermentation process. Local demand for both bitter and sweet palm wine is partly driven by the lack of purchasing power among certain sectors of the population. So many palm-wine outlets have sprung up in the outskirts of the city that there is a risk that the region

24. Mattea Battaglia, 'Noyé dans l'huile de palme. L'explosion de la demande mondiale', *Le Monde Magazine*, No. 39, supplement to *Monde* 20336, 12 June 2010, p. 14.
25. Interview with a communications officer for PAIDECO (Tshopo), held in Kisangani.

will lose its wild oil palms and have to rely on more expensive oil produced elsewhere. Surveys show that many palm-wine producers fell trees without obtaining logging permits, or they apply for authorisation to fell trees to clear land for cultivation and then use these documents to cut down oil palms to make palm wine. The state services have much to do in order to combat this practice.

3. Baked bricks

Baked-brick making meets a real and urgent need for better housing in Kisangani, helping to alleviate the soaring cost of cement used in concrete blocks. Brick making is also a profitable activity that contributes to the household well-being of the makers and of other operators involved in the production process. Because it involves hard labour, the role of women in brick making is usually limited to that of entrepreneurs or cooks preparing food for labourers.

We analysed various aspects of the production process, starting with the main raw material for bricks: earth. When this activity first started, baked-brick makers in Kisangani often used earth from hills in their own plots or on neighbours' land, and people were happy for them to do so because it is easier to cultivate flat surfaces. Over time, however, the baked-brick makers started digging more deeply to increase their output or find better earth so they could produce higher-quality bricks. Baked-brick making is now well established in almost every commune in the city and has completely changed the landscape in and around Kisangani. Brick-making sites and many public places and housing plots are pitted with large open holes that pose a danger to residents (especially children), who are at risk of falling into them. The excavations also cause serious soil degradation, rendering brick-making sites unfit for productive use, long after the activity has ceased.[26] The state services should ban the production of baked bricks on housing plots and in residential areas and oblige brick makers to move to the outskirts of the city in order to protect the urban environment from damage caused by their activities.

Baked-brick making also comes at a high cost to forests, the edges of which are retreating from the city as a result of felling to supply firewood to bake the bricks. The distance between sites where the wood is cut and where it is consumed is increasing by the day; it varies from 12km to 50km, depending on the road network.[27] Kisangani is losing its natural greenery because the secondary forests that should form a windbreak around the city are heavily exploited for firewood for artisanal brick making. While these forests still have great potential and capacity for resilience, the current rate of exploitation makes it imperative that the state services implement reforestation strategies and develop alternative energy sources if forests are to be retained for the benefit of future generations and the environment and biodiversity are to be protected.

26. Field observations made during data collection in communes in Kisangani. The commune of Kisangani is particularly badly affected, between PK 4 and 7 in neighbourhoods along the road to Bangboka airport.
27. Interviews with a baked-brick maker in the commune of Mangobo, and a baked-brick maker in the commune of Kisangani.

Baked-brick makers consume large quantities of firewood because few alternative sources of energy, such as electricity or fossil fuels, are available to them. Demand for bricks is increasing as the government encourages citizens and state services to contribute to the national reconstruction process by constructing solid buildings. Even supposedly environmentally aware institutions are encouraging and helping local organisations to increase their productivity, with little consideration of the effects that their activities are having on the environment. In 2001, for example, PAIDECO supported brick makers in the district of Tshopo in Kisangani.[28] This assistance mainly consisted of advising the managers of selected organisations, providing work tools, such as brick-making machines, hoes and shovels, and legalising and structuring selected organisations.

Another disturbing observation made during the collection of data in the field was that many of the labourers making bricks are school-age minors, even though the child protection law in DRC formally forbids the abusive use of children in informal income-generating activities. According to the International Catholic Child Bureau *et al.* (2004), 'The employment code regulates child labour (duration and conditions of work), but has not been adapted to the economic crisis (dominated by the informal and opportunistic economic sector). This leaves the way open for child labour violations. […] the Labour Code has been reformed; it forbids the worst forms of child labour and has raised the minimum age for employment to 16'. The reality is that children aged between 10 and 17 years are involved in brick production in the Kisangani region. The different services responsible for child protection need to look into this issue.

The majority of baked-brick makers in Kisangani prefer to work at night. Survey respondents said they do so because it is cooler and less tiring and consequently they are more productive (producing more bricks per shift).

4. Biomass energy

DRC is classified as one of the African nations with the greatest potential for 'clean' energy, mainly hydropower. Although DRC has the potential to meet its own electricity needs and those of all its neighbours, only about five per cent of households in DRC have access to electricity, one of the lowest domestic rates of access in the world (Aveling *et al.*, 2004). The most commonly used sources of energy are charcoal and firewood in urban centres, and wood, crop residues and animal dung in rural areas.

The population in Eastern Province grew from 4.3 million in 1984, when the first scientific population census was conducted, to 8.5 million in 2008 (INES, 2008). This rapid demographic growth poses a serious environmental threat because of the increased consumption of charcoal and firewood it implies and the lack of renewable energy and electricity. Cleaver and Scheiber (1994) argued that rapid demographic growth has exacerbated the high dependence on ligneous fuels and increased pressure on natural resources, including forests.

28. PAIDECO (Tshopo), technical report on the identification of baked-brick producers' and makers' associations and the management of storage structures, May 2012.

There is no standard price for firewood in Kisangani due to the liberalisation of the market. All actors seek to maximise their profits by setting their own prices without reference to what others are charging, although prices vary according to the quality of the wood and the rate at which it burns. Charcoal and firewood are the main sources of domestic energy for most people living in and around the city of Kisangani, small semi-industrial operations, for example, bakeries, soap manufacturers and baked-brick makers, and even industrial outfits such as SOTEXKI. Unlike firewood, the price of charcoal is fairly uniform in Kisangani – US$10 per sack when bought from producers/vendors and US$12-US$20 per sack in the city, where the cost of transport is included in the sale price.[29]

The main points of sale for charcoal and firewood in Kisangani city are the markets of Litoi, IAT and the Association of Pirogue Fishermen (ASPIRO) in the commune of Makiso; the Djubudjubu/Tshopo and 11th Avenue markets in the commune of Tshopo; the Djubudjubu/Mangobo and Balese markets in the commune of Mangobo; the Kikongo market in the commune of Kabondo; and the Cimestan market in the commune of Kisangani. Prices vary according to the quality of the merchandise, which is determined by the type of wood. Surprisingly, producers use high-value timber such as afrormosia and other hardwoods because they burn more slowly than other types of wood. According to one charcoal producer and vendor, 'Consumers prefer hardwood products, and we want to meet their demand'.[30]

This means that high-value species that could be used to produce value-added timber products are sought-after for charcoal and firewood. This seems to be largely due to a lack of knowledge among producers and a lack of training and advice from the state services that raise taxes at various stages of the charcoal and firewood supply chain. The state needs to regulate the sector more effectively to protect threatened species, especially hardwoods, which are most at risk. Public authorities, research centres and national and international organisations involved in forest protection should provide training on alternative sources of domestic energy.

Despite these concerns, the charcoal and firewood supply chain does have positive impacts on people's lives and on financial stability in the Kisangani region. The income it generates enables households to meet their daily needs for food, education, clothing and modern medicine, and it enables women, who are very active in marketing, to become more autonomous and to take control of their lives. One female charcoal seller told us that, 'Selling charcoal enables me to feed my family without constantly having to ask my husband, who has been unemployed for ten years, for money'.[31]

Reliance on charcoal and firewood for domestic energy is so high in the region that stopping production would deprive the population of its main source of energy. Locally controlled enterprises in this supply chain need to be better organised so they can

29. Source: Conversations with charcoal sellers and dealers in Litoi market (commune of Makiso), ASPIRO market (commune of Makiso) and Cimestan market (commune of Kisangani).
30. Source: Conversation with a charcoal producer and vendor in the 11th Avenue market in the commune of Tshopo, Kisangani.
31. Source: Interview with a charcoal seller at the Cimestan market in the commune of Kisangani.

continue production without harming the forest. Local communities and entrepreneurial producers need to be made more aware of how to protect the forest, use its resources more carefully and manage it sustainably – for example by replacing trees that are felled for charcoal or firewood. State interventions should include working with national and international partners to disseminate relevant legislation and ensure that every actor in the supply chain obeys the law. This is a key subsector in the provision of domestic energy in the region and merits special attention in order to safeguard people's energy supplies and protect the forest.

The estimated annual consumption of woodfuel in DRC in 2005 was 81.6 million m^3 (FAO, 2010b). This level of consumption is causing deforestation and creating a threat to the environment that affects every link in the charcoal and firewood supply chain. Researchers, politicians, NGOs and donors should ensure that their environmental and biodiversity protection programmes take into account the role that each actor plays in this chain in the Kisangani region. Studies have shown that local people often fell trees for charcoal in primary forests because such forests seem to produce better-quality charcoal than secondary forests and fallow land, and there is strong consumer demand for a good-quality product.[32] Along with legislation, training and guidance for all the actors concerned, the public authorities urgently need to diversify energy resources to reduce the pressure on forests caused by the population's high dependence on charcoal and firewood.

Large amounts of material are also removed from the forest for housing. Almost all villages in the region and the surrounding area are built from non-durable materials – mainly sticks, which are used to construct walls and roofs, fence off plots, enclose livestock, display goods in the market, and make scaffolding and shuttering for cement works.

The prevalence of stick-built houses in the region reflects a lack of purchasing power that prevents local people from constructing and living in solidly built homes. A lack of employment and low salaries mean that a large proportion of the population cannot build their homes from durable materials. If they want to provide their families with a roof over their heads and provide some kind of domestic stability, the only option is to use sticks to build makeshift homes.

It has been shown that stick-built houses can last for 20-30 years, depending on the type of wood used. Some valuable species, such as afrormosia and other hardwoods, are felled as saplings because they provide long-lasting, termite-resistant sticks for housebuilding; an important consideration in an area where termites do a lot of damage. These sticks sell for 300-2,500 Congolese francs, depending on length (40-200cm), type and quality. The main points of sale in Kisangani are the Litoi, ASPIRO, Kikongo and Djubudjubu markets. The real problem here is that the youngest plants are systematically cut with no regard for the vital role they would otherwise play in mitigating climate change by capturing CO_2 and regenerating the forest.

32. A typical example is the consumer preference for charcoal made from *Gibertiodendron dewevrei* (limbali), which is only found in primary forests.

5. Rubber

To a certain extent, rubber production in the Kisangani region contributes to economic growth by creating jobs for men and women. The companies that farm rubber (Lobby Congo and COREX) operate in the interior of the province and use local labour to harvest the latex. Local people tend to use rubber production to supplement what they earn from their fields. They alternate between the two cropping systems, tapping rubber while they wait for their crops to ripen and selling the latex to the rubber company that operates in the locality. The money they earn slightly increases household income, enabling them to cover various household expenses, such as food, medical care and schooling, thus helping reduce poverty.[33]

Unlike rural areas where the population is almost entirely reliant on the forest and its resources, rubber-growing provides work for young people and reduces their dependence on natural forests. Because the rubber trees in this region grow in old, virtually abandoned plantations, local people use their dead wood for charcoal and firewood and as materials for housing, fencing and livestock enclosures.[34] This helps mitigate climate change by reducing pressure on natural forests as a source of these products and by enabling forest regeneration. Rubber production in the region also helps maintain biodiversity because producers only extract latex (in plantations) and do not cause serious degradation to the natural forest.

Nevertheless, researchers working on forest protection are concerned about the use of rubber trees to produce charcoal in Yangambi and Bengamisa (Kisangani PK 52 on the Buta road) because of its possible contribution to greenhouse gas emissions and the potential to cause deforestation unless practical and effective control mechanisms are put in place. Rubber plantation managers should ensure that rubber trees are protected, and they should raise awareness of the environmental role of rubber trees among staff, possibly with assistance from the authorities. They also need to better remunerate their staff, because field information indicates that employees are selling rubber trees to subsidise their salaries.

6. Rattan and *fumbwa*

Rattan is one of the ten most widely sold NTFPs in Kisangani, and it has significant market value. Some canes are used to produce artisanal goods, and much of the raw rattan sold on the market is used for fencing and adobe houses, especially in the suburbs. Rural people make raw rattan into domestic items and take large quantities of it to Kisangani by bicycle, vehicle and pirogue. Bulk shipments from different parts of the region are also sent to the city by river.

Rattan canes make excellent bindings and are widely used in settings characterised by equatorial-type rainfall and urban development dominated by traditional housing, where roofs are regularly replaced and domestic fencing and livestock enclosures constantly need

33. Latex from the rubber trees is sold directly to the company in the area at US$0.15 (150 Congolese francs) per litre.
34. In Yangambi (Kisangani PK 90), the trees from INERA's old rubber plantations are sold to local people for charcoal. Instead of having to travel long distances to find trees, local people negotiate directly with the managers of the local company.

to be reinforced. This requires large quantities of raw rattan, which cannot be recycled after use. Urban workshops that make rattan goods also have to respond to constant domestic demand from city-dwellers and commissions from various economic, health and cultural institutions. With the rehabilitation of the road network and national reconstruction efforts, markets for rattan goods are increasingly opening up in cities in the east.

Our field studies show that men produce nearly all the articles made of rattan in the Kisangani region. This activity is seen as hard, painful and dangerous because harvesters have to deal with ants, thorns and falling branches brought down by lianas, and sometimes they have to walk long distances with heavy loads. Rattan huts, beds, chairs, baskets and other products have always been made by men, while women have traditionally used rattan to make coffins and to weave items such as mats and baskets.

The harvesting and selling of rattan increase the incomes of villagers, giving them greater purchasing power and enabling them to meet basic needs. Rattan is the main source of income for some villagers and has a clear impact on household well-being. In terms of climate change, it seems that the exploitation of rattan as a forest product does not cause major harm to forest resources – although this may not always be the case, given the amount that is harvested and the high demand in local and urban markets. The various state services and national and international NGOs that work on environmental issues need to consider this issue and ensure that relevant legislation is properly enforced.

The *fumbwa* supply chain generates numerous jobs, particularly for women and children, who are the most vulnerable social groups. Women are mainly involved in marketing, which gives them a guaranteed daily income; harvesting tends to be done once or twice per week by children (and also women), providing them with weekly income. The money made from selling *fumbwa* helps stabilise household incomes and is also used to resolve periodic problems with food, health care and schooling.

Most dried *fumbwa* is exported to other African countries, such as Angola, the Republic of the Congo and Gabon, where is it bought by the Kongo, who are big consumers of *fumbwa*. Some product is exported to European countries like Belgium and France, which have quite large Congolese communities. Traders say that the leaves of *Gnetum* species can last up to two weeks after being harvested, but perishability is still an issue in getting the product to market, given the large distances often involved between the point of harvest and the main points of consumption. The *fumbwa* supply chain is poorly organised, and little attention seems to be given to conservation techniques.

Because *Gnetum* species can regenerate much more quickly than other NTFPs, *fumbwa* production does not seem to be causing serious harm to the forest or having any obvious visible impacts on climate change and biodiversity in the Kisangani region. Nevertheless, it has to be said that harvesting methods are very destructive and could eventually jeopardise the survival of this species.

9.4 Assessment of support priorities

A critical evaluation was made of the six surveyed forest subsectors – timber, oil palm, baked-brick making, charcoal and firewood production, rubber production, and NTFPs (*fumbwa* and rattan) – in the Kisangani region and their contributions to poverty reduction, household well-being, gender equity, food and fuel security, mitigating climate change, protecting biodiversity and improving soil fertility without nitrogen inputs. The six subsectors were selected among many because of their local importance. Table 31 summarises the results of the evaluation.

Table 31. Summary of subsector impacts

Subsector / Evaluation criterion	Timber	Oil palm	Baked bricks	Charcoal and firewood	Rubber	NTFPs
Income-generating opportunities for women	4	5	4	5	4	5
Food security	5	5	5	5	5	5
Energy security	4	4	2	5	4	3
Mitigating climate change	2	4	2	2	4	4
Protecting biodiversity	2	4	2	2	4	4
Improving soil fertility	3	3	2	2	3	3
Total	**20**	**25**	**17**	**21**	**24**	**24**

Scores: 5 = a positive contribution is highly likely; 4 = a positive contribution is moderately likely; 3 = there is likely to be no effect, or the social foundation or environmental boundary is not applicable in this subsector; 2 = a positive contribution is unlikely, or there will be a small adverse effect; and 1 = a strong adverse effect is likely.

Table 31 shows that it is highly likely that the regional timber supply chain contributes to food security and household stability by providing numerous jobs in Kisangani city. Women are very active as employers and traders in this chain, which gives them a degree of financial autonomy and enables them to meet their daily household needs. Artisanal operators in the Kisangani region make a moderate contribution to energy security, insofar as local people collect the branches of trees that are felled to produce timber for use as charcoal and firewood. The artisanal exploitation of timber in the region has a slightly negative effect in mitigating climate change and on biodiversity, and few policies encourage reforestation or ensure that the forest is managed sustainably. Finally, artisanal exploitation has had little visible effect on improving soil fertility in the region.

It is highly likely that the oil-palm production chain contributes to household food security and provides good opportunities for women to earn money. As noted above, women are very active at almost every level of this chain, which gives them a degree of financial security and domestic stability. The exploitation of oil palm in the Kisangani region makes a moderate contribution to energy security because villagers use oil-palm waste products to help meet their energy needs, thereby helping reduce the systematic consumption of charcoal and firewood for cooking. With regard to mitigating climate change, our research shows that the multiple sub-products generated along the chain allow a certain part of the population to find alternative sources of income without having to rely on natural forests

for their survival. Similarly, oil-palm production helps maintain biodiversity by reducing pressure on forests arising from human activities. This activity has no visible effects in terms of improving soil fertility in the region without nitrogen-based inputs.

It is very likely that baked-brick production in the region contributes to the food security of actors in the supply chain by generating good income and probably helping to stabilise household finances. Women are less active in the production process, due to the hard labour involved, but they do play a small role in the business side of the chain and can achieve a reasonable degree of financial autonomy as entrepreneurs. Brick production has a slightly negative effect on energy security due to the large (even excessive) amount of firewood required in the baking process and the consequent impact on forests. The systematic use of firewood has a negative impact on climate change mitigation because material is removed from primary and secondary forests in the region and there are few reforestation initiatives and little training on this issue. The systematic removal of firewood is detrimental to biodiversity in the region for the same reason, and the production of baked bricks has a negative effect on soil fertility, sometimes rendering production sites infertile for long periods.

It seems very likely that the charcoal and firewood supply chain contributes to the financial autonomy of women, the food security of households involved in the chain, and the energy security of the majority of the population in the Kisangani region. Charcoal and firewood are the main source of domestic energy for local people, who have few, if any, other options. Women are very active at almost every point of the chain, which enables them to cover their basic needs. However, the supply chain has slightly negative effects on efforts to mitigate climate change, protect biodiversity and improve soil fertility without the use of nitrogen inputs. Selective woodcutting, the preference for high-value timber to meet consumer demand, and the lack of regulations, reforestation policies and training are all contributing to the progressive deterioration of forest resources in the region. Charcoal-burning sites are also used to grow crops at certain times, which affects the resilience of the area.

Rubber production in the Kisangani region involves hard physical labour and has a moderate positive impact on women's incomes. The income generated by selling latex to companies in the region is highly likely to contribute to food security in households that are involved in the supply chain, enabling them to cover the cost of food, medical treatment and school fees. Rubber production probably makes a moderate contribution to energy security in the region because people use the trimmings from branches and shrubs for their domestic energy needs, which also helps slightly to reduce pressure on forest resources. The rubber supply chain also makes a moderate contribution to efforts to mitigate climate change and protect biodiversity, insofar as rubber plantations reduce pressure on natural forests and also play a significant role in helping maintain ecosystems. Rubber production does not appear to help improve soil fertility in the region.

Women are closely involved in marketing NTFPs in the region, especially *fumbwa* and rattan, so it seems highly likely that NTFPs contribute to women's incomes and household food security by providing a level of financial autonomy and domestic stability. *Fumbwa* and rattan do not appear to contribute much to energy security because their raw materials and waste cannot be used as a source of energy. *Fumbwa* and rattan help mitigate climate

change and protect biodiversity in the region to the extent that their exploitation does not directly affect the forests in which they originate, and the income they generate helps reduce direct pressure on the forest. The harvesting of NTFPs does carry the risk, however, of endangering species by overharvesting. The exploitation of NTFPs in the region has no effect on improving soil fertility.

Interpretation and recommendations

These findings indicate that some subsectors may have particular value for sustainable development in the region; for example, oil palm, rubber and NTFP enterprises score highly on aggregate. Nevertheless, the subsectors were assessed for their current impacts, not their potential impacts. This is an important point, as the low aggregate scores for timber, charcoal and brick production really stem from deficiencies in the management of the natural resources from which wood is extracted. Were it possible to enforce sustainable management, these options might provide better alternatives than those that currently are ranked highest.

In part because of this poor enforcement environment, the study provides the basis for the following recommendations regarding sustainable forest management in the Kisangani region:

- All existing regulations on the exploitation of forest resources in DRC (the Forest Code, Order 035, etc.) should be properly disseminated to ensure that all resource users are aware of and understand them.
- Local communities' prior rights to forest resources should be safeguarded by the state services and respected by artisanal operators.
- The state services that issue logging permits and authorisations should oversee artisanal operators throughout the whole production chain to guard against abuses and breaches of contract between artisanal operators and local communities.
- The state services should restructure and limit taxes on artisanal operators, many of whom work clandestinely to avoid paying taxes that may in any case end up lining the pockets of officials.
- The state services should help diversify incomes as much as possible to reduce the pressure that local people place on the forest (their main natural resource). This may require the complete restructuring and retraining of forest service staff.
- State services and national and international NGOs should design and implement businesses in which reforestation and forest regeneration keep pace with the rate of exploitation – in other words, the harvest should not exceed the sustainable supply.
- All actors involved in the artisanal exploitation of the forest should receive training, awareness-raising and advice to ensure that forests in the Kisangani region are managed sustainably.
- Locally controlled forest enterprises in the Kisangani region need to be structured effectively; operate legally (with minimal bureaucracy in registration); and be supported to increase sustainable production, gain access to markets and simultaneously protect the forest.
- Authorities should promote, support and encourage projects that make sustainable energy available (including sustainable charcoal and firewood but also other renewables), with the aim of reducing the unsustainable use of charcoal and firewood as the only sources of domestic energy.
- Environmental research centres should mobilise funding to study the underlying causes of the serious threats to Congolese forests in general, and those in the Kisangani region in particular.


TFT

Furniture workshop in Java, Indonesia.

10

Comparative analysis, lessons and conclusions

Duncan Macqueen

10.1 Introduction – prioritisation to achieve public goods

As noted in Chapter 1, forest landscapes provide a range of public goods. They underpin the social foundations of the poor (Raworth, 2012), by providing options for gender-balanced income generation, food security, energy access and so on. They also help slow humanity's overshoot of environmental planetary boundaries (Rockstrom *et al.*, 2009): they mitigate climate change, conserve biodiversity and fertilise soils without the need for chemical nitrogen inputs. In other words, forest landscapes can help keep life in balance – providing a stream of benefits for the poor and acting as a mop for the excesses of the rich (Macqueen, 2013). So how can we prioritise the best support options to deliver these public goods?

The support options range between two broad extremes:

A. Particular subsectors might deliver best against all criteria in particular contexts. If this is the case, support should be prioritised toward those particular subsectors. The ambition might be a 'monotypic mass' or cluster of enterprises within a single subsector to achieve scale efficiencies in delivering public goods.
B. A mixture of subsectors might be necessary to deliver against all the criteria in particular contexts. If this is the case, support should be prioritised towards more generic business capacity development – rather than a subsector-specific approach. The ambition might be a 'multifunctional mosaic' of enterprises that together deliver public goods.

Were the 'monotypic mass' solution (A above) to be preferred, there might be strong scale efficiencies to be had in the delivery of public goods. It would be easy to attract economic investment into large, scale-efficient, monotypic sites best suited to producing the good in question. On the other hand, monotypic mass solutions might be expected to have ecological and social drawbacks. Large-scale monocultures are vulnerable to soil degradation and flood and drought events – as climates become more erratic – and to related pest and disease outbreaks, which would be a recipe for economic volatility. Socially, the outcome might involve the displacement of local people and livelihoods.

Were the latter 'multifunctional mosaic' solution (B above) to be preferred, there might be strong social and environmental advantages. An integrated patchwork that supplied food, fuel and fibre would be open to smallholder participation and would also maintain some degree of biodiversity and ecological resilience. On the other hand, multifunctional mosaic solutions might be expected to face serious economic challenges. Remote local peoples often have insecure commercial rights and limited business capacity to supply multiple public goods in ways that are both efficient and sustainable. The transaction costs to deliver tailored enabling investments would be daunting.

The prioritisation exercises captured in the preceding eight chapters represent a unique attempt to discern where the real solutions lie on the spectrum between these two extremes. In short, can we focus in on a few subsectors of forest enterprise that deliver almost all the critical goods required by local and international publics, or do we need a broader mix of forest enterprise subsectors to attend to these goods? This chapter draws on the preceding analyses to answer that question.

10.2 Overview of differences and similarities

Differences in ecological context. What is immediately apparent in the eight country assessments is the very different forest resources in question, from the drier sub-tropical forests of Burkina Faso, Mexico and Tanzania, to the moist tropical forests of Brazil, Cambodia, DRC and Vietnam, to the montane forest of Nepal. Each country has a unique flora, with different options for the commercial development of timber, NTFPs, agroforestry and ecosystem services (including tourism). These differences can be classified into enterprise subsectors in various ways. The different analytical teams took rather different approaches to the delimitation of enterprise subsectors. Nevertheless, in all but one country, the teams assessed at least some subsectors in each of four broad categories: timber, biomass energy, plantation/agroforestry/eco-agriculture, and NTFPs (Table 32).

There are notable differences in the nature the subsectors listed in Table 32. For example, the business modalities for timber in Brazil, where trees may be 40m tall – thereby requiring substantial technology and logistics to harvest – differs considerably from, say, the timber business in Burkina Faso, where the trees have smaller dimensions. Similarly, the prospects for biomass energy businesses in Nepal, where topographic constraints make it fairly easy to enforce legality, differ substantially from, say, charcoal production in Tanzania, where competition with illegal production is much harder to enforce. The differences in ecological conditions for plantations, agroforestry, eco-agriculture and NTFP crops are self-evident between countries.

Differences in socio-political context

In addition to differences in geography and ecology, the countries also have very different governance contexts. For example, the Brazilian capacity to enforce timber extraction laws has greatly improved, albeit making bureaucratic compliance more onerous for small-scale timber firms. There is a national logging ban in Cambodia, and community timber enterprises are heavily constrained; this is partly the reason why the team there restricted its analysis to NTFP enterprises. The opposite extreme is in DRC, where a lack of law enforcement undermines the prospects for the establishment of formal and sustainable businesses.

With its system of CFUGs, Nepal has legislation that is highly favourable to local control over forest resources, although there are inevitable legal barriers to turning those core rights into business opportunities. Similarly, the Mexican tenure system provides communities with good prospects for developing local businesses from forest products. The new Forest Protection and Development Law in Vietnam has kick-started a process of devolution towards community forestry business, although this is not nearly as advanced as it is in Mexico and Nepal. Tanzania has a longstanding tradition of PFM. The situation in

Table 32. Summary of forest enterprise subsectors assessed in the eight countries				
Country	**Timber**	**Biomass energy**	**Plantation/agroforestry/ eco-agriculture**	**NTFPs**
Nepal	Logs Sawn timber Paper	Charcoal briquettes	Organic vegetables Dairy farming Fruit (citrus, pears and lapsi) Coffee Tea	Oils Medicinals Gums and resins Ginger Large cardamom
Brazil	Logs Sawn timber	Charcoal	Cocoa Banana	Açaí Andiroba oil
Burkina Faso	Logs Sawn timber	Charcoal Firewood	Fruit (baobab, citrus, mango, tamarind) Acacia seed Néré pulp	Medicinals Cosmetics Honey
Vietnam	Logs Sawn timber	Firewood	Rubber Coffee Pepper	Nuts Bamboo stems, shoots and leaves Mushrooms Honey Medicinals Rattan Ornamental plants
Mexico	Logs Sawn timber	Firewood	Coffee	Honey
Tanzania	Logs Sawn timber	Charcoal Agricultural-waste Briquettes	Indigenous fruits (*Parinari, Strychnos, Vitex, Flacourtia, Sclerocarya* and *Syzygium*) Commercial fruit Coffee Cocoa Nitrogen-fixing trees for agriculture	Honey Butterflies
Cambodia	Logs Sawn timber	Wood for baked bricks Charcoal Firewood		Oleoresin Dry resin *Strychnos seeds* Orchids Mushrooms Bamboo Honey
DRC	Logs Sawn timber	Wood for baked bricks Charcoal Firewood	Rubber Oil palm	Rattan *Fumbwa*

countries like Cambodia is far more constrained, especially in relation to timber businesses, and in DRC there is an ongoing discussion on how community forestry should be treated in revised legislation. These different governance contexts inevitably affect the subsectors or mix of subsectors that are best able to deliver impact against the criteria put forward in Chapter 1.

Differences in economic context

Beyond the differences in geography, ecology and governance, there are also very real differences in market access for locally controlled forest enterprises in the eight countries, and regions within them. In part, these differences lie in the availability of transport infrastructure to large urban and peri-urban markets – either nationally or regionally. Such differences also lie in the income status of people in those urban or peri-urban markets. For example, the transport infrastructure in Kisangani, DRC, and the remote central Sudano-Sahelian zone of Burkina Faso, coupled with the relatively low-income status of people in those areas, substantially restricts market prospects (low-income domestic markets in moderately sized urban settlements). Similar constraints, but to a lesser degree, can be seen in the market prospects in western Pará in Brazil, Cambodia's EPL, and Chiapas in Mexico. Although both the quality of infrastructure and the income levels of adjacent urban areas are higher in those cases. In at least two countries, the study areas (the Central and Western development regions of Nepal and SAGCOT in Tanzania) were chosen precisely because of their relatively good transport infrastructure and market access, although neither Nepal nor Tanzania boasts high income levels in the main adjacent markets. Perhaps Vietnam is the other end of the extreme – the infrastructure is relatively good, and connections with regional booming urban and peri-urban markets are strong.

Despite such differences, it is striking how strongly locally controlled forest enterprises are oriented towards domestic markets. This is particularly true for medium-value, high-volume products such as timber and for low-value, medium-volume products such as charcoal, firewood and fruit. Despite this domestic market orientation there are examples of high-value, low-volume products – coffee in Mexico, Nepal, Tanzania and Vietnam, honey in Burkina Faso, Cambodia, Mexico and Tanzania, and oils, resins and medicinal plants in Brazil, Burkina Faso, Cambodia, Nepal and Vietnam – where there are both domestic market options and the potential for export. While export markets may offer higher prices for such products, the degree of organisation and investment required to achieve the necessary quality and legislative compliance for export is often prohibitive. Where export is facilitated by high-volume commodity traders, for example in oil palm, rubber and cocoa, the returns to locally controlled forest enterprises may be much lower without strong organisation at scale, and such organisation was not evident in most of the study sites. The need for stronger forest and farm producer organisations – for domestic markets and especially for export markets – appears a crucial requirement to unleash the potential of locally controlled forestry.

Differences in prioritisation approaches

All the country teams were invited to respond to a shared process of prioritisation, involving identical terms of reference. While the criteria on which an assessment of impacts was to be made were identical for the groups, substantial leeway was given in how the assessment would be made in practice. Some teams, such as Nepal, opted for a very thorough assessment of a wide range of potential forest subsector enterprise options, using technical experts

embedded in their institutions to rank those options against the various impact criteria. Some other teams, such as Mexico, made a more restricted analysis of the one or two key subsectors that were already well established in the case study area, such as coffee and honey production. One team, DRC, opted to allow local enterprise groups to assess the impacts of each subsector themselves – with a consequent higher emphasis on social benefits. Some teams, such as Tanzania, used complex visual displays to show how different subsectoral enterprise options were positive for some impact criteria but not for others, thereby showing how complementary options, for example within a landscape mosaic, might be needed to provide the full suite of impacts necessary for a sustainable future.

Some teams, such as Burkina Faso, went further by assessing the differing impacts of subsector options depending on the production systems on which those options were based. This showed, for example, that construction-material enterprises stood a much better chance of economic success and impact when based on planted woodlots than on harvesting in natural woodlands. On the other hand, agroforestry food production was best achieved in naturally regenerating parkland savannah ecosystems than in intensive agroforestry set-ups, where investment costs were prohibitive.

Most of the prioritisation exercises focused on the potential of smallholder enterprises, although some, such as Vietnam, looked more concertedly at the possibilities of outgrower supply to mainstream commodity production (such as rubber, coffee and pepper). This raised the important issue of how smallholder production, as a business model, can be made economically competitive. In Tanzania it was noted that market access was much greater for subsectors with low growth prospects, such as indigenous fruit trees, butterfly farming and nitrogen-fixing agroforestry, than for those with higher growth prospects like timber and sawmilling; although there were possible openings given the right scale of organisation. Again, the organisation of forest and farm producers is critical for taking advantage of the more promising markets. A related issue is the time and investment necessary to break into attractive markets that require greater organisation, such as establishing timber plantations from seed. Clearly, poor smallholders need short-term income-generating options to complement longer-term production options that may ultimately become a way to deliver poverty reduction.

Similarity in outcomes

Another striking aspect of the assessment was that, in each of the eight chapters, country teams rejected a single subsectoral (monotypic) priority. In other words, even the most profitable, socially and ecologically sustainable smallholder production system was unable, as a monotypic mass, to deliver all the desired public goods for local populations, let alone for both local and distant populations. Instead, progress against multiple social and environmental criteria required support for a portfolio or blend of different subsectoral enterprises – that is, an approach based on multifunctional mosaics.

In each country context it was possible to identify a multifunctional mosaic blend of forest and farm enterprises that might ensure local sustainability in a system that also included international public goods like climate regulation and biodiversity conservation. For example, the Brazil team prioritised support to timber production derived from both

natural forest and agroforestry together with the domestication of NTFPs in forest and farm settlements. The Burkina Faso team prioritised tree-crop food enterprises and agroforestry fertiliser trees that support agricultural yields, along with secondary woodlot energy and NTFP enterprises. The DRC team prioritised almost everything: timber, wood energy, cash crops and NTFPs; in this case, however, all subsectors require significant governance interventions towards formal and sustainable supply. The Mexican team prioritised tree-based cash crops, such as coffee and honey, and timber and woodfuel from managed natural forest areas. The Nepal team prioritised ecosystem-based farming and biomass-based briquette production. The Tanzania team prioritised woodlots for timber and woodfuel, plus briquetted farm waste, with fertiliser trees and the development of indigenous fruit trees. The Vietnam team prioritised tree-based cash crops, for example rubber, coffee and pepper, with community plantation wood and NTFPs. The Cambodia team opted for blended NTFP options and did not assess other options.

This multifunctional mosaic landscape approach to locally controlled enterprise also meets the need for a mix of short-term and longer-term income streams for local forest farmers. Such forest farmers are typically quite risk averse, so blending a portfolio of income-generation options through enterprise support makes good sense.

Trade-offs

The consensus that, given the need to supply both local and distant public goods at the same time, a blend of enterprise options across the landscape is both necessary and desirable, provides a way forward for agencies seeking to support locally controlled forest enterprises. The task at hand is to assess the feasibility of both short-term, high-return cash crops and longer-term, lower-return socially or environmentally oriented production systems that, together, provide the full range of impacts required by local and global publics. This is the preferred option in many different country contexts, as presented in chapters 2-9.

The challenge is to manage the trade-offs that this approach involves. For example, some short-term options, for example, agricultural export crops, may do little for environmental goals such as carbon sequestration or local social goals such as food security, but they constitute a necessary platform for developing more diversified and longer-term forest product enterprises, such as timber or processed wood, or more intensive agroforestry production systems that meet local food needs.

10.3 Main lessons on what types of support to prioritise

In many of the preceding chapters, the authors concluded with recommendations on the types of enterprise-support activities that might foster multifunctional mosaic landscapes of enterprise options. Table 33 clusters and summarises some of these recommendations, and indicates the specific subsector for which the recommendation is made.

Two areas immediately jump out as critical to future support work. The first area in which support continues to be needed is the brokering of deals for policy improvements in natural resource governance and tenure. The question of secure land and forest rights

upon which locally controlled forest enterprises must be built remains one of the key stumbling blocks to enterprise-support actions that aim to deliver impacts across multiple social and environmental criteria. A recent toolkit on the governance of forest tenure highlights the multiple approaches, tools and tactics that can be used to broker such improvements in natural resource governance and tenure (Mayers *et al*., 2013).

Second, there is a need to invest in organisation-building for forest and farm producer organisations. Across a wide range of country contexts, stronger enterprise organisation is critical for market access by creating the scale efficiencies and networks that bring significant volumes of reliable quality to the market (whether domestic or international). The new Forest and Farm Facility aims to provide funding for such organisation-building within the following vision: 'smallholders, communities and indigenous peoples' organisations have improved their livelihoods and the decision-making over forest and farm landscapes'. At a recent international conference, partly coordinated by the Forest and Farm Facility in China, stakeholders from 42 countries produced a much more detailed synopsis of the importance of such organisation-building (FAO, 2014).

In addition to the two stand-out priorities, it is worth noting two other key priorities. Ongoing capacity development in business management is a critical component of support for locally controlled forest enterprises. This has long been the area of focus of the Forest Connect alliance, the experiences to date of which are captured in a toolkit (Macqueen *et al*., 2013). Developing appropriate mixtures of enterprise options at a landscape level – within a multifunctional mosaic that also restores the ecosystems on which future prosperity will be based – is also essential.

Forest Connect members have participated in 11 dialogues on 'investing in locally controlled forestry' held between investors and local forest and farm rightsholders (Macqueen *et al*., 2013). The dialogues looked specifically at how to make a multifunctional mosaic of small forest and farm enterprises economically viable. At the dialogue held in Nepal, Peter DeMarsh, of the International Family Forestry Alliance, summed up this combined knowledge succinctly in a way that encapsulated several of the key recommendations made above. He noted that local forest farmers will deliver social and environmental forest-related public goods if they can answer yes to each of the following questions:

- If I plant tree x (for food, fuel, fibre and conservation, etc.), will I have the right to sell it? (The tenure question)
- If I plant tree x (for food, fuel, fibre and conservation, etc.), will I be able to sell it at a fair price? (The business support question)
- If I plant tree x (for food, fuel, fibre and conservation, etc.), will I be able to get the management and technical support to protect it from pests and diseases and package it for the market? (The technical extension question)
- If I plant tree x (for food, fuel, fibre and conservation, etc.), will I be able to associate with others to make sure I can carry on answering yes to the previous three questions? (The freedom of association/organisation question)

Table 33. Summary of recommendations for the support needed for various forest subsectors

Recommendation for support	Subsector for which recommendation was made	No. of subsectors subject to the recommendation
Brokering policy deals for policy improvements in natural resource governance and tenure	Biomass energy (Nepal); agroforestry food production and NTFP enterprises (Burkina Faso); timber (Vietnam); NTFP enterprises (Cambodia); mixed enterprise options (DRC)	5
Organisation-building for business – to allow market expansion and strengthen value chains – and the inclusion of smallholders in them	Biomass energy (Nepal); ecosystem-based farming (Nepal); timber (Nepal); timber, agroforestry and oil products (Brazil); NTFP enterprises (Burkina Faso)	5
Capacity development in business management, with tailored training in production management, harvesting, processing and packaging standards	Mixed enterprise options (Vietnam); NTFP enterprises (Cambodia); mixed enterprise options (DRC); timber, agroforestry and oil products (Brazil)	4
Support for developing appropriate smallholder landscape-mosaic, ecosystem-based business models	Ecosystem-based farming (Nepal); biomass energy (Burkina Faso); mixed enterprise options (Vietnam); NTFP enterprises (Cambodia)	4
Brokering market interactions and investment deals	Ecosystem-based farming (Nepal); NTFP enterprises (Cambodia)	2
Research for investigating markets and production systems	Timber, agroforestry and oil products (Brazil); NTFP enterprises (Burkina Faso)	2
Improved and sustainable tree productivity	Timber (Nepal); agroforestry food production (Burkina Faso)	2
Research and development of new technologies	Biomass energy (Nepal); mixed enterprise options (Vietnam)	2
Media work to change public attitudes to timber-growing	Timber (Nepal)	1
Farmer-led research and knowledge for business	Mixed enterprise options (Vietnam)	1

10.4 Policy recommendations

Much practical work can be done to improve support for locally controlled forest enterprises that deliver multiple positive social and environmental impacts. This support is now referred to as 'enabling investment' because it falls outside the remit of – but is a necessary precondition to leverage – more conventional 'asset investment'. Reflecting the questions posed by DeMarsh above, the key policy recommendations to a wide range of government, private-sector and civil-society actors that spring from this work are:

1. Secure commercial land and resource tenure for local people.
2. Simplify the procedures through which enterprise-oriented organisations and ultimately political federations can emerge and underwrite the costs of organisation-building.
3. Invest in practical programmes that strengthen the business capacity of locally controlled forest enterprises.
4. Revitalise the necessary technical extension services to install a mosaic of enterprise options that delivers multiple positive social and environmental impacts.

In the forest sector, current development agendas are focused primarily on two main approaches: (i) using trade conditionality to enforce legality assurances for timber, for example through the FLEGT initiative and the US Lacey Act; and (ii) using climate finance linked to REDD+ to broker better forest governance and provide financial incentives for the sustainable management of forest and farm landscapes.

Given the huge number of locally controlled forest producers, a critical element of both of these approaches must surely be to support the most positive social and environmental impacts of this sector, which undoubtedly is the largest forest-related 'private sector'. To do that, FLEGT and REDD+ programmes must give much more explicit attention to the four key policy recommendations made above. For example, how do the latest FLEGT/REDD+ strategies secure commercial land and forest rights for local people? How do they foster associations that can give scale efficiencies and smallholder representation to further improve the national enabling environment? How do they build the capacity of sustainable locally controlled enterprises in multifunctional mosaics? How do they equip those producers with the agronomic and technical knowledge to manage diverse portfolios of enterprise options within multifunctional mosaic landscapes?

If initiatives can give good answers to these questions, they are likely to be on the right track. If they are unable to answer them adequately, it is likely that they are fostering large-scale monotypic approaches that probably won't provide an optimal mix of forest goods and services that serve both local and international publics. This matters because, at present, humanity is crashing through planetary boundaries while still failing to meet the needs of the world's poorest people.

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In a finite biosphere there is a limit to what a growing human population can do and still survive. A safe operating space between planetary boundaries at one extreme and the needs of the world's poorest people at the other. How to achieve this safe operating space is increasingly the focus of the post-2015 framework for sustainable development. Locally controlled forest enterprises have a substantial contribution to make if supported to produce food, fuel and fibre products in ways that improve local livelihoods and resilience in the face of increasing environmental and economic shocks. They offer an alternative approach to a green economy – 'making economic what is green' rather than 'greening what is economic'.

The sheer scale of locally controlled forest enterprises is at once an opportunity and a challenge. On one hand, these myriad and frequently informal enterprises often constitute the largest forest-based private sector. They have transformative potential at a landscape scale – as examples from places as disparate as China, Guatemala and Sweden readily attest. On the other hand, providing the organisational, technical and business support required to unleash this potential is a formidable challenge when they are spread across remote, and often impoverished, forest areas.

Lamentably, international aid for support to locally controlled forest enterprises is scarce. Prioritising those scarce resources therefore becomes crucial. Should particular forest subsectors receive priority support because of their disproportionately positive provision of public goods? Or is a mosaic of different forest subsectors necessary to deliver the full range of public goods – and if so, what particular types of support are most generically useful to sustain such a mosaic? This report draws together eight country studies from Nepal, Brazil, Burkina Faso, Vietnam, Mexico, Tanzania, Cambodia and the Democratic Republic of the Congo, that attempted to answer such questions. The answers matter because, at present, humanity is crashing through planetary boundaries while still failing to meet the needs of the world's poorest people.

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