CHAPTER 8

The Root of the Problem

WHAT'S DRIVING TROPICAL DEFORESTATION TODAY?

Wood for Fuel

Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

CHAPTER 8

Wood for Fuel

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FIRE HAS BEEN ESSENTIAL TO CIVILizations for millennia, providing heat in the cold, light in the dark, and warm food. So fundamental is fire that most ancient societies have a myth relating to its "discovery."

Since fire was first harnessed, wood has been the primary fuel for it. Although most of the developed world now gets the majority of its energy for cooking and heating from fossil fuels like coal and petroleum, wood fuels are still a major source of energy for people in developing countries. Here, wood fuels account for between 50 and 90 percent of the fuel used (FAO 2010). As populations in developing countries grew in the 1970s and 1980s, many believed there would be a massive wood fuel shortage and that an increasingly desperate population would move into untouched forests, causing massive deforestation. For the most part, these wood fuel shortages never came to pass, and while there was a large amount of deforestation in the tropics, little of it was a direct result of wood fuel use. However, the common belief that wood fuel collection is a major driver of deforestation has persisted, though there is little empirical evidence to back it up (Cooke, Köhlin, and Hyde 2008).

Even while concerns about wood fuels continue, they are increasingly looked at as a carbon-neutral fuel of the future. Wood fuel use has increased in recent years in the developed world, and more attention is being given to finding sustainable wood fuel for use in the developing world (FAO 2010). This chapter examines beliefs about wood fuels' role in deforestation, reviews the current state of their use in the developing tropics, and highlights some examples of sustainable industries and production methods.

Defining Terms: You Say "Fuelwood," I Say "Wood Fuel"

There are some important terms to note when discussing wood fuels. The terms "fuelwood" and "wood fuel" are often incorrectly used interchangeably. **Wood fuel** refers to any energy source that comes from woody biomass. These cover a range of fuels, including fuelwood (sometimes used synonymously with firewood), charcoal, industrial fuelwood, wood pellets, biogas, cellulosic ethanol, and other advanced forms of bioenergy. **Fuelwood,** or **firewood**, consists of any unprocessed woody biomass used to fuel a small fire, most often for cooking or warmth. In the developing world most firewood comes from dead woody material and small trees. **Charcoal** is a wood fuel made from burning wood in a low-oxygen environment. The dense black substance that results is made up mostly of carbon and produces more heat and energy per kilogram than wood. **Industrial fuelwood** refers to using a variety of wood fuels for industrial purposes, whether

Charcoal is created by burning logs in a low-oxygen environment using mounds of earth or kilns, such as these in Brazil

Women carrying firewood in the African Rift Valley

iron smelting or tea processing. Some industries use charcoal, some use sawdust, while others use logs of specific species to achieve precise temperatures. This report focuses on firewood, charcoal, and industrial fuelwood since they are typically used in the tropics.

Fuel for Fire: Misconceptions about Wood Fuel Use and the Firewood "Crisis"

Population growth in developing countries during the 1970s and 1980s led to substantial encroachment on forests throughout the tropics (Hiemstra-van der Horst and Hovorka 2009). Forests were cleared at an alarming rate as governments encouraged farmers to establish new agricultural lands (see Chapter 9). As populations increased and forests decreased, many worried that conflicts would arise as forest products, especially firewood, became increasingly scarce. This so-called firewood crisis dominated the policy discussion well into the 1990s (Hiemstra-van der Horst and Hovorka 2009). Further, it was argued that firewood scarcity was a major force leading to deforestation as rural populations cleared forests for new sources of fuel. This resulted in a number of policies that attempted to protect woodlands from firewood collectors and encourage the planting of trees for an additional source of firewood.

In most parts of Sub-Saharan Africa, firewood collection and trade is considered sustainable. Most material collected is already dead, and collection rates are typically below the regeneration rate.

Beginning in the mid-1990s, however, researchers began to study the "firewood crisis" and discovered that for the most part, there was no crisis after all, only scarcity in some areas (Egeru et al. 2010). Even in areas where forests were cleared, there was not a shortage of firewood (Cooke, Köhlin, and Hyde 2008). Further, researchers found that in most areas firewood demand was not a driver of deforestation. Most of the forest clearing during that period was a result of agricultural expansion, and while a household might use some of the cleared wood for fuel, it did not cause the clearing. Just because firewood collection occurs on land where the forest was cleared does not mean that it was

firewood collection that caused the clearing. It may simply be that the clearing provided firewood.

Furthermore, most firewood does not come from forests, but from trees in lots and woodlands outside of forests; therefore, wood from the clearing of forests was a minor part of the supply (Hiemstra-van der Horst and Hovorka 2009). Also, firewood primarily comes from dead branches or shrubs, not large, live forest trees. Even most firewood collected from intact forests consists of dead matter (Morton 2007).

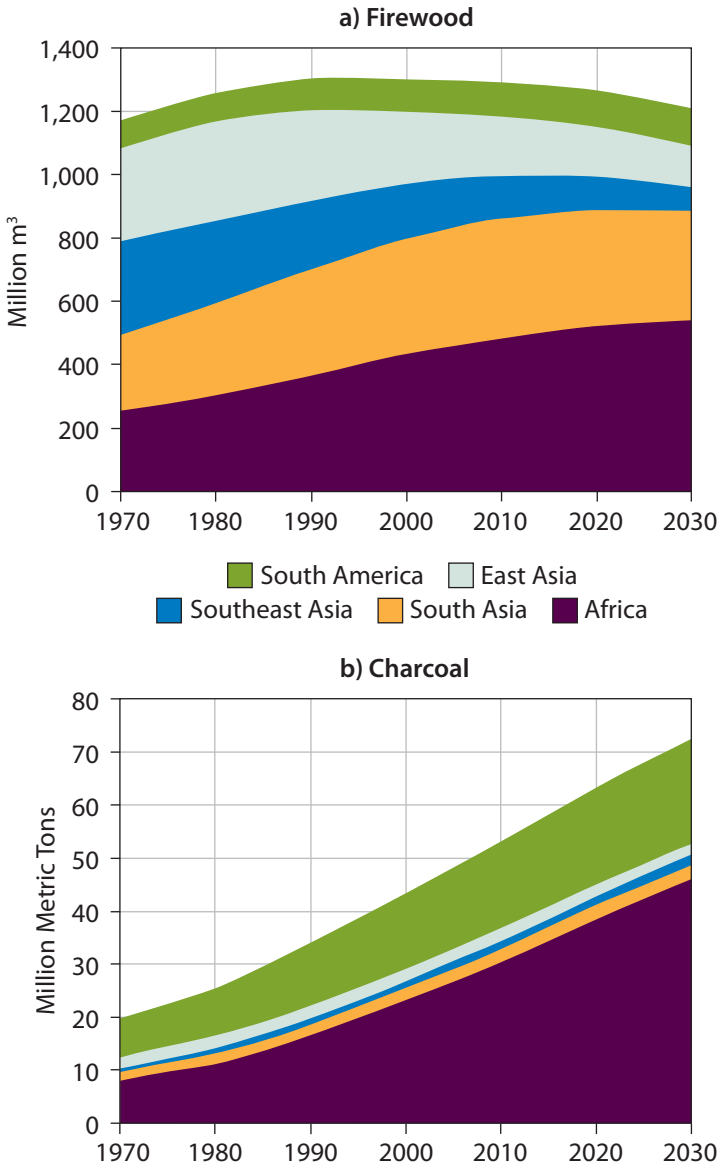
Despite empirical evidence that firewood does not drive deforestation on a large scale, many reports from development groups or NGOs still claim that firewood is a major driver of deforestation (Leplay and Thoyer 2011; Yengoh 2008). These reports use few peer reviewed sources, and those that do usually cite references from before the early 1990s. They tend to make sweeping statements like "small scale agriculture and firewood collection are major drivers of deforestation…" Again, most of these studies indicate that small-scale agriculture was what drove deforestation, so linking agricultural expansion to firewood in this way is misleading.

These studies also relied on misinterpretations of data from the Food and Agriculture Organization of the United Nations (FAO) to demonstrate their point. The most recent FAO data show that between 40 and 80 percent of wood products from tropical countries are used as fuel (FAO 2009). Many refer to this data to argue that firewood is a major driver of deforestation. However, as stated earlier, most firewood comes from outside of forests, consists of dead material, or comes from plantations. Even firewood that does come from forests (and is not already dead material) usually comes from small understory trees or shrubs. So, while the amount of wood collected may be large, it is not causing deforestation.

Fueling the Developing World

Although wood fuel is not a major driver of deforestation on a global scale, it can have significant effects at the local level (FAO 2010). The effects of wood fuels not only differ among regions, but also vary among fuel types, with charcoal being a problem in some areas and industrial fuelwood in others. Across the tropics about 1.4 billion cubic meters of firewood are used each year and around 40 million metric tons of charcoal are produced. Based on a wood-to-charcoal conversion rate of between 8 and 17, the global charcoal supply in tropical countries is between a quarter and a half of the firewood supply (these numbers vary greatly by region) (Figure 8.1).

Figure 8.1. Projections of Future Firewood and Charcoal Use in Developing Regions



a) Firewood consumption is expected to remain constant or decline over the next 20 years. b) Charcoal use is expected to increase over the next 20 years.

Source: Hofstad, Kohlin, and Namaalwa 2009.

Africa

For most regions of the world large commodity agriculture is the major driver of tropical deforestation. However, in Africa the importance local actions like wood fuel collection have in relation to land use change is higher. Particular attention has been paid to firewood use in the semi-arid tropical regions of Africa (Sahel and savanna), since for many years firewood collection

Collecting firewood in Basankusu, Democratic Republic of Congo

was thought to cause desertification of the Sahel. However, it turned out that drought conditions existed before any expansion of firewood use (Benjaminsen 1993). In fact, most of the firewood came from trees that died off as a result of those droughts. In Uganda, for instance, firewood use seems to be sustainable, since families generally collect from small, fast-growing species (Naughton-Treves et al. 2007).

Most of the firewood is used in rural areas (FAO 2010). It is either self-collected or purchased from small dealers. While in some places women and girls are the primary firewood collectors, one cannot assume that is always the case. There is rather broad evidence from a variety of Asian and African countries that both men and women collect, and men may even be the primary collectors (Cooke, Köhlin, and Hyde 2008). Households tend to buy more firewood, rather than simply collect it, when there is a local scarcity. Farmers also sell firewood as a way to provide extra income (Hiemstra-van der Horst and Hovorka 2009).

In most parts of Sub-Saharan Africa, firewood collection and trade is considered sustainable (Hiemstra-van der Horst and Hovorka 2009). Most material collected is already dead, and collection rates are typically below the regeneration rate. Additionally, supply chains tend to be relatively short.

Charcoal production, on the other hand, has a greater environmental cost than firewood collection. It is made by burning large logs in kilns or in mounds of earth to create low-oxygen environments. Unlike firewood, charcoal usually comes from trunks or large limbs and requires cutting trees (Girard 2002). This means that charcoal requires some land clearing. Some studies suggest that around urban areas charcoal production is a cause of deforestation, but it can also follow timber harvesting and not be the initial driver of deforestation. For example, around the Tanzanian capital of Dar es Salaam researchers found that although charcoal production was heavy in the forest immediately surrounding the city, there were additional rings of degradation beyond that. Farther out, forests of medium-value timber were cleared, and beyond those, forests of high-value timber were cleared. This same pattern was observed at a later date, but all the rings had extended outward. This indicates that timber harvest is the initial deforestation agent, and charcoal production continues the deforestation process when the timber harvest is no longer profitable (Ahrends et al. 2010).

While charcoal may not always be the primary driver of deforestation, it can contribute significantly to degradation and destruction of forests that have already been disturbed (Hofstad, Kohlin, and Namaalwa 2009). In parts of Uganda, the pace of consumption of hardwood is currently faster than regrowth. It is possible to manage these stocks in a way that is sustainable through forestry practices, but those practices currently are too expensive for local producers (Naughton-Treves et al. 2007).

Unlike firewood, charcoal usually comes from trunks or large limbs and requires cutting trees. While charcoal may not always be the primary driver of deforestation, it can contribute significantly to degradation and destruction of forests that have already been disturbed.

Charcoal production, like firewood collection, is still done mostly on small local scales and used as a means of supplementing farmers' incomes. One study demonstrated that, on average, charcoal producers had smaller farms and less capital than farmers who did not participate. Because charcoal is easier to transport than firewood and also produces less smoke and sulfur fumes, it tends to be more commonly used in urban areas. Most charcoal is produced in rural regions and

used in urban ones, so producers are not directly linked to consumers. A series of middlemen (traders and transporters) are necessary to complete the supply chain. They gain mostly from the charcoal trade, leaving less money for the producers (de Miranda et al. 2010).

Since the charcoal trade is so dispersed it is difficult for governments to control it (Girard 2002). In some cases massive charcoal production has fueled civil unrest (Box 8.1). Because urban populations are expected to increase (see Chapter 2), demand for charcoal is likely to grow. Thus, the charcoal industry is expected to have an increasing environmental impact.

Industrial fuelwood represents only about 10 percent of wood fuel use in Africa (Canadell, Raupach, and Houghton 2009). For the most part industrial wood fuels come from timber plantations, which are specifically grown for that purpose. Although industrial wood fuel does not come directly from forests, plantations can have an indirect role in deforestation. In one part of Uganda, for instance, the tea industry buys up large tracts of land to grow eucalyptus plantations (Naughton-Treves et al. 2007). This leaves less unused land for agriculture, causing farmers and others to clear forest in order to have sufficient land.

Asia

Asia is the region with the greatest use of wood fuels. Unlike Africa, where most wood fuel production is on a small scale, much of the wood fuels in Asia come from plantations. Of the roughly 8 million hectares of wood fuel plantations in the world, 6.7 million—an area larger than the state of West Virginia—are located in Asia (FAO 2010). Most plantations are located in China and India, countries that have already depleted most of their natural forests. There is some evidence that plantations help alleviate strains on natural forests (Kohlin and Parks 2001). Throughout most of the region wood fuels from plantations are used for preparing crops (e.g., tea and tobacco) and for the brick and ceramic industries. However, in India nearly two-thirds of plantations are non-industrial and the firewood is used for families and communities (Brown 1999). As in Africa, the majority of rural people in Asia rely on firewood as their primary source of fuel, but this is declining in most parts of the region (Hofstad, Kohlin, and Namaalwa 2009; Arnold et al. 2003). Charcoal is not heavily used in Asia.

Latin America

Of all the tropical regions, Latin America uses the least amount of wood fuel. In many Latin American

BOX 8.1.

An Illegal Charcoal Trade Threatens Biodiversity

One extreme example of the negative effects of the charcoal trade is Virunga Park (Nellemann, Redmond, and Refisch 2010). It is located in the Democratic Republic of Congo (DRC) near the borders of Uganda and Rwanda, and is one of the last remaining habitats for the endangered mountain gorilla. Beginning in the 1990s unrest in these three countries made Virunga an epicenter of conflict. Groups of rebels and national armies constantly use the park as their home base. Often these groups raise money by exploiting the land for minerals, timber, and the booming charcoal trade.

The illegal charcoal trade in the park is massive. It is estimated that rebels make around $28 million a year from this charcoal. Much of the work is carried out by prisoners held by rebels. Not only does this trade provide funds for rebel groups, it also threatens valuable biodiversity. In addition to destroying habitat, the rebels often rely on bushmeat for food. They have been known to kill gorillas in retaliation for charcoal seizures. To help combat the rebels and control the charcoal trade within the park, UNEP recommends strengthening the UN security presence in the region as well as instituting policies like REDD+ to help finance protection of the forest (Nellemann, Redmond, and Refisch 2010).

The charcoal trade is threatening the mountain gorilla

countries firewood is no longer the primary source of energy for rural populations. Brazil, for instance, introduced subsidies for natural gas use in the 1970s, and as a result many households have switched to propane for cooking and heating. Most wood fuel in the region is used for industrial purposes. In Brazil there is a great deal of concern over charcoal produced for the pig iron (an intermediate product in the iron-making process) and cement industries (Rose, Remedio, and Trossero 2009). Brazil is the largest consumer of industrial charcoal in the world, using around 7 million metric tons a year (Mugo and Ong 2006). While much of this comes from forests, Brazil is increasingly turning to eucalyptus plantations to meet these demands (Mugo and Ong 2006). As in other regions, charcoal use is expected to increase in the future.

Firewood use is expected to remain relatively level over the next 20 years, while charcoal use is expected to increase considerably. This increase in charcoal demand correlates with the expected increase in urbanization, as urban dwellers use more charcoal than rural ones. Therefore, it is worth developing more efficient and sustainable charcoal markets.

A Fuel for the Future?

Wood fuels have long been a major source of energy and are expected to remain so for some time. Firewood use is expected to remain relatively level over the next 20 years, while charcoal use is expected to increase considerably (Figure 8.1). This increase in charcoal demand correlates with the expected increase in urbanization, as urban dwellers use more charcoal than rural ones. There may also be increased competition for wood products if the demand for industrial wood fuels and

Men gathering wood in Cuba

BOX 8.2.

Benefits of Reducing Charcoal Use

In developing countries, smoke-related illnesses affect many people, like this mother and child in Kenya

Besides easing pressure on degraded land around urban areas, reducing charcoal use can have a direct effect on public health and climate. Indoor air pollution from charcoal stoves is a major cause of poor health in developing countries (Babanyara and Saleh 2010). According to the World Health Organization, 1.5 million people die prematurely each year due to indoor air pollution from cooking fuels. There are also 40,000 new cases of chronic bronchitis each year from soot and smoke. Reducing the use of charcoal and other domestic wood fuels can greatly improve the health of billions of people living in developing countries.

In addition to affecting public health, soot from biomass burning and other sources, also known as black carbon, is a powerful global warming agent (Hofstad, Kohlin, and Namaalwa 2009). One recent study suggests that black carbon is the second strongest contributor to global warming after carbon dioxide (Ramanathan and Carmichael 2008). Black carbon and other aerosols also play a major role in regional climate patterns (Menon et al. 2002).

other advanced bioenergy increases. Given that charcoal production can lead to forest degradation, such an increase is cause for concern.

Substantial research has gone into making charcoal use and production more sustainable. Many efforts focus on improving the efficiency of charcoal-burning stoves. These have not always been successful because of the high cost of the stoves and fragility of the ceramic liners in the more efficient stoves. However, some projects are successful because of more efficient stoves. Likewise, improving the efficiency of charcoal production can minimize the environmental effects of charcoal. Improved kilns not only decrease the amount of wood needed to produce charcoal, but can decrease the amount of carbon dioxide lost in the atmosphere (Girard 2002).

Switching to plantation species as a means of producing charcoal can also serve to make the industry less environmentally damaging (Girard 2002). In Brazil, for example, efforts are being made to use FSC-certified eucalyptus plantations to supply the charcoal industry (FAO 2010). Improving efficiencies or reducing use can have a number of other benefits as well (Box 8.2).

Another option, particularly for urban areas, is to find an alternative source of energy. Providing electricity to households has been proposed as an alternative to fuelwood. However, at least one study in South Africa demonstrated that even after electrification, many households still relied on firewood (Madubansi and Shackleton 2007). There are a number of reasons for this. First, using electricity to cook is thought to be slow and inefficient. Second, firewood in some cases is cheaper than electricity. Third, cooking and heating with electricity require expensive appliances. There are other options for urban fuel sources (e.g., kerosene or propane), but these also have drawbacks, such as high cost (Knöpfle 2004).

Beyond improving efficiencies, there are some community-level policy options being implemented that can make the trade of wood fuels more sustainable. In Africa a set of policies to encourage community-based wood production (CBWP) has had some success in making wood production sustainable in certain areas

Using charcoal for blacksmithing in Burkina Faso

(de Miranda et al. 2010). These programs arose because those who lived closest to forests and wood fuel sites were often exploited by urban producers and traders who received exploitation rights from state or national agencies. Under CBWP schemes, communities are given specific rights to their lands by resource agencies and the locals are then responsible for issuing permits. Communities can establish quotas and collect a tax on wood fuels, ensuring that more money stays in the community. In Senegal and Niger, CBWP schemes have led to an increase in forest cover. The nature of the wood fuel markets (many small producers and traders) makes them hard to regulate at a national level, but CBWP programs allow for diffusion of that regulation, which can lead to greater enforcement and sustainability.

Conclusion

Wood fuels are still the major source of energy for much of the developing world. As a whole, wood fuels are not a major driver of deforestation around the globe, but they can have negative effects at the local level. This is particularly true of charcoal production, which is expected to increase in the future. Therefore, it is worth developing more efficient and sustainable charcoal markets. Using fast-growing plantation species rather than slow-growing hardwoods, increasing efficiencies of charcoal kilns and stoves, and finding alternative sources of energy can reduce the impact of charcoal production. Further, developing strategies by which small- and medium-scale charcoal production is controlled and regulated by local communities can make the charcoal trade more sustainable.

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The Root of the Problem

WHAT'S DRIVING TROPICAL DEFORESTATION TODAY?

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About the Union of Concerned Scientists

The Union of Concerned Scientists (UCS) is the leading science-based nonprofit working for a healthy environment and a safer world. UCS combines independent scientific research and citizen action to develop innovative, practical solutions and to secure responsible changes in government policy, corporate practices, and consumer choices. More information is available about UCS at *www.ucsusa.org*.

About the Tropical Forest & Climate Initiative

The Tropical Forest & Climate Initiative (TFCI) is a project of the UCS Climate and Energy Program. TFCI analyzes and promotes ways to cut global warming pollution by reducing tropical deforestation. To learn more about this work, visit *www.ucsusa.org/forests*.

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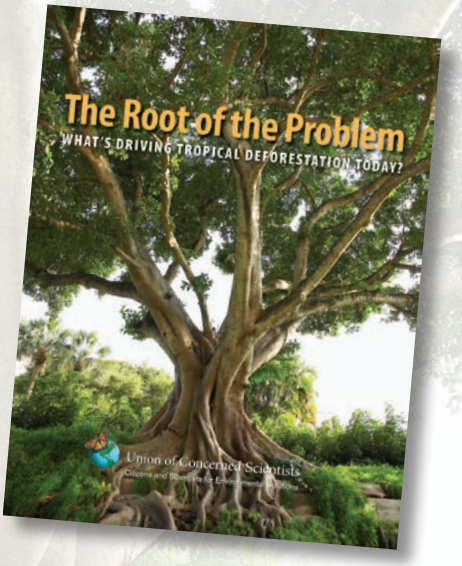

Deforestation and forest degradation have been occurring for thousands of years. Both are important sources of global warming pollution, as well as threats to biodiversity and the livelihoods of forest peoples. Thus it is important to understand the causes of these changes—the "drivers" of deforestation.

In this report we focus on the economic agents that currently play a critical role in deforestation, as well as agents that have played a historical role in deforestation (to determine their role today).

Background and Context

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The full report, executive summary, and chapters are available online (in PDF format) at *www.ucsusa.org/whatsdrivingdeforestation*.

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

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The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

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