



PRODUCTIVE LANDSCAPES (PROLAND)

STIMULATING SMALLHOLDER WOODFUEL
PRODUCTION: LESSONS FROM HAITI'S THRIVING
CHARCOAL MARKET



PHOTO CREDIT: YVES GOSSIN

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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.

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INTRODUCTION: GREEN ENERGY OVERTAKES HAITI BY STEALTH¹

For a country commonly characterized as ravaged by political instability, economic dysfunction and environmental collapse, Haiti is surprisingly self-sufficient in energy. Imported energy, all petroleum products, makes up only a quarter of what Haiti consumes. Most of the balance, over 90 percent of the country's domestically sourced energy, is produced by smallholder farmers (IEA, 2020; Bureau des Mines et de l'Energie, 2005).² The surge of tree cultivation that accounts for this success story was unforeseen even a few decades ago. Observers of the process have long portrayed the woodfuel market as the primary cause of tree cover loss in Haiti (ESMAP, 2007), and warned that overharvesting would bring deforestation followed by ecological disaster (Voltaire, 1979; Angelier, 2005;

Haitians meet most of their domestic energy needs not through the felling of primary forests but through sustained charcoal production on tree-covered land including secondary forests, woodlands, woodlots, and arboreal fallow.

- Wampler et al., 2019

¹ The ProLand Woodfuel Case Studies draw on peer-reviewed research and fieldwork to illustrate design principles relevant to USAID programming in the sustainable cultivation and management of trees harvested for the commercial production of woodfuel. The Haiti field research team included Glenn Smucker, a cultural anthropologist, and two field agronomists, Yves Gossin and Odibert Cothiere. Fieldwork was conducted in August and September 2019 and March 2020. ProLand has also conducted case studies on this topic in Senegal and Madagascar.

² Hydropower and sugarcane produce the remaining 8 percent (4.2 percent and 3.8 percent respectively) (IEA, 2020; Bureau des Mines et de l'Energie, 2005).

MTPTC, 2006). It is thus astonishing that, in contrast to many countries dependent on woodfuel, Haiti replaces woodfuel almost as quickly as it is consumed.³

Concerns regarding the environmental impact of woodfuel in the 1970s and 1980s made intuitive sense. Demand for woodfuel was strong and rising, and the country's forests were disappearing. The population was growing rapidly, and almost all the households in the country cooked with woodfuel (Larsen & Pierre, 2017). Rural households used firewood, as did small and medium urban enterprises such as bakeries, dry cleaners, limestone kilns, and distilleries. But it was charcoal demand by urban households that caused the greatest concern. Between 1960 and 1980, the population of Haiti's cities nearly doubled, rising from 603,000 to 1,160,000.⁴ Observers also noted that urban households were not reducing demand by transitioning to other sources of energy as expected. The higher cost of using alternatives, such as charcoal's main rival, Liquefied Petroleum Gas (LPG), prevented their widespread adoption.⁵

The second concern of those sounding the alarm in the 1970s and 1980s was also true: the country was rapidly losing its natural forests. Studies testify to a precipitous decline in natural tree cover from 60 percent in 1923 to 1 or 2 percent in 1989 (Burns, 1954; OAS, 1972; USAID, 1979; World Bank, 1982; Ehrlich et al., 1985; ESMAP, 2007; Smucker et al., 2007). The dire warnings, however, were based on a false assumption of causality. Harvesting for woodfuel did not lead to Haiti's deforestation. Estimates of forest impact based on woodfuel demand proved inaccurate. Since the colonial period, loggers have clear-cut Haiti's forests for timber export (Bellande, 2015), while smallholders have cleared the land, even steep mountainous slopes, for crop and livestock production. Together, the timber industry and agricultural expansion depleted Haiti's natural forest (Tarter et al., 2016).

Haiti has lost its natural forests, so it is surprising that charcoal prices have risen no faster than those of alternative fuels (ESMAP, 2007), and that woodfuel supply continues to meet rising urban demand. As the natural forests disappeared, smallholders, especially those in the country's dry agroecological zones, began cultivating trees and shrubs largely unobserved by research (Tarter, 2016). Overall, tree cover remains sparse in the country but reaches a much greater extent than once was believed, far exceeding the projections of recent years. Recent estimates of national level tree cover using satellite imagery range from 9 to 36 percent (Tarter et al., 2018), with the differences mainly attributed to varying definitions of tree cover. Areas of high charcoal production in particular, such as between Fonds des Blancs and Cote de Fer (Zone 1 in Figure 1) and the Anse à Pitre region (Zone 6), show tree cover regrowth (Hansen et al., 2013; CIRAD, 2016). On the island of La Gonave, where charcoal production is practiced by over 50 percent of farmers, shrub coverage in agricultural and eroded lands increased by 87.4 percent between 1990 and 2010 (White et al., 2013).

This is a case study of Haiti's forest transition and the forces that have driven it.

³ In a "business as usual" scenario, stocks of above-ground woody biomass would decline by approximately 4 percent between 2017 and 2027 (Ghilardi et al, 2018).

⁴ The growth has continued, and by 2019, it had jumped to 6.3 million, over ten times the 1960 number (Macrotrends).

⁵ Both LPG burners and the gas they use were considered costly. This situation continues today, and only when sold in small retail quantities—amounts in which bottled LPG is not sold—do charcoal prices rival or exceed those of LPG (ESMAP, 2007; ProLand fieldwork, 2020).

WHAT THIS PAPER IS ABOUT: LESSONS FROM SCARCITY

Haiti has done what few other countries dependent on woodfuel have been able to do: develop a thriving woodfuel sector based on woodfuel cultivation by smallholders. Perhaps more remarkably, Haiti has achieved this success despite the absence of enabling conditions commonly assumed necessary to create a robust and sustainable woodfuel sector. The central government provides no regulation of the sector and has not created an accessible land titling option. Few farmers hold valid titles to their land. Further, the government and its development partners provide virtually no technical assistance or inputs to woodfuel producers.

Government action did not foster Haiti's sustainable woodfuel sector. Instead, the sector has been stimulated by scarcity. Urban residents have scarce access to affordable energy alternatives and thus continue to purchase charcoal. Woodfuel producers have scarce access to natural forests and thus rely on planted trees. Smallholders have scarce livelihood options and thus integrate woodfuel production into their farming systems alongside annual food crops and livestock. Haiti's case is far from ideal; its overall success derives from conditions that other countries would not choose to emulate. Yet there are elements of success in Haiti's renewable woodfuel sector from which we can draw lessons to inform governments and development practitioners investing in other countries' woodfuel sectors.

This paper describes why Haiti's smallholders dedicate their limited resources to cultivate trees and produce charcoal. It explores the advantages the charcoal market and woodfuel agroforestry provide to smallholders. In doing so, it leads us to question conditions commonly assumed essential to creating a sustainable woodfuel market system, such as the provision of technical assistance and improved tree stock, regulated markets, and formal tenure. Haiti is not the only country unable to provide these inputs and establish these conditions. How can others tap into the dynamism of the private sector to generate widespread income growth and sustainably supply energy?

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.

METHODS: HOW WE RESEARCHED HAITI'S FOREST TRANSITION

To produce this case study, the ProLand research team reviewed data and literature relevant to Haiti's woodfuel sector and conducted site-based observation and inquiry. Documentary research included recent studies of land-use shifts over time based on comparative remote sensing data; major studies of the agricultural sector; the agricultural census of 2012; reports on the production and marketing of charcoal and woodfuel; and recent studies of charcoal transport to major urban areas.

ProLand researchers also conducted field site visits in the North and Northeast Departments of Haiti. The team had initially targeted three other regions of the country for field interviews; however, the time frame for fieldwork coincided with a severe political crisis that virtually locked down the country, along with growing security risks that inhibited safe access to field sites.

The study focused on the North-Northeast region because:

- It is the primary source of supply for charcoal for Cap-Haïtien and other urban areas of the northern tier.
- It produces charcoal and other wood products from contrasting agroecological zones, including both humid and dry climatic areas.
- Qualitative field interviews for this study also complement a recent USAID study of charcoal entering Cap-Haïtien from the North and Northeast Departments.

- There are sizeable blocks of state land occupied by leaseholders and other occupants deeply vested in charcoal harvesting.
- It includes sustainable and unsustainable practices in charcoal and wood production.
- It is marked by a significant flow of undocumented charcoal coming into Haiti from the Dominican Republic, a subject of controversy and limited field-based information.
- Sizeable stands of mangroves on the north coast offer an opportunity to study illicit charcoal harvesting in a protected area.

The team carried out qualitative interviews with 49 farmers, charcoal makers, and other actors in the charcoal value chain in the Northeast Department, and 14 in the North. Researchers also interviewed representatives of donor and NGO project personnel, local elected officials, and Ministry of Agriculture field personnel. An interview guide served to orient semi-structured interviews with key informants. Interview questions were tailored to the specific profile of respondents, who included woodlot owners and wood sellers; charcoal makers and wood buyers; charcoal traders; cross-border charcoal key workers; project staff; and local officials. Researchers undertook interviews with individuals and small groups at sites noted in the text box above. Interviewees included tree farmers and charcoal workers on both private and state land, as well as charcoal workers in a mangrove protected area.

Field Site Interviews	
Northeast Department	
Fort-Liberté	Ouanaminthe
Dérac	Charcoal market
Dumas	Deppé (Dilaire)
Loiseau	
Acul Samedi	Carice & nearby border areas
Terrier Rouge	Savane Sal
Fond Blanc mangroves	Bois Poux
Caracol	
North Department	
Limonade	Bahon (Montagne Noire)
Dondon	
St. Raphael	Grande Rivière du Nord
Bois Neuf	
Gad Bet charcoal market	Cap-Haïtien charcoal market

THE OUTLINE: HOW WE PRESENT OUR CASE STUDY

We break our explanation down to three “stories” that have led to this transformation:

The Governance Story: Intervention limited to local government. We begin by presenting the limited role government has played in providing an institutional framework for Haiti’s woodfuel sector. The effective absence of regulation has enabled the growth of an informal and inclusive woodfuel market.

The Market Story: How an inclusive value chain engages rural smallholder participation. We then turn to a description of the charcoal market system that provides incentives for smallholder farmers in Haiti to cultivate trees. Haiti’s charcoal value chain motivates thousands of smallholders and entrepreneurs to sell wood and produce charcoal to generate income and reduce livelihood risk.

The Production Story: How smallholder farmers have made tree cultivation fundamental to their livelihood strategies. We conclude by presenting how smallholder farmers respond to the market by integrating tree cultivation into their agricultural systems. The section includes a description of the methods farmers use to produce woodfuel, and a discussion of why they have dedicated valuable resources to integrate tree cultivation alongside their other crops.

THE GOVERNANCE STORY: INTERVENTION LIMITED TO LOCAL GOVERNMENT

The government has not created a context supportive of enterprises generally, nor of woodfuel specifically. The World Bank's 2020 ease of doing business assessment ranks Haiti at 179 out of 190 countries (World Bank, 2019). Statutes have been promulgated to regulate wood harvest and commerce, but no laws specifically regulate charcoal production and sale. Only local governments appear to engage in the sector, using their limited resources to protect the trees valued by their communities and to set some conditions for tree felling and the charcoal trade.

Although Haiti's unstable and under-resourced national government has done little to prevent overharvesting for woodfuel, promote afforestation, or regulate the value chain, it did lay the legal groundwork. Since the mid-1950s, Haiti has promulgated numerous laws and administrative orders to regulate the woodfuel sector. Restrictions on tree harvesting are found in laws of 1955, 1958, and 1972, and in the Rural Code of 1962. Laws passed in 1955 and 1987 regulate the sale of woodfuel. Other decrees from 2005 and 2006 provide an institutional framework for managing natural areas. The country also developed a draft national energy sector plan for 2007 through 2017. The draft included commonly accepted approaches to managing the woodfuel sector, such as incentives for transition to alternative fuels and improved cookstoves. It also called for afforestation efforts, the creation of woodlots, and increased imports of charcoal, and proposed the passage of laws to prevent unauthorized wood harvesting (MTPTC, 2006). National decrees as far back as the 1970s announce that taxes will be levied on the woodfuel sector to fund national reforestation.

These numerous pronouncements have had little impact as they are poorly enforced. The national government does not regulate tree harvesting, charcoal production, woodfuel transport or its sale. It administers no permits, fees, or fines. Nor does the government create incentives. It provides neither subsidies nor technical assistance for tree cultivation and the creation of woodlots. The 2007–2017 energy plan was never adopted as policy and the Bureau of Energy (BME) receives no revenue from the sector. ProLand interviews with Ministry of Agriculture representatives in Ft. Liberté illustrated this condition. Departmental agricultural officials decried the uncontrolled harvest of charcoal while at the same time reporting that over 90 percent of area farmers cut down trees for charcoal. Smallholders harvest trees and produce, transport, and sell charcoal unhindered by government agents except for limited efforts by decentralized bodies.⁶

The absence of central governmental regulation of the woodfuel sector has created a vacuum that local authorities have only partially filled. Local governments have made sporadic efforts to regulate woodfuel, including limited measures to protect fruit trees, mangroves, and tree felling on slopes. Some local bodies have also sought to mitigate conflict over local charcoal production and trade. ProLand fieldwork confirmed an earlier finding that local elected officials play the most tangible role in the regulation of charcoal and wood harvesting (USAID, 2014). In the northern region, local elected officials have supported the creation of surveillance brigades to monitor mangroves in Bas-Limbé, Caracol, Limonade, and Ft. Liberté, and to protect stands of upland pine in Bois Poux and Mont Organisé. Further examples include the rural Communal Sections of Dumas (Ft. Liberté). In Dumas, the elected council (*conseil d'administration de la section communale*, or CASEC) undertakes limited regulatory functions. To deter theft, the CASEC has instituted a pass system to verify ownership of charcoal being transported. The CASEC also monitors harvesting to protect trees with public utility, such as roadside shade or adjoining

⁶ The recent 10-year strategy from the Ministry of Environment targets reforestation and energy production. As with previous policy, the test will be in its implementation (MDE, 2021).

springs, and issues permits to authorize tree cutting for charcoal. It also mediates disputes over tree sales.

THE MARKET STORY: HOW AN INCLUSIVE VALUE CHAIN ENGAGES RURAL SMALLHOLDER PARTICIPATION

Farmers grow trees to meet household needs, but it is income generation from the charcoal value chain that has led to the great expansion of tree cover in Haiti. At an estimated value of \$400 million, charcoal ranks as Haiti’s second most valuable agricultural commodity after mangos. It contributes almost 5 percent to the national economy (Tarter et al., 2018). The dry agroecological zones where production is concentrated cover some 60 percent of the landscape (Figure 1 below).⁷

I earn more from charcoal than field gardens. Charcoal educated my eight children. Today one is a lawyer and another a nurse. My lawyer son is now the mayor of Caracol. I am very grateful to charcoal.

—RP, a farmer & 40-year career charcoal maker, Caracol

Trees are the source of my life. Trees educated my children. I paid for the weddings of my three daughters with charcoal revenues.

—LP, a 30-year career charcoal maker who plants trees, Loiseau (Ft. Liberté)

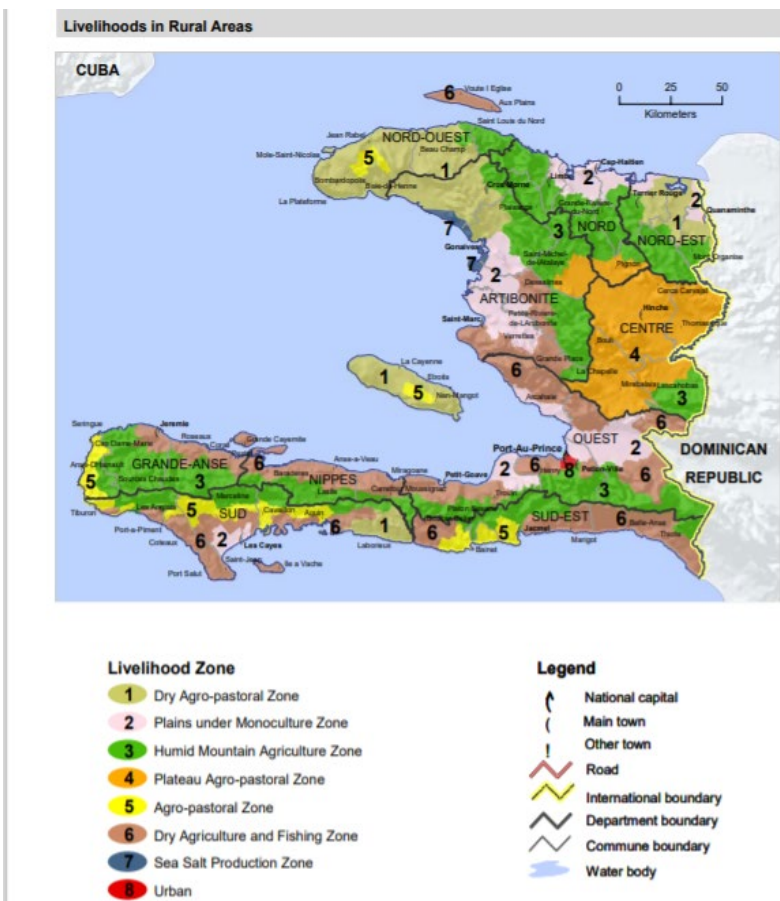


Figure 1. Agroecological zones of rural livelihood (USAID, 2005)

Geographically diffuse and socially inclusive, Haiti’s charcoal value chain enables hundreds of thousands of smallholders to earn an attractive level of revenue. It also provides income for small and medium entrepreneurs across the country. The charcoal value chain, excluding tree cultivation, is estimated to employ over a quarter million people. In all, woodfuel generates an estimated 10 to 15 percent of rural incomes (CIRAD, 2016; ESMAP, 2017; Tarter et al., 2018).

The impact of charcoal on the economy is so great that, far from a last resort coping strategy for poor households, it is an important source of income for virtually all income levels in charcoal producing rural areas. This includes middle- and upper-income households (FEWS-NET, 2005). In the zones of highest charcoal production, medium

⁷ These include the Agro-Pastoral Zones (Zones 1, 4, and 5) and the Dry Agriculture and Fishing Zone in coastal areas (Zone 6).

income households gain a greater portion (40 percent) of their incomes from charcoal than do poor households (10 percent). One case study in Central Haiti, where 45 percent of the households produce charcoal, found that charcoal-producing households on average were more wealthy than non-producers in their communities, and held more land, planted more trees, and farmed a greater diversity of crops (Kennedy, 2015).

According to government agricultural maps, over 50 percent of dry zone farmers produce charcoal.⁸ In some areas, over 90 percent of households engage in the practice (ProLand interviews). Charcoal production also takes place in the humid mountain zones, but on a much smaller scale and primarily during the slack season for annual crops.

Research has found no evidence of consolidation by large urban elites in this unusually inclusive market, although there is a range of large and small traders. In other countries, the revenue generated by charcoal has attracted large enterprises that dominate the sector (Miller et al., 2020). In Haiti, ProLand interviews found the sector to be highly decentralized, engaging thousands of widely scattered small farms, small producers, and traders. Even charcoal transported in large trucks to major markets is owned by many different traders, each paying separately for their bags to be transported.

Farmers who own trees may choose to convert them to charcoal themselves, sometimes hiring paid labor, or they may sell the trees to charcoal producers or traders. ProLand found smallholders sell trees for 21 to 48 percent of the price of charcoal sold on-site. Producers hire labor to fell trees; chop the wood to size; transport and stack it at the kiln site; prepare and oversee carbonization as the kiln burns day and night; and rake and sack the charcoal. Field operations observed by ProLand field researchers invested a little more than two person-days of labor per sack of charcoal produced. Interviews in high-charcoal-production areas of the Northeast found scales of production of up to 300 sacks per operation.

The charcoal market both allows for widespread participation and enables benefit sharing. Much of the income generated through charcoal production stays in rural areas. In an illustration of the charcoal value chain conducted for this study (see Table 1), the charcoal producer purchased and harvested one hectare of trees in Dérac (Ft. Liberté), which he transformed into 220 sacks of charcoal, and then sold to a wholesaler on site. The wholesaler transported the stock to Cap-Haitien and resold it in lots of 10 to 20 sacks to smaller wholesalers. This second tier of wholesale traders in turn sold individual sacks to retailers which they resold to consumers in smaller units (*mamit*). Upon final sale, the value had increased to more than eight times the initial sale of trees. 60 percent of value added remained at the rural production site. This includes tree sale, labor, and on-site sale to charcoal buyers.

Table 1. Distribution of value added by each link in the charcoal value chain, an example

Value chain actor	Value added (%)	Notes
Tree seller	12	1.0 ha of trees sold for 35,000 gourdes (\$388.89)
Tree buyer, charcoal maker	11	Raised money, hired labor, cut trees, made charcoal
Labor input	18	87 person/days, G43,000 (\$477.78)
Wholesaler, 1 st tier buyer	18	On-site purchase, 220 sacks of charcoal, G500/sack
Transport Dérac/Cap-Haitien	13	220 sacks @ G100 /sack
Wholesalers, 2 nd tier buyers	6	Resold in lots of 10-20 sacks @ G900/sack
Retailers, 3 rd tier buyers	22	Purchase by the sack @ G1,000 g, resale by <i>mamit</i> @ G60, equivalent to G1,320/sack (USD\$14.67)
Total	100	Estimated total value of consumer sales G290,400 (\$3,226.67 USD)

⁸ Terrier Rouge and Fort-Liberté in the Northeast region; Pointe à Raquette and Anse à Galets on Gonâve Island in the West; Petit Trou de Nippes in Nippes; Bombardopolis in the Northwest; Terre-Neuve in Artibonite; and Anse d'Hainault in Grand'Anse (Joseph, M., 2012).

Other studies confirm that rural areas retain an important percentage of the income generated by charcoal production in Haiti. Estimates vary, and differences in the cost of transportation, the number of intermediary traders, and prices in the end market all influence the percentage kept locally. Researchers have found retention rates of 30 percent (BME, n.d., based on 1990s data); 20 percent (ESMAP, 2007) and 35 percent (CIRAD, 2016).

THE PRODUCTION STORY: HOW SMALLHOLDER FARMERS HAVE MADE TREE CULTIVATION FUNDAMENTAL TO THEIR LIVELIHOOD STRATEGIES

WOODFUEL HAS BECOME A CROP ALONGSIDE OTHERS

The dramatic expansion of woodfuel production in Haiti has required a transformation of smallholder agricultural systems at a fundamental level. Throughout the country’s dry agro-ecological zones, farmers have reduced investment in food crops to dedicate their limited land and precious time to woodfuel production (RGA, 2012; CIRAD, 2016). Farmers in developing countries rarely adopt expert recommendations regarding agroforestry (Rahman et al., 2017), yet the integration of woodfuel trees into farming systems has come to play an essential role in the survival of hundreds of thousands of households in Haiti, many with no direct assistance from experts.

On-farm Tree Census 2009	
36,173,483 trees	
30,023,990 productive trees	
	%
Plantains and bananas	34
Mangos	12
Timber	12
Citrus	8
Coffee	7
Avocados	6
Coconut	5
Breadfruit	4

Source: RGA (2012)

Haiti’s roughly one million small farms are formed of two or three noncontiguous parcels of land and average a half hectare. Together they include at least 400,000 woodlots and an estimated 35 million trees (RGA, 2012; Philius, 2013) that provide a range of services and products. Farmers plant trees in living fences, woodlots, and orchards. They also harvest trees and shrub cover they allow to naturally regenerate on fallow land. Virtually all the yards of houses in rural Haiti include trees and shrubs.

In Loiseau, farmers without trees spend scarce cash to purchase acacia seed. To establish a tree garden, they scatter acacia seed onto the land, then burn off the grassy ground cover. Clearing the land with fire causes scarification of seed and enhances germination. Newly emergent acacia benefit from weeding and animal control efforts to protect an initial harvest of food crops before acacia seedlings grow tall. The fast-growing acacia eventually shade the land and are ready for an initial harvest of biomass by the end of the second year.

The highly varied agroecological zones of Haiti’s mountainous landscape influence how farmers integrate trees into their agricultural systems. In drier areas, they rely more heavily on regrowth during extended periods of fallow and use trees to enrich soils and provide fodder. Over time, these farmers have become increasingly reliant on species that produce wood suitable for charcoal, particularly drought-tolerant, native, and exotic species that will regrow when repeatedly cut down to the stump, a process called “coppicing.” ProLand field research identified the following five basic ways in which farmers in Haiti’s dry zones integrate trees into their cropping patterns.

Stands of managed forest. Farmers in the Northeast manage blocks of naturally reforested land and trees on open range grazing land, where seeds are dispersed by grazing animals. They coppice the trees—largely acacia, mesquite, and campeche—for charcoal, while protecting their live stumps and root systems with a view to regrowth. Harvest cycles tend to be two or three years, but acacia rotations may be as short as eight to 12 months.

Stands of planted trees. Farmers plant woodlots of densely spaced trees in fields previously dedicated to annual crops. Tree species include fast-growing tropical hardwoods introduced by projects 30 years ago, particularly acacia, Venezuelan mahogany, and neem.

Rotations of trees and annual crops. Farmers cultivate trees and annual crops in rotation on the same land. After clear-cutting woodlots for charcoal, they cultivate food crops such as sorghum and peanuts until trees shade over the land.

Rotations of trees and pasture. Farmers collect mesquite seeds and plant them in fields to provide forage for grazing livestock. This may be done in association with food crops.

Managing fallow for charcoal. Farmers with a shortage of labor allow fields to lie in fallow well beyond the one or two years commonly practiced. They may then harvest the trees and shrubs that have regrown for woodfuel rather than burning them off, the traditional practice.

Farmers in Haiti’s humid agroecological zones also include trees in their farming systems. Predominantly shaded tree crops and fruit trees, woodfuel production is not the primary objective of their cultivation. These zones have nevertheless produced a rising amount of charcoal in recent years following the decline in coffee production due to disease and insect predations. As farmers have shifted from tree crops to annual food crops, they have harvested the shade trees previously used in coffee cultivation (ProLand interviews). The wood of the mango trees common in humid regions is highly valued for use as charcoal due to its density, although trees are harvested only after they are no longer productive.

WOODFUEL IS A HIGH VALUE COMMODITY RELATIVE TO THE OPTIONS

Farmers have integrated tree cultivation deeply into their systems partly because of the deterioration of alternative sources of income. As Haiti’s economy has stagnated over the past sixty years, its agriculture sector has dropped off precipitously. In 2015, the country’s gross national product (GNP) was smaller than in 1960 (World Bank, 2021a). Agriculture, which represented half of the GNP in 1957 (Riordan et al., 1997), now provides less than a fifth of GNP (World Bank, 2021b). Decades of limited public investment in agriculture have left the sector struggling, while low tariffs on imported food commodities since the 1980s have undercut local production by propping up cheap imports. Currently, Haiti imports at least half of the food consumed on the island (Associated Press, 2010; CIRAD, 2016). The production factors that increase risk and further constrain crop cultivation include progressive soil degradation,

PA, a woodlot owner and farmer in Acul Samedi harvested 4-year-old acacia, leaving live stumps in the ground. He planted peanuts, rice, sweet manioc, and yams for a single harvest cycle. He expects acacia regrowth will shade over garden space by the end of the first year. At the end of the second year, he plans to selectively harvest trees to open up space for smaller trees to thrive.

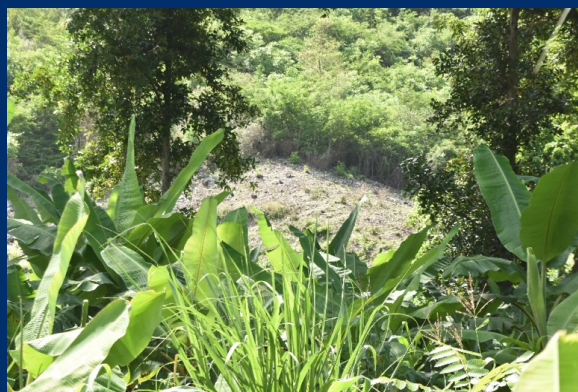


Figure 2. Mesquite & Food Crop Rotation

PHOTO CREDIT: GLENN SMUCKER

advanced erosion on unprotected slopes, and a high risk of natural disaster exacerbated by climate change variation and extremes, including hurricanes, severe flooding, and extended drought.

As cultivating food crops has become less remunerative, farmers have increasingly invested in cultivating trees and woody shrubs (RGA, 2012; CIRAD, 2016). Remote sensing analysis has captured this transition in land use. Between 1990 and 2010, ground cover on the island of La Gonave, a major charcoal zone, showed an 87 percent increase in shrub coverage on agricultural land (White et al., 2013). More recently, between 2000 and 2013, the dry agricultural zones on the Southern coast saw tree cover expand. They now serve as a key source of charcoal (Hansen et al., 2013).

WOODFUEL IS A GOOD MATCH FOR AVAILABLE RESOURCES AND INCOME STRATEGIES

As farmers have seen their other options drop off, they have taken up tree cultivation because its production requirements match available resources. Farmers have the inputs, labor, technical skills, and land required to cultivate trees. They use tree cultivation to diversify their crop portfolio and reduce risk, and they appreciate the options it provides for saving capital and engaging in the charcoal value chain.

Matching Available Resources

Suitable tree species. Woodfuel producers in Haiti's dry zones prefer trees with a high wood density, drought tolerance, and the ability to grow rapidly in local soils that are often fast-drying, saline, and of low fertility. They also prize the capacity to regenerate when coppiced. Trees with these characteristics are now widespread in Haiti's dry zones. Examples include campeche, acacia, and *lignum vitae*, as well as naturalized exotics including acacia species and mesquite. Trees and other perennials and semi-perennials are also a more sustainable production strategy on unprotected slopes compared to erosion-intensive annual crops.

Low demand on labor. The methods that Haiti's smallholder farmers use to cultivate woodfuel (described above) require low maintenance and little labor, less than for crop cultivation. This is particularly important for the many households whose younger members have migrated out of rural areas.



Figure 3. Coppice from live stump

PHOTO CREDIT: GLENN SMUCKER

Silvicultural skills. Over time, the technical skills necessary to cultivate trees have become widespread throughout farming communities. In addition to coppicing, farmers have mastered planting trees through direct seeding, transplanting volunteer seedlings, and transplanting seedlings from backyard nurseries. They understand how to weed young trees due to their cultivation in association with food crops, and

Farmers Retained Practices from Technical Assistance

In the 1980s and 1990s, USAID and other donors promoted on-farm tree cropping of fast-growing, multiple-use hardwoods. Projects introduced new species, backyard nurseries, and enhanced agroforestry associations. Farmers in these old project zones are currently more likely to prepare tree nurseries and actively manage their tree gardens compared to other areas where farmers rely primarily on naturally occurring stands of scrub forest. In dry agroecological zones, farmer adoption of tree cropping promoted by projects transformed whole landscapes. (ProLand interviews)

know how to thin and prune the trees they have planted.

Available land. No matter how well tree cultivation fits into the small-farm agricultural system, insecure tenure can easily undermine the integration of trees into livelihood strategies. Farmers need assurance of long-term rights to the trees in which they invest their resources. This condition has been met in Haiti through a combination of formal and informal forms of tenure.

Over 82 percent of rural land parcels in Haiti are individual private holdings, yet this includes inherited land (RGA, 2012). Most rural land is worked without updated title (FAO/INARA, 1997). As a result, farmers must rely heavily on kinship ties, informal agreements, and personal stocks of social capital to protect their rights to land (Smucker et al., 2000). Farmers also sharecrop or rent an estimated one in ten parcels, and lease approximately 2 percent of all agricultural parcels from the state (RGA, 2012). Leaseholders of state lands tend to manage their land as if it is private property; lease rights are bought, sold, rented, sharecropped, and inherited.

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 (Kennedy, 2015; Smucker, 1988). Customary tenure, government leases, and even sharecropping arrangements are not necessarily a barrier to planting and harvesting trees for woodfuel. 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.

Options for income from woodfuel

Risk management. When farmers add woodfuel as a new source of income they lower overall household risk because different production and market risks affect tree crops than food crops or livestock production. By increasing the different types of risk to which they are vulnerable they limit the potential for any one hazard to cause catastrophic damage. Climate extremes and pest outbreaks raise production risk. Price variations from political instability and changes in government policy create market risk. 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.

Store wealth. Farmers appreciate trees because, similar to livestock, they can be used as a form of savings. Because they are less liquid than cash, crops, or livestock, farmers can store value in trees as one would use a bank. They may also use standing trees as collateral against loans (Smucker & Timyan, 1995; ProLand interviews).

Flexible use. Farmers may also add value to varying degrees. They may sell standing trees, harvest the trees and sell woodfuel, or use their trees as an input to on-farm charcoal production.

Charcoal is the principal source of income for families here. All households without exception profit from charcoal as wood sellers, charcoal producers or workers. Charcoal generates enough income for Loiseau families to build or buy second homes in the city of Ft. Liberté so they can send their children to better schools.

—HA, tree planter and charcoal maker, Loiseau (Ft. Liberté)

CONCLUSIONS AND RECOMMENDATIONS

The story of Haiti's expanding tree cover casts doubt on several conditions commonly assumed to be critical to the development of a sustainable woodfuel market.

Formal Markets. Despite its informality, the sector generates substantial economic growth and has not caused the loss of natural forests. Haiti's woodfuel market is not formalized in the ways understood to provide for economic growth. The businesses are informal and not incorporated, and their capital investments are small. Banks and other formal financial institutions do not provide credit.

Charcoal is not a bad thing as such. It all depends on what trees you cut down. The community here does not see the harvest of watapana (Acacia farnesiana) as an environmental problem, unlike the mangroves. The environmental fragility of charcoal is the mangroves.

—RP, Mayor of Caracol

Regulation. The Haitian government does not enforce laws promulgated to regulate where and how woodfuel may be harvested, and how it should be processed, transported, or stocked. It also does not enforce regulations regarding the sale of woodfuel or impose quality standards on the product, nor does it generate revenue from the sector. There are no fees, taxes, or permits. Although the absence of regulation has left natural forests unprotected, overharvesting for woodfuel

was not the primary cause of the country's deforestation.

Technical assistance. Despite an absence of technical assistance, a large segment of Haiti's smallholder farmers cultivates trees. With little assistance from donors and the government, they mastered methods appropriate to their resources to meet a growing urban demand for woodfuel. Networks of nurseries, seed certification, and reforestation campaigns were not required.

Formal land title. Despite a lack of private land titles, farmers withdraw resources from annual food crops to invest in the longer investments required for tree cultivation. Government-led land-titling campaigns were not necessary to provide sufficient security for tree cultivation by individuals.

RECOMMENDATIONS

It is unlikely that other countries would be able, or even desire, to reproduce all the conditions related to scarcity and poverty that have fostered the rise in tree cultivation by smallholder farmers in Haiti. These include a paucity of natural forest, a lack of alternative forms of energy, shortages in labor, and the absence of more lucrative sources of income. Nevertheless, governments and their partners planning to support the development of sustainable woodfuel markets should take into consideration the factors that have created incentives for Haiti's smallholders to engage in the sector. The Haiti

example suggests approaches for other countries to create more inclusive markets that provide smallholders, producers, and traders with returns that compete favorably with those of other agricultural products, especially when the secondary benefits of woodfuel production are taken into consideration. These include product flexibility, ecosystem services, stocked value, and risk mitigation.

Based on the lessons from Haiti's experience, we recommend the following:

Support more inclusive markets

- Undertake campaigns to promote farm forestry and sustainable harvesting of fast-growing trees that produce a range of wood products, including poles, planks, fuelwood, and charcoal.
- Motivate smallholders to plant trees and invest in efficient charcoal kilns through differential taxation and other forms of government fiscal incentives; and “green” branding, certification, or other means to increase prices.
- Improve market access. This could consist of improved diffusion of market information, as well as infrastructure improvements, including upgrading roadways and neighborhood charcoal markets.
- 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. Although vulnerable to hijacking by elites, associations in Haiti have been successful in increasing smallholder access to kilns, and jointly held land for tree planting.

Reduce regulatory burdens

- Remove or ease fiscal or administrative burdens on smallholder-produced woodfuel products.
- Reduce government imposed bureaucratic and financial requirements—such as management plans, harvesting permits, or transportation fees—for small producers and traders. Support policy that favors inclusive markets and prevents consolidation.

Facilitate adoption of sustainable woodfuel practices

- Target agroecological zones of declining productivity in traditional crops, especially slopes. Promote tree cultivation on dryer agro-ecological zones affected by climate change.
- Focus on adaptation to local systems, on the trees and bushes already present in existing stands of productive trees and woody shrubs that regenerate naturally. As in a Farmer Managed Natural Regeneration (FMNR) approach, target simple upgrading of patterns of regrowth. Use the five approaches Haitians have used to integrate trees into cropping patterns, or similar approaches found elsewhere, to inform design.
- Diffuse technical approaches that build on local skills and use existing resources. Examples include methods of direct seeding, transplanting volunteer seedlings, selecting high-quality stumps, improved pruning techniques, protection from fire and animal predation, and improved silvo-pastoral strategies.

Support tenure practices that incentivize investment

- Rather than targeting private land titles, develop 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. Explore land certificates and better-regulated customary systems.

- Where land titling exists, support procedures that facilitate smallholder capacity to update titles. This may include the elimination of onerous tax burdens.
- Protect smallholder investment in tree crops by strengthening public sector capacity to prevent illicit harvest of fuelwood and other wood products in protected areas.



PHOTO CREDIT: GLENN SMUCKER

Figure 4. Forested landscape protected by sustainable charcoal production, Fonds des Blancs

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