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PRODUCTIVE LANDSCAPES (PROLAND)

PROMOTING SUSTAINABLE WOODFUEL SYSTEMS: A REVIEW OF THE LITERATURE AND RECOMMENDATIONS FOR PROGRAM DESIGN

JULY 2021

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The Productive Landscapes (ProLand) project supports USAID Missions to improve land use management using a systems approach to resilient development that integrates ecological, economic, and governance aspects. Using primary and secondary research, ProLand develops and disseminates evidence-based guidance around best management practices for sustainably intensifying land use. The ultimate objective of the guidance is to help USAID achieve integrated impacts related to increased food production, reduced biodiversity loss, reduced greenhouse gas emissions, and increased resilient and inclusive economic growth. Accordingly, USAID tasked the ProLand team to review the evidence-based literature to develop recommendations for promoting sustainable woodfuel production.

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Cover Photo: Coppice from live stump, Haiti. Photo by Glenn Smucker

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

BME	Bureau of Mines and Energy
CBFM	Community-Based Forest Management
CIAT	International Center for Tropical Agriculture
DENR	Department of Environment and Natural Resource
ESMAP	Energy Sector Management Assistance Program
FAO	United Nations Food and Agriculture Organization
FMU	Forest Management Unit
FRA	Forest Replacement Associations
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit*
IEA	International Energy Agency
IEMS	Inclusive Entrepreneurial Market Systems
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
Mha	Million Hectares
MEDD	Ministry of Environment and Sustainable Development
NNNP	North Negros Natural Park
NPPFRDC	Ngan, Panansalan, Pagsabangan Forest Resources Development Cooperative
NYDF	New York Declaration on Forests
ProLand	USAID Productive Landscapes Project
USAID	United States Agency for International Development
WB	World Bank
YISEDA	Young Innovators for Social and Environmental Development Association

PREFACE

Countries dependent on woodfuel recognize the threat this energy source represents to their forests. In areas of high demand such as around urban centers, overharvesting trees for fuel can damage forests and lead to deforestation. Governments work to reduce demand through attempts to transition users to other energy sources, and they invest in technologies to transform and burn woodfuel more efficiently. They complement these efforts with programs to protect natural forests and increase overall tree cover. Governments also undertake afforestation campaigns, regulate the forest sector, and strengthen local forest stewardship. Less directly, governments influence the woodfuel sector by altering the agricultural context and business climate for smallholder tree cultivation. These four components of a sustainable woodfuel program can reinforce each other. Government-led reforestation campaigns generate political will and popular awareness, while efficient and equitable regulation controls overharvesting and supports inclusive markets. Decentralizing forest management empowers and engages local communities, while enabling smallholder tree cultivation creates a sustainable alternative to wood harvested from natural forests. In this paper, we describe each of these components and the considerable challenges governments face implementing them, and offer recommendations for addressing those constraints. We give special attention to the growing trend of smallholder tree cultivation, which plays a critical role in enabling inclusive and sustainable woodfuel markets.

1.0 PURPOSE, SCOPE, ORGANIZATION, METHODS, AND THE LIMITS OF OUR UNDERSTANDING

Governments and the international development community are increasingly concerned about the impact of woodfuel harvesting on forests (Arnold et al., 2006; Sola et al., 2017; FAO, 2017). Forests play a critical role in sustaining the world's biodiversity, mitigating climate change, and supporting global economic growth. Overharvesting for woodfuel can diminish these benefits and, in extreme cases, destroy forests. Improved woodfuel management supports international environmental goals, is an element of landscape revitalization efforts such as the Bonn Challenge, and contributes to global efforts to reduce forest carbon emissions. Donors and governments also see woodfuel as a potential driver of rural development and income generation (Smith et al., 2019). This paper aims to assist development practitioners to strengthen programming intended to reduce the environmental impact of woodfuel harvesting. It provides an overview of the woodfuel sector and four components of sustainable woodfuel programming, lists common challenges facing the sector, and includes recommendations intended to orient national-level programming.

This study focuses on the sustainable production of woodfuel. It provides only limited information on other topics related to woodfuel such as: the impact of woodfuel use on health; income impacts from woodfuel sales; and the sale, transformation, transportation, and marketing of woodfuel. Nor does it focus on the important topic of the marginalized role of women in the sector, or the introduction of alternatives to woodfuel. For information about clearing forests for agriculture, an important source of woodfuel in many countries, see ProLand's Agriculture's Footprint: Designing Investment in Agricultural Landscapes to Mitigate Tropical Deforestation report.

Women bear a woodfuel burden

Of the 850 million people engaged in the arduous tasks of collecting fuelwood or producing charcoal, about 83 percent are women (FAO, 2018). Cooking with woodfuel, which produces various airborne toxins, also damages the health of women more frequently than men.

This paper begins with a description of woodfuel sources, and the impacts on forests associated with them. The chapters that follow describe four interrelated components of a sustainable woodfuel program and present the challenges faced in the application of each. They also illustrate challenges to decentralizing national woodfuel management through two "mini-case studies" describing efforts in Burkina Faso and the Philippines. The final chapter offers recommendations for government and donor investment to promote the sustainable production of woodfuel.

Annex I provides abstracts and links to woodfuel case studies ProLand conducted in Senegal, Madagascar, and Haiti. These cases illustrate the points made in this paper and provide the basis for many of our recommendations. The Madagascar study describes the factors that influence the sustainability of woodfuel sourcing at national and regional scales. The Senegal study chronicles the regulatory challenges the country faces in the transition to increased local management of forests producing woodfuel. The Haiti case study focuses on the factors that influence smallholder tree cultivation. Annex II presents an annotated list of tools useful in the design of programs to promote sustainable woodfuel markets.

This document draws on a review of recent scientific literature and selected development literature. While we have used the best information available, additional research could increase the confidence of our claims. Despite the increase in research on woodfuel since 2000, gaps remain regarding the

institutions and behaviors that provide the requisite controls and incentives in the woodfuel sector. Speculative prescriptions dominate the development literature, in which claims of success are often made with a few sentences, bullet points or paragraphs. In 2017, Sola et al. (2017) systematically mapped recent peer-reviewed research of the woodfuel value chain in sub-Saharan Africa and found significant weaknesses in the design of almost all the 152 selected studies, concluding that current literature provides a "weak and geographically limited evidence base" upon which to develop policy recommendations. Additionally, some technical questions at the core of woodfuel harvesting remain unanswered, such as the impacts of different harvesting plans and regeneration rates in different forest types. Other topics addressed in our study require research on adjacent subjects. For example, a complete understanding of the incentives for field tree cultivation would require targeted research on non-market drivers, such as associated benefits to agricultural production, which is currently missing in the literature as noted by Mendum and Njenga (2018). The Intergovernmental Panel on Climate Change (IPCC, 2019b) concluded that, overall, much remains to be learned concerning the traditional biomass sector, including woodfuel.

2.0 THE WAYS WOODFUEL IMPACTS FORESTS

Governments, the development community, and researchers have long debated the role of woodfuel production on forest health. The absence of credible information regarding the impact of harvesting has allowed for large shifts in the attention given to this sector. Periods of limited concern may be attributable to the belief that dependence on woodfuel as an energy source does little damage to forests. Properly managed, woodfuel can be a sustainable source of energy (Neufeldt et al., 2015). Woodlands in many countries can eventually regenerate the biomass and biodiversity lost from tree harvesting, although that may take 30 years (Chidumayo & Gumbo, 2013; Woollen et al., 2016; Doggart & Meshack, 2017).

More recently, attention has returned to woodfuel harvesting because the threat it poses to forest health has become clear. In 2019, the IPCC concluded that national dependence on woodfuel for energy causes high land and climate impacts (IPCC, 2019b). Demand has increased as urban populations continue to grow and expected shifts to alternative energies have not occurred (see the "What constrains the transition to other energy sources?" text box). Recent projections find that woodfuel harvesting will result in long-term forest degradation (Santos et al., 2017). Even though woodfuel harvesting for fuel rarely causes deforestation, and when it does, the impact is localized (Chidumayo & Gumbo, 2013; Bailis et al., 2015; Masera et al., 2015; FAO, 2017; Santos et al., 2017), harvesting woodfuel is among the most significant causes of degradation in the world's forests (New York Declaration on Forests [NYDF] Assessment Partners, 2019).

What constrains the transition to other energy sources?

Continued dependence on woodfuel is commonly associated with rapid population growth, low incomes, limited access and unreliable supply of other sources of energy, and a constrained capacity to generate more electricity. Consumer preference also plays a role; many households continue to cook with woodfuel even as other options are available.

This paper gives most attention to one segment of the market, charcoal production for urban populations, because it both contributes the most to the creation of hotspots of forest loss and provides opportunities for intervention since it is geographically concentrated and more closely regulated than rural consumption patterns. Charcoal commoditization provides opportunities to use inclusive market system approaches to increase income generation. We focus primarily on woodfuel systems in Africa because the continent contains countries with some of the hottest hotspots and greatest woodfuel energy deficits.

2.1 THE SOURCES OF WOODFUEL

The 2019 IPCC Special Report on Climate Change and Land notes that woodfuel use impacts forests differently depending on the process through which it is produced. The strength of demand and the harvesting regime determine the impact of woodfuel harvesting on forests. Land type, local climate, and initial carbon stocks also play a role (IPCC, 2019a). Below we provide an overview of supply sources and demand, and how the manner and timing of harvesting impact forests differently.

Approximately 30% of woodfuel consumed exceeds rates of regrowth. This unsustainable portion emits an estimated 1–2.4 Gt of CO_2e annually and contributes 2 to 7 percent of global anthropogenic emissions (Bailis et al., 2015; FAO, 2016b).

Forests. By far the greatest portion of woodfuel is harvested from forests whose trees have regrown naturally after being cleared. Primary forest also provides woodfuel, but these forests tend to be more remote, and better protected.

Plantations. A much smaller portion of woodfuel comes from trees that have been planted. China, India, and Brazil harvest a growing portion of their woodfuel from trees planted in monocrop plantations. Brazil has established more than 4Mha of large-scale charcoal producing Eucalyptus plantations (*Deutsche Gesellschaft für Internationale Zusammenarbeit* [GIZ], 2015). While growth led by these countries increased the area of global planted forest by more than 30 percent between 2000 and 2017, plantations still represent only 7 percent of all forested land (World Bioenergy Association, 2019). Africa sources a much smaller proportion of its woodfuel from planted trees, less than 5 percent (Drigo et al., 2014; Sepp et al., 2014; FAO, 2017). In East Africa, where the largest plantations are found, governments and donors have been reducing funding in plantations since the beginning of this century, leading to a slow decline in their economic sustainability. See the ProLand Madagascar case study (Miller et al., 2021) for a description of woodfuel production on plantations in one country.

Area in plantations (ha)

- Zambia: 52,000
- DRC: 58,000
- Kenya: 153,000
- Madagascar: 312,000
- Uganda: 465,000
- Tanzania: 553,000
- Ethiopia: over a million
- Sub-Saharan Africa average: 196,000

(FAO, 2020)

Agricultural lands. People also harvest and sell wood from trees planted in small woodlots, orchards, field boundaries and pastures. In Senegal, non-forest woodfuel sources include relatively stable parklands with a 5 to 10 percent tree cover and extensive orchards in peri-urban areas (Herrmann et al., 2013). In rare cases, woodfuel markets depend on trees cultivated on agricultural lands. Smallholder farmers produce over 90 percent of Haiti's domestically sourced energy (International Energy Agency [IEA], 2020; Bureau of Mines and Energy [BME], 2005).

Clearing land for agriculture. In some contexts, land-use change produces significant amounts of woodfuel.[1] Countries with large forest areas derive a greater percentage of their woodfuel as a byproduct of land clearing and logging. Given accessible markets, woodfuel produced through land clearing may enter commercial streams and generate income. In this case, woodfuel demand is not the primary driver. Its sale does not stimulate additional logging or forest clearing (Drigo et al., 2014; FAO, 2017).

Minor sources that provide woodfuel as a byproduct include remnants, chips, or pulp produced during timber processing (Drigo et al., 2014; FAO, 2017).

2.2 THE IMPACT OF HARVESTING REGIMES

Intensity, methods, and the tree selection criteria. These three factors may determine whether harvesting results in regeneration, degradation, or deforestation. Distance to forests plays a role in the frequency and extent of harvesting. Because woodfuel is a bulky, low value commodity, transportation costs strongly influence economic returns. Poor or costly transportation networks create pressure to harvest from nearby forests. As a result, supply zones typically expand outwards from urban centers over time as closer sources are exhausted.

[1] This potential for land-use change to generate woodfuel explains much of the uncertainty in estimates of woodfuel supplies, as there is no reliable data regarding proportions of cleared trees that are converted to woodfuel.

In rural areas with a low population density, harvesting for domestic use has little impact, especially when the wood is primarily collected from dead trees and fallen branches. Conversely, commercial operations more frequently harvest large portions of forests, and lead to slow regrowth rates and impaired ecosystem services. Charcoal, the most commercialized form of woodfuel, is widely associated with intensive harvesting and land degradation (IPCC, 2019b). In parts of eastern and southern Africa, prolonged and frequent harvesting of a high percentage of trees for charcoal has transformed areas of woodlands to scrub lands (Chidumayo & Gumbo, 2013). Urban markets for charcoal contribute strongly to modeling projecting overharvesting in the future (Santos et al., 2017; Bailis et al., 2017).

The potential to reverse charcoal's damage to Zambia's forests

Growth of urban populations has produced a 45-fold increase in the demand for charcoal in Zambia since 1969. This demand spike in turn drove a ten-fold increase in degraded forest area (Ziba & Grouwels, 2017).

The damage is not necessarily permanent everywhere. Biodiversity eventually returns to the country's miombo forests after harvesting has been discontinued (Dlamini et al., 2016). Carbon stocks recover after 20 years (Kalaba et al., 2013).

Some commercial charcoal producers clear-cut. This removal of all trees clearly destroys forests. In Africa, clear-cutting appears to be more widespread in east and southern Africa. In West Africa, selective harvesting may be more prevalent (Chidumayo & Gumbo, 2013). In certain regions, charcoal enterprises exclusively harvest hardwoods because they result in a higher quality product. This selective harvesting for woodfuel, if it is continuous, alters forest composition and impairs forest ecosystem functions, resiliency, and productivity (Bailis et al., 2015; FAO, 2016a). Woodfuel may also be harvested through coppicing, which entails cutting trees back at ground level. Here too, the regime makes a difference. Harvesting trees of the right size at the right height for their species may greatly increase regrowth rates (Syampungani et al., 2017).

TABLE 2.1: SOURCES OF WOODFUEL BY TREE ORIGIN AND SCALE OF MANAGEMENT

		TREE ORIGIN		
		NATURAL	*REGROWTH*	*PLANTED*
MANAGEMENT SCALE	HOUSEHOLD	Primary forest cleared for agriculture	Fallow, field trees, coppiced fallow	Orchards, woodlots, hedges, windbreaks, perennial crops
	COMMUNITY	Primary forest managed or owned by communities	Secondary forest managed or owned by communities, enclosures	Community woodlot
	NATIONAL	Primary forest in protected areas and concessions	Secondary forest in protected areas and concessions	Reforestation programs

3.0 THE FOUR COMPONENTS OF AN INTEGRATED APPROACH TO PROMOTING INCLUSIVE, SUSTAINABLE WOODFUEL MARKETS

Sustainable woodfuel programs require long-term investments that integrate complementary approaches. Governments promote sustainable woodfuel production through: afforestation campaigns; forest sector regulation; decentralization of forest management; and actions altering the agricultural context and business climate for smallholder tree cultivation. Government-led reforestation campaigns generate political will and raise popular awareness, while efficient and equitable regulation controls overharvesting and supports inclusive markets. Decentralizing forest management empowers and engages local communities, while enabling smallholder tree cultivation creates a sustainable alternative to wood harvested from natural forests. Despite the potential of the growing trend in smallholder tree cultivation, reforestation and afforestation do not substitute for protecting forest. Natural forests support substantially greater levels of biodiversity than lands where trees have been planted, and on average store 40 times more carbon than plantations, and 6 times more carbon than agroforestry (Chamshama & Nwonwu, 2004; NYDF Assessment Partners, 2019). Nor does progress in reforestation necessarily slow loss of natural forest, as shown in Vietnam (Kull et al., 2019). Governments and their partners need to attend to all four of the components to successfully promote sustainable and inclusive woodfuel markets.

3.1 COMPONENT ONE: GOVERNMENT-LED REFORESTATION

Efforts to increase woodfuel supply fit naturally within national-led campaigns to increase the regrowth and cultivation of trees. Throughout modern history, governments have undertaken large-scale tree cover restoration campaigns to increase timber supply, provide ecosystem services, and combat erosion or flooding. To achieve their goals, governments may use compulsory measures such as land expropriation, or implement incentive programs that rely on payments or other benefits, such as rights in land. The campaigns may promote regrowth in forests, monoculture plantations, or trees on agricultural lands. While few campaigns focus on the woodfuel market, they all contribute to woodfuel supply.

Between 1953 and 2007, South Korea expanded forest cover from 35 percent to 64 percent of the country's total area. Between 1940 and 2010, Puerto Rico raised its forest cover from 6 percent to 60 percent of the island. Sweden and Costa Rica have also experienced large-scale restoration (Hanson et al., 2015). Large-scale government-led reforestation programs have most often demonstrated success where strong centralized governments target specific, urgent needs, such as reducing soil erosion or meeting the demand for commercial timber. Addressing these challenges of national importance often requires dramatic reforms of forest policies and increased investment of government

Factors behind progress in El Salvador

- El Salvador restored 122,000 hectares of forest between 2014 and 2018. Key factors in making the political will for reforestation a reality were:
- Participatory planning process from the beginning
- Restoration goals integrated into strategies, policies, and laws across ministries and at all levels of government
- A National Monitoring Plan

(NYDF Assessment Partners, 2019)

resources over a long time period. Successful campaigns require organized, thorough, and persistent effort. They also require a systematic approach to land resource management, and effective local and national reward systems (Mansourian et al., 2017; Stanturf et al., 2019). China launched the large-scale "Grain for Green" program to address flooding and soil erosion and increased forest cover by 9.5 million hectares (Mha) between 2000 and 2010, primarily through afforestation with timber species on erosion-prone mountainous terrain and barren lands. The PRC Government motivated farmers to participate in the voluntary program by providing seedlings, grain subsidies, and annual cash stipends, in addition to forest land-use rights certificates. Vietnam increased forest cover by 2.5 Mha over the same period, largely through state timber plantations (NYDF Assessment Partners, 2019; Rudel et al., 2020).

Countries collaborating on the Bonn Challenge take a variety of approaches to promote reforestation. The campaigns are as varied as the countries that undertake them, targeting cocoa agroforestry systems (Ghana); financing small-scale farmers (Rwanda); assisting natural regeneration (Burkina Faso); and restoring degraded mangrove areas (Vietnam, Thailand, Indonesia).[2] As of 2019, 13 countries expressed commitments to restore 44 Mha, principally through silviculture and natural regeneration on degraded forest lands, and agroforestry on agricultural lands. A small percentage are supporting commercial plantations to restore degraded lands (Dave et al., 2019).

3.1.1 Challenges to National Reforestation Campaigns

Countries where governments have invested fewer resources over less time have not seen an enduring change in tree cover. African plantation programs of the 1970s and 1980s designed to provide woodfuel for urban centers rarely proved sustainable, and when donor funding dried up activities were discontinued and production gradually deteriorated on the unmaintained woodlots and plantations. Ethiopia established as many as 40,000 hectares of energy plantations between 1975 and 1994 in peri-urban areas that were neither maintained nor expanded upon (Chamshama & Nwonwu, 2004). Projects promoting community-level plantations elsewhere in Africa over the same period faced similar challenges, and similar fates. Parallel to planting campaigns, woodfuel harvested from natural forests continued to be sold at prices that undermined the economic viability of plantations established by governments, while poor management, lack of technical expertise, and conflicts over land also proved detrimental (Hofstad et al., 2009; Chidumayo & Gumbo, 2013; GIZ, 2015). In the 1970s and 1980s, over approximately 12 years, the Government of the Republic of Niger, supported by international development agencies, implemented projects that planted 60 million trees. The effort is often considered a success, yet less than half of the planted trees survived (Hanson et al., 2015).

Despite global commitments and apparent governmental will, countries that have taken up the Bonn Challenge have fallen short of their targets. Even El Salvador, one of the most successful countries, has met only 12 percent of its restoration pledge (see "Factors behind progress in El Salvador" text box). Overall rates of reforestation in participating countries have slowed over the past decade (NYDF Assessment Partners, 2019).

Challenges to landscape restoration

The Madagascar 2017 National Strategy for Forest Landscape Restoration and Green Infrastructure identifies four primary challenges to landscape restoration that may hinder the afforestation initiative: 1) weak management by the national government; 2) a lack of local governance capacity; 3) a shortage of technical skill; and 4) a lack of national and international financial support (Ministère de l'Environnement et du Développement Durable [MEDD], 2017).

Critics argue that restoration takes too long, costs too much, and produces too few benefits to justify public or private expenditures (Stanturf et al., 2019). Successful campaigns require more political will and resources than many

[2] More information on all these efforts and those of other countries may be found at the Bonn Challenge website and the International Union for Conservation of Nature (IUCN) Bonn Challenge portal.

governments can dedicate. They are weakened by competing interests and conflict between prioritizing livelihoods versus biodiversity (Dave et al., 2017).

Whether undertaken as one component of a restoration campaign, or designed exclusively to increase the availability of woodfuel, sustainable and substantial growth in woodfuel production at a national scale requires a supportive policy and regulatory context, the engagement of local stakeholders, and a vibrant and inclusive market for smallholder-produced woodfuel. The following sections provide background and recommendations for the implementation of these three complementary components of an integrated woodfuel program.

3.2 COMPONENT TWO: NATIONAL GOVERNMENT REGULATION OF WOODFUEL

Management of the woodfuel sector naturally falls under the much larger domain of forest policy. Woodfuel regulation typically focuses on the protection of natural forests through restrictions on the location, methods, and frequency of harvesting. It may also limit production through controls on transformation, transportation, storage, and sales. Common policy tools governments use to achieve these objectives include harvesting plans, licenses and permits. They may also require permits and assess fees higher up the supply chain to enforce standards for the transport, transformation, storage, and sale of woodfuel. Ideally, policymakers base woodfuel policies on forest and supply chain monitoring. The revenue generated through regulations may become an important source of revenue for the forest service.

3.2.1 The Unsuccessful Regulation of this Challenging Sector Forestalls Formalization, and Biases Larger Actors

Governments in the developing world have difficulty fostering sustainable, equitable, transparent, and efficient woodfuel markets (de Miranda et al., 2010; Blundo, 2011; Zulu & Richardson, 2013; Schure et al., 2013; Sepp et al., 2014; Iiyama et al., 2015; Faye & Ribot, 2017). The sector is perhaps most challenged in Africa, but these challenges are not unheard of elsewhere, as evidenced by recent studies of corruption and elite control in the woodfuel value chain in Peru and the Philippines (Bennett et al., 2018; Pulhin & Ramirez, 2016).

Barriers to better policy

- Policymakers assume woodfuel is an underlying cause of forest degradation and deforestation
- International initiatives fail to recognize the importance of wood energy as part of the energy mix
- Policy makers regard woodfuel energy as "primitive" or "backward," and promote unattainable alternative "modern" energy sources
- Reliable forest sector data is unavailable and does not inform government policies and strategies (World Bank [WB], 2013)

Three characteristics common to woodfuel markets make this sector particularly difficult to regulate: 1) They are complex, as woodfuel comes from multiple sources of different scales and types; 2) They are geographically diffuse, as woodfuel comes from large geographic zones that reach into remote areas; and 3) They are informal, as the woodfuel value chain receives little capital investment and is dominated by person-to-person transactions (Sepp et al., 2014). These characteristics of the sector, combined

African NDCs shortchange woodfuel

When African countries have expressed their commitments to reduce national emissions and adapt to the impacts of climate change in their Nationally Determined Contributions (NDCs) they have given little weight to the woodfuel sector. NDCs commonly suggest woodfuel is a "backwater technology," gloss over specifics, and fail to identify institutional responsibilities (Amugune et al., 2017).

with other common constraints on woodfuel sector policies (see: "Barriers to better policy" text box), regularly lead governments to: 1) develop incomplete, coercive policies that suppresses economic activity and 2) improperly and incompletely administer policies, which leads to overharvesting and market concentration.

Incomplete, coercive policies that suppress economic activity. National policy frameworks for woodfuel are often a low priority, poorly developed, and rely on penalties more often than incentives. Governments treat woodfuel as a sector of lesser importance and invest insufficient resources to developing policies. Forestry may be the most natural "home" for woodfuel regulation, but policy in this sector often focuses exclusively on regulating the timber industry. Policy regarding the use of forest products focuses on logging concessions and their administration, while policy regarding trade in forest products focuses on roundwood. Rather than developing unified coherent legislation for woodfuel, governments tend to address it piecemeal and across multiple sectors. Rules that impact the production and marketing of woodfuel may be found in legislation concerning forestry, agriculture, environment, local government, land law, commerce, and other sectors. In Africa, rules that address woodfuel most often appear within the laws codifying the management of decentralized forests (Kohler & Schmithüsen, 2004). Many of the governments with an overall woodfuel strategy, such as Zambia, Cameroon, Malawi, Democtratic Republic of Congo, and Kenya, have rules regarding woodfuel in the legislation of multiple sectors (Sola et al., 2019). Legislation regarding charcoal generally receives even less attention than does woodfuel. As of 2006, in East Africa, only Kenya and Northern Sudan specifically addressed charcoal in policy (Mugo & Ong, 2006). Because they are conceived independently and at different times, the various rules often overlap, conflict, and are incomplete or unclear (WB, 2011a; Schure et al., 2013; Iiyama et al., 2015; Neufeldt et al., 2015; Sola et al., 2019). Malawi is one of the few countries in Africa with a comprehensive charcoal strategy. (See "One country with a charcoal strategy" text box.)

Successful policy innovation: woodfuel replacement

Begun in Brazil in the 1980s, Forest Replacement Associations (FRAs) contract farmers to grow trees to replace woodfuel consumption by businesses. Key elements:

- Law requires businesses to replace the wood they consume.
- To meet this requirement, businesses pay a fee to a local FRA, which contracts with farmers to produce trees. The government monitors the process.
- The FRA provides seedlings to local farmers. It may also provide technical assistance, fertilizer, pesticides, or fencing materials.
- Farmers own the trees, but agree to give the participating business first refusal when the wood is sold.
- Farmers may be required to meet conditions, such as dedicating a specific area to trees, or a percentage to native fruit and wood species.
- FRAs function less well at a distance from wood-consuming businesses and where there is less available land that is unsuitable for agriculture, but suitable for tree crops.

(Source: WB, 2013; GIZ, 2015).

One country with a charcoal strategy

The Malawi National Charcoal Strategy promotes fuel-efficient cooking; improved collection and dissemination of information; better enforcement and regulation; and the cultivation of fast-growing tree species through concessions to large-scale commercial interests and on degraded government plantation land, in combination with smallholder out-growers producing on marginal lands or homesteads (Republic of Malawi, n.d.).

The poorly developed policies that governments promulgate tend to rely on coercive powers. They rarely include incentives to improve forest stewardship or promote reforestation or afforestation, such as tax incentives, payments for environmental services, cost sharing, or improved access to markets (Sepp et al., 2014; Smith et al., 2019). The punitive measures at their core, such as taxes, fines, and permits, are designed to control behavior and dampen economic activity (WB, 2011a; Sola et al., 2019). As a result, they do not exploit

the sector's potential to provide broad-based incomes and economic development in rural areas (Iiyama et al., 2017).

Incomplete and improper administration of poorly developed policies leads to overharvesting and market concentration. Governments complement lax policy development with underfunded implementation. The forestry services tasked with administration are strapped for resources: too few field agents allotted too few vehicles monitor remote forests ineffectively, review harvesting plans inadequately, and administer systems of permits and fines ineffectively and inequitably. Rather than working in forests, agents are often posted in easy-to-access locations, such as transportation routes and markets (United Nations Food and Agriculture Organization [FAO], 2014). Beyond the reach of the forest service, value chain actors reuse permits, or do not make the effort to obtain or update them. Transporters evade regulation by driving at night or on unregulated routes. Actors all along the value chain rely on bribes when they get caught (Hofstad et al., 2009; de Miranda et al., 2010; Schure et al., 2013; Neufeldt et al., 2015; Iiyama et al., 2015).

This threadbare implementation of poorly developed policy produces perverse consequences. It creates a bias towards larger actors and enables corrupt behavior. The administrative burdens of regulation create a bias towards individuals with the know-how, connections, and resources to navigate administrative controls (Neufeldt et. al, 2015). They also push market actors towards the gaps produced by the incomplete coverage, and towards illicit behaviors and unregulated geographies beyond government's reach. This increases the amount of illicitly produced woodfuel which, by escaping the costs of regulated production, sells at lower prices than regulated woodfuel, thus undercutting the goals of regulation. The continued informal nature of the sector reinforces negative perceptions and decreases the potential for investment from the government and the private sector necessary to develop a more sustainable system (Owen et al., 2013; Doggart & Meshack, 2017; Sola et al., 2019). The ProLand Senegal case study (Miller et al., 2020) presents one country's experience confronting these and other common regulatory challenges.

Mini-case study 1: Burkina Faso, promising local forest management has been hampered by stalled decentralization

Burkina Faso may have the oldest locally managed production forests in Africa, created through a woodfuel scheme supported with project funding in the 1980s.. Local associations called Forest Management Units (FMUs) implement forest harvesting plans and provide revenue to workers, local institutions, and the national government. In 2006, an estimated 55,000 people earned income from the value chain. The largely self-sustaining FMUs depend on NGOs for capacity building, but otherwise operate independent of project support. Now in their second 20-year rotation, the forests appear to be managed sustainably, if not in perfect accordance with harvesting plans. They provide about one fifth of all woodfuel consumed in the country.

The endurance and apparent success of FMUs belies critical limitations to the approach. Local forest management in Burkina Faso has not lived up to the promise of decentralization under which it was initiated. After the creation of the FMUs, the Forest Service increased its role in local forest management and constrained the authority of local management groups. Justified as part of a process to empower local communities, the approach, funded by donors, enabled the Forest Service to extend its control and more thoroughly regulate the FMU forests (Côte & Gautier, 2018). A cadre of urban merchants took advantage of continued management by the national government, widespread corruption, and lacunae and contradictions in the regulatory framework to capture the lion's share of revenue generated by the value chain.

Revisions to the Forest Code in 2011 granted greater community participation, but top-down governance remains the rule (Arevalo, 2016). This is in part due to conflicts among local jurisdictions. In some cases, locally managed forests span several administrative units. This creates conflicts of authority among local governments, traditional governments, and the managers of forest management units (Coulibaly-Lingani et al., 2011).

The approach has not spread across the country. When donor support was discontinued, no new FMUs were created. The stalled national process of decentralization and the government's inability to extend the approach to other areas of the country has left much of the country's forests unmanaged. The Forest Service and local governments effectively control only a very small portion of the country's forest; today, most of the woodfuel consumed in Burkina Faso continues to be harvested illegally, outside of managed forests.

This mini-case study is based on common findings in the following articles, with only exceptions cited above: (Coulibaly-Lingani et al., 2011; Sawadogo & Tiveau, 2011; Bouda et al., 2011; Arevalo, 2016; Côte & Gautier, 2018; Foli et al., 2018).

3.2.2 Recommendations for Providing Support to Improve Woodfuel Regulation[3]

Over the long term, broad improvement in governance may provide the foundation for progress towards sustainable and inclusive woodfuel markets. Analysis of data across 45 sub-Saharan countries suggests that deforestation driven by commercial woodfuel systems can be reduced by improving governmental effectiveness and controlling corruption (Sulaiman et al., 2017). Recommendations for more targeted programs follow.

Strengthen the policy context:

- Address stigma associated with woodfuel and highlight the sector's importance as a potential source of revenue and income generation.
- Conduct cross-sectoral studies on woodfuel policy to identify gaps and conflicts in regulation.
- Support coherence in the development of woodfuel policies, and support their harmonization with policy in other sectors.
- Integrate support for tree planting and plantations into overall forest policy.

Support effective policy:

- Explore creating regulatory incentives to counterbalance punitive measures. Examples include differentiated taxation systems that impose tax only on wood sourced from non-managed areas other than private land; and payments for ecosystem services schemes providing payments to landholders who invest in sustainable woodfuel production.
- Promote scalable policy reforms that pose achievable resource demands on the national government; can be adopted at the local level without ongoing financial support; and depend on local knowledge and expertise or persons hired by local communities.
- Develop flexibility in the legal and regulatory framework to accommodate local community, forest, and market characteristics. Technical and administrative requirements should be

Tools to support transparency

Transparency International's INDEPENDENT REDD+ GOVERNANCE MONITORING provides civil society organizations and practitioners involved in tackling REDD+ corruption and governance issues an overview of key considerations for the design and implementation of effective independent governance monitoring systems.

Transparency International and United Nations Human Settlement Programme's Tools to Support Transparency in Local Governance provides a collection of practical tools that civil society organizations and other advocacy groups can use in their efforts to promote accountable and responsive local governments.

[3] These recommendations draw from Schure et al. (2013); FAO (2004); FAO (2017); de Miranda et al. (2010); WB (2011a); and Smith et al. (2019). The ProLand Senegal, Madagascar, and Haiti case studies also provide a basis for these recommendations, some of which are discussed at greater length in those documents.

adaptable to the capacity and needs of communities managing small forests and commercial enterprises working larger areas.

- Support low-cost systems of improved monitoring for woodfuel harvesting and the value chain.

Improve implementation of regulations:

- Invest in institutional practices and staff capacity development to create accountability mechanisms.
- Institutionalize transparency and ease of public monitoring through such measures as:
  - campaigns to increase awareness of laws and regulations;
  - public decision-making;
  - public presentation of results of monitoring, and posting of harvesting and transportation permits allotted; and
  - the creation of accessible procedures for seeking recourse (see: "Tools to support transparency" text box).

3.3 COMPONENT THREE: STRENGTHENING LOCAL GOVERNANCE OF WOODFUEL PRODUCTION

Research suggests that when forest communities have secure rights over their land, they are more likely to conserve and sustainably utilize that land (Agrawal, 2007; Robinson et al., 2014; Seymour et al., 2014). This idea that local communities can effectively manage forests they control has led many countries—often supported by international donors—to take steps to progressively devolve national authority over forest management to the local level. Countries as diverse as South Korea, Nepal, Burkina Faso, the Philippines, and Mexico have sought to improve forest stewardship by conferring rights and responsibilities at the local level. Improved forest management, including more sustainable woodfuel harvesting, may not be the sole objective of this process. Governments devolve power over forests to achieve equity and economic objectives as well. The steps taken by governments to increase the role of local actors in forest management range from the assignment of minor tasks to profound changes in governance. At one end of the spectrum, the forest service invites local partners to undertake specific activities, such as creating firebreaks or replanting trees. At other end of the spectrum, changes in forest management take place in a larger process of land tenure reform and the decentralization of fundamental powers of government. The process in this latter case, which requires decades to complete, may include deconcentrating national administrative institutions (granting new powers to regional forest service offices, for example), the formalization of local governments, or empowering traditional institutions. Countries may grant the authority to manage trees and products such as woodfuel to private individuals, individual communities, groups of communities or villages, indigenous governments, or elected local governments. In some countries, such as Côte d'Ivoire and Ghana, the government limits local communities to a consultative role. In others, such as Tanzania and The Gambia, the government grants local authorities control over forest management (Wily, 2002). Governments may also allow for varying levels of decentralization in different regions of a country (see "The Philippines" mini-case study found on page 14 for an example of this approach.)

3.3.1 Challenges to Strengthening Local Governance of Woodfuel Production

Few countries have completely decentralized forest stewardship to local governments, a process that requires national governments to transform their centralized administrative systems and create functioning local governments. A review of 40 years of community-based forest management by the

FAO concludes that the process of conferring tenure to local actors requires not only legal reforms but also accompanying development measures. Defining national objectives in legislation may take years. Administrations must then develop, communicate, and oversee the implementation of a framework of new policies, regulations, and protocols. They then need to develop and implement procedures for enforcing the exercise of these new powers by local institutions. Community-based forest management providing charcoal to commercial markets requires capacity building of government staff, community members, and other value chain actors. They need to learn and institutionalize a raft of technical and business skills. Enterprises and government institutions must be created. Business management skills and governance procedures need to be institutionalized. Existing patterns of behavior and relationships of power may need to change. Rather than completing this process rapidly, the efforts of many countries have either stalled and/or created new systems that constrain local authorities with technical and bureaucratic barriers (Riedl & Dickovick, 2010; Larson, 2012; RECOFTC – The Center for People and Forests, 2013).

In Africa, newly created decentralized governments are thus far limited in their powers, sidelined by better resourced, more influential national forest services. Or they are "upwardly accountable" and more responsive to the agendas of national institutions, such as political parties, than of local communities. National government natural resource exploitation for revenue may override local environmental protection priorities. The result may be continued overharvesting of woodfuel (Zulu, 2010; Ribot et al., 2010; Larson, 2012; Adam & Eltayeb, 2016; Atisa et al., 2018).

Resource and capacity limitations. Although decentralization may be intended to confer authority upon local institutions, the process may expand the oversight role of the forest service, at least during the transfer of control. In countries where forest services already strain to meet their responsibilities, developing and implementing additional responsibilities correctly may be impossible. For example, control by local governments may depend on the development and implementation of forest management plans, which will require the forest service to provide training and assistance to local communities or governments to complete the plans, and consequently to review them and monitor their implementation (WB, 2013).

Local institutions will also need to make vast strides. The local governments granted new authority will need to develop skills and processes to manage the new resources. Success will require the provision of impartial oversight over the commercial exploitation of forests, ensuring that benefits and responsibilities are equitably distributed among community members, and preventing local institutions from being coopted by external actors. If woodfuel enterprises exist locally, decentralization may require them to learn new administrative and technical procedures (Miller et al., 2020).

Impediments to the transition of power. Decentralizing forest management to local institutions will take place in a context of rebalancing of control over productive resources. The forest service may resist the loss of authority and opportunities for revenue and illicit rent. When national governments authorize the forest service to oversee the transition of power from national to local institutions, which is often the case, it puts that agency in a position to create barriers to local management. Forest services commonly require technically valid but unrealistic requirements that prevent communities from asserting authority conferred through laws (Djeumo, 2001; FAO, 2004; Kohler & Schmithüsen, 2004; Miller et al., 2020). Urban-based entrepreneurs may also resist a shift to local management. Confusion and conflict may stall decentralization efforts where

USAID's Sourcebook for Community-Based Forestry Enterprise Programming aims to inform the design and implementation of community forestry interventions that seek to deliver social, environmental, and economic outcomes in developing countries and contains an annotated list of guides and tools to support practitioners investing in activities to develop local forest management and forest product enterprises.

local governments' jurisdictions do not coincide with traditional institutions, or where new formal jurisdictions do not coincide with the land covered by forests (Stanturf et al., 2019).

Mini-Case Study 2. The Philippines: variations in state control over rights, responsibilities, and rewards for communities and elites

In the Philippines, where woodfuel gathering and charcoal production are key drivers of deforestation, (Carandang et al., 2013), the government has engaged community members in forest management activities since the early 1990s, and promoting active community participation in the protection and governance of forest resources is a principal of the national forest management strategy. In recent decades, the strategy has played out differently in different locations as the Department of Environment and Natural Resources (DENR) has employed approaches that give varying weight to the objectives of protecting the environment, local empowerment, and equitable economic growth (Guiang et al., 2001; Lasco & Pulhin, 2006).

In Negros Occidentale province, harvesting trees for charcoal production is one of the main threats to the North Negros Natural Park (NNNP). Much of the harvesting is illegal; it also serves as one of the largest sources of income for local smallholders. The DENR manages Community-Based Forest Management (CBFM) programs on government land that promote controlled reforestation and crop planting in multi-use areas, and provide small stipends to volunteer forest guards in the protected areas. The approach does not entail a transfer of tenure over land to local communities. In this case, continued control by the DENR may provide the poorest segments of society with access to land use and forest products (Chechina et al., 2018).

In Negros Occidentale the Young Innovators for Social and Environmental Development Association (YISEDA) gained a CBFM with the DENR. Under the CBFM, YISEDA appears to have reduced pressure on local forests due to smallholders diversifying their sources of fuelwood by planting trees on household lots and field trees (Mohammed et al., 2016). This positive environmental impact was not produced through increased community control, however. Under the CBFM agreement, local farmers gain reforestation and protection responsibilities; they do not gain rights in land, nor do they increase their authority to manage forest. Rather, under the arrangement the DENR has been able to extend its control to local forests. DENR was hardly present before CBFM, and "individual farmers had sole and full control over their farmlands in forest areas." Under the CBFM project, "all control over the CBFM area seemingly lies with the DENR" (Peras et al., 2016).

In Mindanao, the experience of the Ngan, Panansalan, Pagsabangan Forest Resources Development Cooperative (NPPFRDC) demonstrates that communities face additional challenges in the commercialization of forest products despite being allotted stronger tenure rights. In recent years, government policy has evolved in response to feedback that CBFM in the Philippines confers responsibilities rather than rights to smallholders. The government now allocates renewable 25-year tenure agreements to "people's organizations." Over a third of the country's forestlands now fall under such agreements.

Acquiring these agreements does not come easily. Communities must undertake several expensive and time-consuming steps to formalize agreements and legally exploit forest products. Steps include developing and submitting forest management and harvest plans. Even after forest management and harvesting plans have been approved, stringent regulation continues to constrain harvesting and marketing of forest products. These policies are meant to protect the existing forest cover and sustain the flow of goods and services obtained from the forest, yet rigorous regulation—often beyond the management and technical capacity of communities—creates the opportunity for corruption by those in power (Pulhin & Ramirez, 2016).

Overall, CBFM in the Philippines has not been considered a success (Peras et al., 2016). Despite progress towards devolving greater rights over forest management to communities, and developing a rigorous regulatory framework, illegal harvesting continues, and the largest landholders and political elites continue to reap the greatest advantages in the forest product markets (Pulhin & Ramirez, 2016; Chechina et al., 2018).

3.3.2 Recommendations for Strengthening Local Governance of Woodfuel[4]

Focus on the four conditions critical to the establishment of sustainable community-based forest enterprises (CBFE):

- Secure rights to manage and sell a forest product or service and support long-term CBFE investment.
- Strengthen communal forest and enterprise governance and management through increased leadership, technical knowledge, accountability, and financial integrity.
- Establish a viable social enterprise model that produces financial benefits for reinvestment and provides economic or social benefits to the community.
- Support value chain partnerships—with government, donors, civil society, and the private sector—for funding, technical support, and market access (Deshmukh & Donahue, 2020).

Identify and support laws, regulations, and procedures that foster, rather than hinder, community forest management.[5]

- Support regulation requiring that community forest management plans be based on minimum environmental standards and required to collect only essential information. Examples:
  - Plans that consist of simple zones associated with a conservative rotational cycle.
  - Simplify rules regarding species and size of trees to be harvested and methods to be used for comprehensive inventories.
  - Define lower limit to the size of a forest requiring a plan. Forests under 25ha in Ghana do not require a plan.
  - Develop criteria for community forest management plans separately from commercial requirements, and specify fewer requirements, as in Cameroon.
- Support laws and protocols that allow communities or local governments to establish or adapt standards for forest management.
  - Guinea, Madagascar, Senegal, and The Gambia require that owners or users, rather than the administration, prepare plans (although this may bias larger forest owners).
  - Require local participation in the development and implementation of plans. Forest law in Benin includes procedural rules that require local engagement.
  - Establish protocols that rely on local expertise and community members trained and certified by the forest service, managed and paid locally.
  - Build capacity among local institutions for monitoring, research, and learning rather than imposing technical prescriptions.
  - Allow for approval of forest management plans by decentralized authorities rather than national administration, as in Madagascar and Burkina Faso.

[4] These recommendations draw from: Schure et al. (2013); FAO (2004); FAO (2017); de Miranda et al. (2010); WB (2011a); and Smith et al. (2019). The ProLand Senegal, Madagascar, and Haiti case studies also provide a basis for these recommendations, some of which are discussed at greater length in those documents.

[5] This set of recommendations is based on ProLand woodfuel case studies and Kohler and Schmithüsen (2004).

3.4 COMPONENT FOUR: FOSTERING WOODFUEL PRODUCTION BY SMALLHOLDERS

Key factors influencing a household's decision to produce trees

- Access to markets
- Household demographics, assets and livelihood strategy
- Rights in agricultural and non-agricultural land
- Land suitability of trees vs. crops
- Characteristics of available trees
- Access to technical support

Adapted from Kennedy (2015); McConnell et al., 2015; and Ahimbisibwe, 2018.

As natural forest continues to be lost, examples of localized private sector production of "out of forest" trees contributing to the woodfuel supply proliferate (Arnold et al., 2006; Iiyama et al., 2014; Gazull & Gautier, 2015; Peltier, 2019). Woodfuel from trees outside of forests can be sourced from those in and around fields, and from woodlots maintained by rural producers and urban investors. They may take the form of agroforestry systems, orchards, or in hedgerows; or abandoned pastures or fallows enriched with specific species. Smallholders produce woodfuel by clear-cutting woodlots, selective harvesting of trees, and repeatedly cutting trees down to the stump, a process called "coppicing."

Smallholders in Bangladesh, Indonesia, and the Philippines have undertaken tree-based farming at scale (Rahman et al., 2017). In Tanzania, Niger, Haiti, and Madagascar, smallholders and entrepreneurs cultivate trees specifically for woodfuel. In Ethiopia, rural households have increasingly been converting farmland to eucalyptus woodlots (Alemayehu & Bewket, 2018). An in-depth analysis of the Mekong region using satellite data reveals that most reforestation in the area since 2010 has taken place outside of forests; tree cover is increasing on croplands, shrublands, and other non-forest land uses at a higher rate than inside forests (NYDF Assessment Partners, 2019). Rwanda, one of the few African countries with increasing forest cover, presents the most striking example of self-sustained reforestation by smallholders. In this country, the expansion of plantations drove the growth of tree cover by 7 percent from 2000 to 2005. Currently, virtually all woodfuel in the country comes from planted trees (GIZ, 2015; Lindegaard, 2019).

Not just a last resort

While the poorest continue to rely on woodfuel as a safety net, larger producers increasingly invest their capital in tree cultivation and/or produce charcoal to diversify their livelihood strategies (Iiyama et al. 2017).

Governments may strongly influence incentives for smallholder tree cultivation. Widespread tree planting may also be driven by broad contextual changes beyond the control of governments or not specifically directed at restoring landscapes. These include changes in climate that force new livelihood strategies; removal of energy subsidies that change market demand; resolution of conflict that stabilizes land tenure; the spread of a new species; or an influx of migrants (Lambin & Meyfroidt, 2010; Kull, 2017). Yet, even in these contexts, governments influence smallholder tree cultivation and sustainable woodfuel markets. They do so through four sets of factors: demand for woodfuel; the "fit" of tree cultivation within household livelihood strategies; expectations regarding rights in trees; and the availability of appropriate tree varieties. We discuss how these factors can create supportive conditions for smallholder tree cultivation below.

Competitive woodfuel prices. Effective government suppression of the harvest of naturally grown trees may foster smallholder cultivation. The increased scarcity of wood in Madagascar, Rwanda, and Indonesia, caused in part by stronger constraints on illicit harvesting, raised prices and thus fostered tree planting (WB, 2013; Rahman et al., 2017).

A decline in local forest may also increase incentives for smallholder tree cultivation through market demand. Examples have been reported in Sri Lanka, Bangladesh, the Philippines, and Kenya (Rahman et al., 2017). Transportation costs may have a parallel impact. In some countries, distance to natural forests correlates with tree planting. Further distances to forests may support the economic viability of urban woodlots, for example (Meyfroidt & Lambin, 2008; WB, 2013; Bervoets et al., 2017).

In Rwanda, rising woodfuel prices led tea farmers to invest in tree cultivation, especially on marginal lands. The lower production costs of small-scale Eucalyptus plantations increases farmer profitability by 47% over tea plantations (GIZ, 2015; WB, 2011b).

Smallholder ability to integrate tree cultivation into their household livelihood strategies. Smallholders consider a range of costs and benefits when deciding whether to invest in the cultivation of trees. Standing trees provide ecological services, such as erosion control and improving soil fertility, and other products, such as wood and bark. They may also be used to store wealth or serve as collateral for loans. Smallholders try to limit opportunity costs through measures such as expanding tree cultivation only on degraded lands no longer suitable for other crops, or planting them only in contexts where theft has reduced the viability of livestock raising (Rahman et al., 2017; Miller et al., 2021).

Benefits to smallholders from planting trees may also include a lower risk to livelihoods through the diversification of income sources (Rahman et al., 2017; Smucker & Miller, 2021). Farmers lower their overall household risk when they add woodfuel as a new source of income because production and market risks affect tree crops differently than they do food crops or livestock production. By increasing the different types of risk to which they are vulnerable, farmers limit the potential for any one hazard to cause catastrophic damage. Climate extremes and pest outbreaks raise production risk, while price variations from political instability and changes in government policy create market risk. So, farmers that cultivate trees for woodfuel reduce their overall risk because the relevant tree species tolerate a wide range of climate and environmental hazards, and woodfuel prices are stable and demand is growing. Woodfuel may allow for greater flexibility and income in contexts where smallholders have the option of producing charcoal from the trees they grow (Smucker & Miller, 2021).

Sufficient access to land and control over trees. The expectation of future rights to harvest and sell tree products influences smallholder decisions to plant trees. In some contexts, weak or unstable rights over trees constrain reforestation efforts (Van Noordwijk et al., 2008). In such contexts, government steps to strengthen smallholder perception of rights in trees, such as land certification or title, may increase the likelihood of tree planting (Arnold et al., 2006; Rahman et al., 2017; Kulindwa & Ahlgren, 2018). In other contexts, smallholders do not require government allocated titles to cultivate trees. Under some tenure regimes, smallholders may strengthen their rights in land by planting trees. In others, non-formal arrangements create sufficiently strong security for smallholders to take the risk of cultivating trees (Smucker & Miller, 2021).

Tenure as a business risk

Haiti's farmers weigh tenure against other considerations when they plant trees. They plant trees more often when they have a formal title, but still cultivate trees surprisingly often on land for which they have only informal title or time-limited forms of tenure. Rights in trees are never absolutely secure, yet many of Haiti's smallholders have decided that the potential benefits from mature trees outweigh the small risk of losing rights to the trees they cultivate (Smucker & Miller, 2021).

Access to appropriate tree species. The characteristics of available tree varieties influence tree planting (Van Noordwijk et al., 2008). The quality of wood a variety produces may influence smallholder decisions to plant a tree. Customers tend to prefer species with a high calorific value. Yet, woodfuel products are rarely differentiated by type (Iiyama et al. 2017), and ease of cultivation tends to play a more important role in smallholder calculations. The trees that smallholders prefer must be suitable to

local agroecological conditions. They should establish themselves with ease, withstand poor conditions, and grow in agroecological niches inhospitable to other livelihoods. Smallholders often decide to plant trees on eroded, sloped lands less suitable for crops (Lambin & Meyfroidt, 2010; McConnell et al., 2015; Iiyama et al., 2014; Rudel et al., 2020). In some countries, the abandonment of land has resulted in the influx of woody vegetation that has been harvested for woodfuel. *Prosopis juliflora* has spread rapidly in the drylands of India and Haiti and now constitutes a major source of fuelwood in these countries (Arnold et al., 2006; Smucker & Miller, 2021).

3.4.1 Challenges to Creating Conditions that Support Smallholder Tree Cultivation

The absence of inclusive markets creating the conditions described above will reduce the likelihood of smallholders to cultivate trees for woodfuel. A number of characteristics inherent to trees, some of which are not found in other crops, also strongly influence the potential for their commercial cultivation.

Marketlinks: Sharing good practices for market systems development | Marketlinks

The USAID Marketlinks website provides extensive resources and networking opportunities to assist practitioners strengthen smallholder engagement in markets. The Value Chain Development Wiki, just one example, provides information on value chain development and emerging learning in inclusive market systems development for both experts and people new to the value chain approach.

Characteristics of trees as a crop. The time it takes to produce woodfuel distinguishes this crop from many others. Producers used to annual crop cycles may have a particularly hard time integrating trees into their portfolio. Because returns on the labor, land, and capital invested in trees materialize no sooner than four or five years, and in many cases much later, the long-term nature of the investment in trees alters the financial calculus for investors, discouraging many (Enters et al., 2004).

Characteristics of woodfuel as a commodity. Woodfuel is a bulky, low-value commodity with limited opportunities to upgrade. It is also widely disbursed across countries and landscapes. Rainy season may prevent transport for sale, making it a seasonal crop. Unlike other commodities, producers depend on governments to suppress local competition from forests (Arnold et al., 2006). Effectively exploiting economies of scale present in transformation, transportation, and storage requires resources often only attainable by larger enterprises.

Characteristics of trees as property. The complex, overlapping, changing, latent, and informal mesh of rights may hinder investments in trees. Rights to plant; use the fruit, branches and leaves of; and harvest trees may differ from each other, and likely differ from the rights in the land on which the trees grow. Tenure rules regarding trees are also variable, and often hard to enforce. Farmers may lose their rights in field trees if they leave the field to fallow. In tenure regimes in which tree planting confers rights in land, authorities may attempt to control tree planting more closely (Van Noordwijk et al., 2008; Iiyama et al., 2015). Even in contexts of scarce woodfuel—such as among the ultra-poor of Malawi—an absence of secure rights in land may constrain tree planting (Lindegaard, 2019).

3.4.2 Recommendations towards Fostering Sustainable, Inclusive Woodfuel Production and Sale[6]

Inclusive markets for sustainable woodfuel generally depend on a country's business climate, as the design of programs to strengthen the context for smallholder tree cultivation will draw on market system approaches developed for other products and markets. In this section, we list considerations

[6] These recommendations draw from: Schure et al. (2013); FAO (2004); FAO (2017); de Miranda et al. (2010); and Smith et al. (2019). The ProLand Senegal, Madagascar, and Haiti case studies also provide a basis for these recommendations, some of which are discussed at greater length in those documents.

that appear most frequently in woodfuel literature and include descriptions of resources for a broader perspective.

FAO's The Charcoal Transition, Greening the charcoal value chain to mitigate climate change and improve local livelihoods report uses a comprehensive analysis of the latest data and empirical evidence to present a transformational pathway for greening the charcoal value chain, thereby supporting sustainable livelihoods and providing energy security, especially for the world's poor.

Help local enterprises build their networks horizontally and vertically.

- Encourage organizational measures that increase the market position of smallholders. Producers leverage economies of scale through grower/producer associations or cooperatives. By organizing, they may reduce costs and strengthen negotiation through aggregation and more direct access to markets. National federations built from the bottom up may help with policy advocacy.
- Support the business skills of entrepreneurs and reinforce commercial networks. Support multi-sectoral dialogue through networking events. Facilitate communication and relationships between local enterprises and lead enterprises in the woodfuel value chains.
- Improve coordination among value chain actors by formalizing business relationships, such as through agreements to transport or store charcoal for local associations.

Help producers add value.

- Support methods to increase efficiencies in harvesting, transformation, transportation, and storage that improve the product—principally lower-cost or longer-burning charcoal, but potentially other upgrades in quality (wood type), or service (consistency of supply or delivery).
- Motivate smallholders to plant trees and invest in efficient charcoal kilns through differential taxation and other forms of government fiscal incentives; use "green" branding, certification, or other means to increase prices.

International Center for Tropical Agriculture's (CIAT) Linking Farmers to Markets Research Group has developed Tools and methodologies to make market linkages work to support NGOs, development agencies, governmental institutions or private sector actors that are interested in implementing participatory agribusiness development programs. It includes methodologies, tools and learning approaches that have been developed based on numerous collaborative projects in Latin America, Africa and South-East Asia.

- Improve market access through improved diffusion of market information, as well as infrastructure improvements, including upgrading roadways and neighborhood charcoal markets.

Support adequate property rights and tenure.

- Private land titles may not be necessary. Adopt a "good-enough" approach to land tenure. Identify current local arrangements of customary and formal institutions that together provide sufficiently stable rights in land for tree cultivation. Land certificates or better-regulated customary systems may suffice.
- Where land titling exists, support procedures that facilitate smallholder capacity to update titles. This may include the elimination of onerous tax burdens.
- Public education and improved enforcement may be necessary to reduce fire and theft of trees and their produce.

Reduce regulatory constraints.

- Reduce government-imposed bureaucratic and financial requirements—such as management plans, harvesting permits, or transportation fees—for small producers and traders.
- Consider working in smaller markets, where small-scale commercial producers feed smaller urban areas that have not yet been captured by urban elites and benefits are more equitably distributed (Smith et al., 2019).

4.0 CROSS-COMPONENT RECOMMENDATIONS FOR DESIGNING WOODFUEL INVESTMENTS

4.1 OVERARCHING RECOMMENDATIONS FOR THE DESIGN OF INTEGRATED SUSTAINABLE WOODFUEL PROGRAMS

Build on existing institutions, capacities, and practices. Building up from existing assets, a good approach in many development contexts, is particularly appropriate for programs integrating the four components of a sustainable woodfuel program. The implementation of policy innovations, local institution formation, woodfuel market strengthening, and farming system diversification will need to take place across large portions of remote, resource-poor regions. For these changes to persist without ongoing support, they need to be based on current practice, local knowledge, and available expertise. Experience shows that adapting local institutions, rather than creating new ones, facilitates the transition to local forest management (Ferguson & Chandrasekharan, 2012; Brooks et al., 2013). Working with local methods, rather than importing new technologies, accelerates adoption. Haiti's smallholders supply a thriving and sustainable woodfuel market using common methods for direct seeding; transplanting volunteer seedlings; selecting high-quality stumps; applying improved techniques for pruning, and protection from fire and animal predation; as well as improved silvo-pastoral strategies (Smucker & Miller, 2021). The recommendations below include additional examples of the building-on-assets approach appropriate to the woodfuel sector.

Combat the persistent threats of market concentration and corruption. The politics and economics of woodfuel markets tend to favor wealthy, urban-based entrepreneurs. Their greater resources and access to government officials enable them to understand, satisfy, and evade regulations in ways that smaller, rural-based traders and producers cannot. In addition to influence over the drafting and implementation of regulations, they use their resources to acquire rights in land, dominate local forest management institutions, and monopolize woodfuel transport and storage. Program design will benefit from the insights of the growing body of practical resources to promote inclusive market systems, in addition to the recommendations above that target empowering smallholders in the woodfuels market. (See "Practical Analytical Framework for Inclusive Market Systems [IEMS]" text box.)

Adaptive management. Certain questions will be very difficult to answer prior to the launch of activities due to the complexity of the sociopolitical and biophysical environment in which woodfuel systems occur. Programs reforming regulations and modifying market incentives often produce unexpected behaviors. Questions specific to the woodfuel sector that arise in the literature and need to be explored through practice include 1) the regeneration rates of trees and the impacts of different harvesting plans; and 2) the mix of incentives that drives smallholders to harvest and cultivate trees.

USAID's Practical Analytical Framework for Inclusive Entrepreneurial Market Systems (IEMS) tool provides structured guidance on how to examine underlying, informal variables in market systems that may present barriers or opportunities in the enabling environment for private sector engagement efforts.

4.2 CONSIDERATIONS FOR DECIDING THE LEVEL OF EFFORT TO INVEST

Market, governance, and donor conditions influence the potential for progress towards inclusive sustainable woodfuel markets. The decision to engage in the sector should not depend on the presence of overharvesting hotspots alone. Conditions that will support investment in this sector include:

- **Demand for directly harvested woodfuel:** A strong demand for woodfuel, especially an urban demand for charcoal, and a low likelihood of transition to other forms of energy are necessary conditions, but not sufficient. Different approaches may be necessary where demand is primarily met through imports, or as a byproduct of land clearing.
- **Government posture:** Commitments to international conventions towards landscape restoration provide a basis for action, while steps towards implementing coherent reforestation policy provide a more auspicious indicator. Experimentation using incentives to influence harvesting, rather than an exclusive reliance on deterrent measures, may indicate a willingness to innovate more broadly. Programs targeting a transition to local forest management may only be possible where the government as a whole is moving towards decentralization.
- **Donor commitment:** Sustained transformational growth will require long-term investments. Policy reform usually requires changes beyond the woodfuel sector, involving sectors such as forest management, land tenure, and local governance. The process of promulgating and implementing new regulations in these areas may take several decades.

4.3 TOPICS TO BE ASSESSED PRIOR TO PROGRAM DESIGN

Programming interventions in the woodfuel sector require assessments of the political and economic landscape, market conditions, and local institutions. Annex I includes resources, some of which fall outside of the forestry sector, that may support assessment of the topics of particular importance for investment in the woodfuel sector described below:

Assess the political and economic landscape.

- **Patterns and levels of nonformal and corrupt behavior:** Do not underestimate the potential for resistance to changes in the forest and woodfuel sector. Members of the government, and the forest service may perceive reforms as contrary to their interests. The administration may depend heavily on fees and fines, and forest service staff may rely on informal and illegal payments. Politically connected entrepreneurs may also seek to delay or divert reforms. Decentralization and increased smallholder production may reduce their revenue. An understanding of political relationships between the national and local levels is also important, as political parties may influence decisions at the lower level. Reaching out to experts outside of the forest sector may prove useful.
- **Power in the market system:** Woodfuel markets may be controlled by a limited number of better-financed, politically connected entrepreneurs. Design should be based on an understanding of the extent of concentration, the interests of key stakeholders, and identifying champions for reform. This may require innovative methods due to the illicit and informal nature of the market and the potential for stakeholders to be members of the political or economic elite.

Assess the value chain.

- **How much "formalization" can the sector bear?** Woodfuel sales may not justify the development of rigorous harvesting plans, paid forest guards, or hard-copy permitting systems. Cost is one reason enterprises do not comply with the requirements of the formal sector. Constraints to commercializing woodfuel, some of which were discussed above, limit the amount of revenue local enterprises and the institutions that manage them can generate. Estimates of potential growth in revenue generated by value chain assessments provide a basis for deciding how to formalize the sector.
- Because legal restrictions on harvesting, wood availability, and transportation costs vary across countries, assessments of woodfuel value chains require a geographic component. While consistent

and increasing demand for woodfuel is the norm, assessments will identify opportunities for upgrading the value chain.

- In many countries, the sector may not generate the revenue necessary to support the costs of local forest management. USAID should be realistic in its assessment of the business case for formal local woodfuel enterprises.

Assess local institutional capacity and smallholder technical skills.

- Program design should be based on an understanding of patterns of forest exploitation and its management. An understanding of the strengths and weaknesses of local institutions, and of their capacity to manage forest use, should inform the collaborative development of new systems. Key questions include: Who currently exploits forests, and how are they managed? What are the interests of extra-local actors?

- Forests rarely fall cleanly into manmade jurisdictions, whether those jurisdictions are defined by traditional institutions or the national government. Program design should include an understanding of any plans for resolving any potential conflict over their management.

- Investments in the promotion of smallholder cultivation of trees will be strengthened by a clear understanding of the farmer-preferred tree and shrub varieties available, and of any existing knowledge or experience in tree cultivation on which they might build.

Assess conditions for community and smallholder tree cultivation and transportation of woodfuel.

- Agroecological zones: Identify locations where farmers may be motivated to integrate trees into their farming systems. This may result from declining opportunities for other crops combined with degraded landscapes. Farmers may welcome planting trees on slopes no longer viable for other crops, for example.

- Transportation networks: The low-value, bulky nature of woodfuel means that transportation costs need to be managed to make community forests profitable or to stimulate smallholder production. In addition to exploring modes of transportation, length of routes, seasonal variations, and storage options, the potential for innovative financing, contracts and cooperation should be weighed. In the charcoal value chain, locating efficient kilns closer to points of harvest also influences transportation costs.

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ANNEX I: ABSTRACT OF THE PROLAND WOODFUEL CASE STUDIES

Productive Landscapes (ProLand): Stimulating Smallholder Tree Cultivation for Woodfuel: Learning from Success in Madagascar

Deforestation and forest degradation are common challenges for countries that rely heavily on woodfuel. To reduce damage to forests, governments undertake efforts to manage harvesting and increase the supply of trees. They promote alternative energy sources and energy-efficient stoves. They regulate actors in the value chain, confer forest stewardship to local institutions, and launch afforestation campaigns. They also, usually with less intentionality, create the conditions for commercial production of woodfuel by smallholders. In Madagascar, the government appears to have gone a long way in creating conditions that stimulate private-sector tree cultivation. Forest plantations, woodlots, and individually planted trees flourish on the island. In this case study, we examine the environment that enables tree cultivation in three regions of the country. To do so, we describe the production, governance, and business factors that either stimulate or hinder widespread smallholder tree cultivation supplying charcoal to urban centers. In the process, we identify opportunities for intervention applicable to Madagascar and other countries whose forests are threatened by the heavy dependence of their urban centers on woodfuel.

Productive Landscapes: Lessons from Regulating Urban Woodfuel Markets: The Case of Senegal

Governments regulate urban woodfuel markets to achieve a variety of public objectives. Countries value the sector's economic contribution and the revenue it generates for the government. They also regulate this value chain to manage environmental impacts and control how and when trees are harvested to produce fuel. Regardless of the objectives countries select, efforts to govern this diffuse and largely informal sector often falter. Poorly conceived policies and their incomplete and improper implementation allow for corruption, politicization, and the oligopolistic control of the market. Corruption and elite control afflict the charcoal value chain in Peru (Bennett, Cronkleton, Menton, & Malhi, 2018), while widespread illicit trading and local resistance weaken efforts to roll out new regulations in Zambia (Ziba and Grouwels, 2017). Similar challenges undermine regulations intended to reduce overharvesting and promote sustainable forest management in many countries (de Miranda, Sepp, Ceccon, Mann, & Singh, 2010; Blundo, 2011; Schure, Ingram, Sakho-Jimbira, Levang, & Wiersum, 2013; Sepp, Sepp, & Mundhenk, 2014; Liyama, et al., 2015; Faye & Ribot, 2017).

Senegal presents a well-documented example of the hurdles governments face as they regulate behavior in the woodfuel market. In recent decades, the Senegalese government has developed and implemented national policy reforms designed to transform the market system supplying charcoal to the country's urban centers. Undertaken in the context of a larger process of governmental decentralization, a suite of laws, regulations, executive orders, declarations, and donor-financed projects has sought to empower local governments to manage woodfuel harvesting and sales in their communities.

Productive Landscapes (ProLand): Stimulating Smallholder Woodfuel Production: Lessons from Haiti's Thriving Charcoal Market

In countries that rely heavily on woodfuel, overharvesting often threatens remaining natural forests. Governments of these countries use a variety of strategies to reduce this practice, protect forests, and increase national tree cover. They promote alternative energy sources and energy-efficient stoves. They regulate actors in the value chain, confer forest stewardship to local institutions, and launch afforestation

campaigns. They also—usually with less intentionality—create the conditions for the commercial production of woodfuel by individuals. In Haiti these conditions appear to have been met without deliberate government policy. Sustainable smallholder production of charcoal flourishes on the island.

So that other countries may draw lessons from Haiti's experience, this case study explores the reasons why hundreds of thousands of Haitian smallholders invest their limited resources to produce woodfuel. A strong market stimulates production of woodfuel, especially charcoal. Scarcity and poverty also contribute to this practice: a paucity of natural forest, a lack of alternative forms of energy, shortages in labor, and the absence of more lucrative sources of farm and off-farm income motivate smallholder farmers to embrace this livelihood. Through our review of Haiti's experience, we provide recommendations to inform the design of donor investments supporting sustainable tree cropping and reduced harvesting of natural forest for woodfuel. We highlight the importance of inclusive markets that meet smallholders' needs for income and flexibility; the potential of customary land tenure institutions, local technical skills, and available tree species; and the need to match design with smallholder productive resources and livelihood strategies. Our conclusions also provide insights into the broader topic of interest in the development community: how to leverage economic incentives to protect and restore natural resources.

ANNEX II: DOCUMENTS PROVIDING KEY INFORMATION OR PRACTICAL GUIDANCE, LISTED BY COMPONENT

COMPONENT ONE: GOVERNMENT-LED REFORESTATION AT THE LANDSCAPE LEVEL

The Restoration Diagnostic, developed by the World Resources Institute and the International Union for Conservation of Nature as part of the Restoration Opportunities Assessment Methodology (ROAM), is a structured method for determining the status of enabling conditions within a landscape being considered for restoration, and for designing the requisite policies, practices, and measures needed for successful restoration.

The Global Partnership on Forest and Landscape Restoration and The Bonn Challenge websites have many resources describing forest landscape restoration (FLR) principles and practices. FAO's The Forest and Landscape Restoration Mechanism also has numerous publications, webinars, presentations, and links to other websites focused on assessing landscape degradation and restoration opportunities as well as monitoring and evaluating restoration projects.

COMPONENT TWO: NATIONAL GOVERNMENT REGULATION OF WOODFUEL

FAO's Policy Brief: Incentivizing Sustainable Wood Energy in Sub-Saharan Africa (SSA) reviews country experiences with woodfuel policies and regulations in SSA aimed at avoiding the negative impacts of woodfuel sourcing and accentuating the benefits, and presents six main findings for promoting sustainable wood energy in the region.

Transparency International's INDEPENDENT REDD+ GOVERNANCE MONITORING is a guidance document that provides civil society organizations and practitioners involved in tackling REDD+ corruption and governance issues with an overview of key steps and considerations for the design and implementation of effective independent governance monitoring systems. It draws on a growing body of experiences and case studies undertaken by civil society organizations within and outside the Transparency International movement, and across different tropical forest countries. It provides an overview of good practices, methodologies, and practical tools for monitoring REDD+ governance. The document also discusses key enabling conditions and lessons learned for scaling-up and replicating existing initiatives.

Transparency International and United Nations Human Settlement Programme's Tools to Support Transparency in Local Governance offers a collection of practical tools that civil society organizations and other advocacy groups can use in their efforts to improve the transparency of local governments. The Toolkit highlights the potential of civil society to create mechanisms for scrutiny and control of public institutions and to demand and promote accountable and responsive public administration.

COMPONENT THREE: STRENGTHENING LOCAL GOVERNANCE OF WOODFUEL PRODUCTION

USAID's Sourcebook for Community-Based Forestry Enterprise Programming aims to inform design and implementation of community forestry interventions that seek to deliver social, environmental, and economic outcomes in developing countries. It includes an annotated list of guides and tools to support practitioners investing in activities to develop local forest management and forest product enterprises.

FAO's Sustainable Forest Management (SFM) Toolbox has a module on Wood Energy with a section on tools that range from guides to assessments. There are several other modules that have useful information including, Management of Non-Wood Forest Products, Management of Planted Forests, and Development of Forest Based Enterprises.

Methodological guide for village forest management for wood energy production is a French language guide developed by the Regional Program for the Promotion of Domestic and Alternative Energies in the Sahel (PREDAS) based on Sahelian experiences in the management of natural forests for the production of wood. It is accompanied and supplemented by a Training Module on Village Forest Management for Energy Wood Production.

FAO's Simpler forest management plans for participatory forestry is a working paper that aims to present and stimulate thinking about some of the constraints imposed when conventional forest management plans (FMPs) are used for participatory forestry. It describes approaches to address these constraints, mostly based on a study of forest management plans in 22 countries. The study also focused on some promising experiences in simplifying forest management plans for livelihood-oriented and enterprise-oriented forestry. Traditionally, FMPs were developed primarily for large-scale timber concessions, and thus focus on the requirements of large scale timber and production-oriented forest management. The formats of such FMPs require forest managers to have high levels of technical and financial capacity. This working paper shows that some FMPs are simpler than conventional FMPs although there is much variation in the level of simplification taking place. However, many of these FMPs are still too complicated for collective forest managers (CFMs) and it remains difficult for CFMs to prepare such FMPs by themselves without receiving significant external professional assistance. A number of relevant policy issues which affect the preparation and implementation of FMPs are also discussed.

USAID's Technical Note on THE 5RS FRAMEWORK IN THE PROGRAM CYCLE describes the "5Rs Framework", a practical methodology for supporting sustainability and local ownership in projects and activities through ongoing attention to local actors and local systems. The 5Rs Framework is intended as a simple and practical tool to promote good systems practice. The 5Rs Framework highlights five key dimensions of systems: Results, Roles, Relationships, Rules and Resources. Collectively these 5Rs can serve as a lens for assessing local systems and a guide for identifying and monitoring interventions designed to strengthen them. This Technical Note is divided in two parts. The first part introduces the 5Rs Framework and the systems practice from which it emerges. The second part demonstrates how systems practice can be embedded in the Program Cycle by continuously applying the 5Rs, especially to the design, implementation, and monitoring of USAID projects and their accompanying activities.

COMPONENT FOUR: FOSTERING WOODFUEL PRODUCTION BY SMALLHOLDERS

FAO's Arid zone forestry: A guide for field technicians is a working guide for field technicians involved in arid zone forestry practices. The manual is organized into ten sections, including a general description of the arid environment, the function and place of trees and shrubs in arid zones, techniques of nursery operations in arid regions, the establishment and management techniques of forest plantations, special forest plantations, irrigated forest plantations, rehabilitation of saline environment, non-wood forest products, the involvement of local people, and tree and shrub species for arid zone forestry.

FAO's The Charcoal Transition, Greening the charcoal value chain to mitigate climate change and improve local livelihoods report uses a comprehensive analysis of the latest data and empirical evidence to present a transformational pathway for greening the charcoal value chain, thereby supporting sustainable livelihoods and providing energy security, especially for the world's poor. Targeting the entire chain – sourcing, production, transport, distribution, and use – is a key to success. The report presents policy options for creating a climate-smart charcoal sector, such as developing national policy

frameworks for the sustainable management of the charcoal value chain; reforming land tenure and increasing resource access to attract new investments in a greener, healthier charcoal value chain; and making the charcoal value chain a specific component of nationally determined contributions to mitigate climate change.

Energypedia's Woodfuel Production Options website includes information and numerous links to practical manuals, example forest management plans (FMPs), and other relevant information related to forest plantations, management of natural forests, and trees outside of forests.

CROSS-COMPONENT RECOMMENDATIONS FOR DESIGNING WOODFUEL INVESTMENTS

USAID's Marketlinks: Sharing good practices for market systems development website provides extensive resources and networking opportunities to assist practitioners strengthen smallholder engagement in markets. The Value Chain Development Wiki, just one example, provides information on value chain development and emerging learning in inclusive market systems development for both experts and people new to the value chain approach.

International Center for Tropical Agriculture's (CIAT) Linking Farmers to Markets Research Group has developed Tools and methodologies to make market linkages work to support NGOs, development agencies, governmental institutions or private sector actors that are interested in implementing participatory agribusiness development programs. It includes methodologies, tools and learning approaches that have been developed based on numerous collaborative projects in Latin America, Africa, and South-East Asia. The approaches focus on three dimensions: (i) capable producers; (ii) willing buyers; and (iii) the enabling environment. When these factors come together, it is possible to establish trading relationships that are both durable and profitable for farmers and buyers and thus contribute to the reduction of poverty and hunger. The presented methodologies follow the theories of knowledge management to help facilitate a continuous learning experience of the various actors involved in rural development processes.

USAID Feed the Future's Practical Analytical Framework for Inclusive Entrepreneurial Market Systems is a first step in building on existing enabling environment tools and market system theoretical frameworks to provide concrete guidance to USAID Missions, Operating Units, and implementing partners on how to examine the underlying variables in systems that may present barriers or opportunities to private sector engagement efforts. Designed by the Feed the Future Enabling Environment for Food Security (EEFS) project team in collaboration with EcoVentures International, the IEMS framework: identifies and clearly documents a comprehensive set of underlying, systemic variables that influence new business formation, growth, and inclusive gains in market systems; builds on existing business enabling environment measurement tools and indices that have focused on formal legal/regulatory variables to include a more explicit consideration of the informal, underlying variables that influence the policymaking process and the enforcement of formal rules; and provides practical guidance for USAID and implementing partners to assess systemic factors that may affect project investment outcomes.

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