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THE ENVIRONMENTAL AND SOCIAL IMPACTS OF WOOD CHARCOAL IN BRAZIL

INTRODUCTION

The human and environmental impact of charcoal production in Brazil must be seen first-hand to be appreciated. It has largely escaped the kind of attention that has been given to large infrastructure projects such as dams and highways, but the consequences of myriad small charcoal making camps hidden in ranches spread over thousands of square kilometers can have an impact equivalent to any such mega-project. The insidious nature of charcoal making manages, in pratice, to allow this activity to escape the safeguards provided by Brazil's environmental and labor laws, as well as international protections such as those included in World Bank loan agreements.

ENVIRONMENTAL IMPACTS

AMAZONIAN FOREST

Charcoal manufacture contributes significantly to the loss of Amazonian Forest today, and the potential of future impacts is very great. Most critical is the Grande (Greater) Carajás Program area, a portion of eastern Amazonia covering 900,000 km² (about twice the size of the U.S. state of California). This regional development program is centered around the Carajás iron mine, site of the world's largest high-grade iron ore deposit (MINISTERIO DA AGRICULTURA, 1983; FEARNSIDE, 1986). While many of the grandiose development plans announced for the area in the early 1980s have been successively delayed for lack of sufficient funds, the mining facility and its 890-km railway to a new port at Ponta da Madeira (near São Luís, Maranhão) were implanted with financing from the World Bank and the European Economic Community, and began operation in 1984. The mine and railway make the area attractive for pig iron manufacture, as the railway can both bring the ore to the mills and carry the resulting pig iron ingots to the port, from whence they can be transported elsewhere for smelting into steel. Conversion to pig iron eliminates the rock from the ore (leaving only iron), thereby reducing shipping costs. Because the capacity of the Ponta da Madeira port is what limits the rate that ore can be mined at Carajás and exported, conversion of some of the ore to pig iron nearby increases the total that can be sold (pig iron is exported from a different port, located at Itaqui, also near São Luís). Brazil's coal deposits are mostly located far away in the state of Santa Catarina, and they are not of a type appropriate for conversion to coke for use as a reducing agent in smelting iron. Charcoal, however, can serve both as a source of heat to melt the ore and as a reducing agent — a substance that essentially sucks the oxygen out of the ore, leaving only iron behind.

Like many large development projects in Brazil and elsewhere, the Grande Carajás Program has evolved over the years. A series of official announcements has been followed by a trail of real events that often fall short of the grandiose plans initially announced, but that nevertheless constitute tremendous changes in their own right. By 1986 the Grande Carajás Interministerial Council had approved incentives for seven pig iron plants, two iron alloy plants and two cement factories, all of which function with charcoal. These 11 enterprises were expected to demand 1.1 million metric tons of charcoal annually (CODEBAR/SUDAM, 1986). Producing this much charcoal would consume annually a pile of logs equivalent to a 281-story building (FEARNSIDE, 1989C). The full plan was even larger, calling for production of 2.8 million tons of pig iron per year, and implying a consumption of 2.3 million tons of charcoal. The planned production of pig iron implied clearing 1,000 km² per year if calculated based on the average biomass of all forests in the Grande Carajás region or 1,500 km² per year if calculated using the biomass of forest in a 150-km strip along the Carajás railway (ANDERSON, 1990).

The price of pig iron remained at low levels over the decade following the beginning of charcoal production in 1988, discouraging the rapid expansion of smelters originally foreseen. Nevertheless, the charcoal production promoted under the Grande Carajás Program continues gnawing at the forest slowly and continuously. Whether this occurs at a faster or a slower rate, all accessible forest can be expected to be consumed eventually. Carajás represents a virtually permanent demand for charcoal for pig iron manufacture, as this 18 billion ton deposit of ore is expected to last 400 years at the current rate of mining.

Although official statements often mention silvicultural plantations as a future wood source for charcoal, native forest appears to be the most likely source as long as it remains

standing. At least in theory, firms are required to obtain the wood used for charcoal from sustainable sources after a given period. At present, their principal source is wood from lands being clearcut for pasture. As this source becomes exhausted in the area of the mills, charcoal suppliers are supposed to mount "forestry management" schemes. Experiments were initiated at Buriticupu (Maranhão) to measure growth after wood removal at a variety of intensities, including clearcutting (DE JESUS ET AL., 1986; THIBAU, 1986). The sustainability of such planned management has been questioned, but firms can be expected to promise whatever is needed to get permission to begin exploitation, as they can later abandon their projects at a profit when they "discover" that the systems were unsustainable after all (FEARNSIDE, 1989; FEARNSIDE, 1990). Authorization of forest management for charcoal has a potentially damaging role as a smokescreen for destruction of the forest.

Charcoal also provides a spur to deforestation and to logging by increasing profitability of these activities. Pig iron proponents claim that it is loggers and ranchers who destroy the forest, while the charcoal industry only salvages the scrap that would otherwise be lost. Loggers themselves blame the ranchers in the same way. However, the wood sold for charcoal, both from logging scrap and from areas that have recently been or soon will be deforested, adds to the overall profitability of clearing. Profit from charcoal thereby contributes to the environmental destruction wrought by both logging and deforestation.

CERRADO

The *Cerrado*, or central Brazilian scrub savanna, has traditionally been the principal source of wood for charcoal used by Brazil's iron and steel industry, especially the major part of this industry that is located in the state of Minas Gerais. As this vegetation has dwindled in Minas Gerais, charcoal has been trucked to the smelters from progressively more distant areas of *Cerrado*, especially from the state of Mato Grosso do Sul. *Cerrado* trees are of small diameter, making them easy to convert to charcoal, as well as making *Cerrado* easy to clear. Brazil's *Cerrado*, which once occupied about one-quarter of the country, has undergone rapid conversion to pasture and agriculture, especially soybeans (KLINK ET AL., 1994). *Cerrado* is also one of Brazil's ecosystems with the smallest proportion of protected area (FEARNSIDE & FERRAZ, 1995).

As of 1987, 86% of Brazil's use of charcoal was for industry (i.e., iron and steel) and 14% for residential and commercial purposes (i.e., for barbecued meat) (FEARNSIDE, IN PRESS). Minas Gerais was the site of 80% of Brazil's production of charcoal as of 1993, and 60-70% of this was made from wood from native vegetation (GUERRA, 1995). Nevertheless, the economic force of demand elsewhere extends the range of charcoal's impact. The impact of this economic force is reflected in the endless stream of trucks carrying charcoal that can be seen on the highways entering the state of São Paulo from Mato Grosso do Sul.

ATLANTIC FOREST

Brazil's Atlantic Forest has been exposed to the pressures of dense human population much longer than Amazonia, and has been reduced to remnants. By 1992, the Atlantic Forest had shrunk to only 8.8% of its original 1,085,544 km² area (FUNDAÇÃO S.O.S MATA ATLÂNTICA, 1992). Much of the loss has occurred only in the last few decades. The last remaining areas of the Atlantic Forest harbor an extraordinary number of endemic species, many of which are threatened with extinction. Each hectare of additional clearing in the Atlantic Forest therefore has a heavy impact on biodiversity. Demand for charcoal in the cities along Brazil's Atlantic coast draws wood from the Atlantic Forest. In addition, the pig iron industry in the state of Minas Gerais draws charcoal made from native vegetation of all types within the radius for which it is profitable to transport it. This includes the Atlantic Forest areas, especially in the state of Bahia.

SILVICULTURAL PLANTATIONS

With over seven million hectares of silvicultural plantations, mostly of eucalyptus species, Brazil is one of the world's major players in this area. Brazil's vast land area with climate appropriate for plantation trees makes large-scale expansion more feasible than in many other parts of the world. Markets for the products of plantations represent another vital ingredient in such expansion, and the demand for charcoal by Brazil's iron and steel industry is an important part of this.

Of wood used for firewood and charcoal in Brazil in 1992, 69% came from plantations, 29% from firewood collection and 2% from sawmill scraps. The great expansion of charcoal use in Brazil's iron and steel industry occurred between 1972 and 1987, a period over which the volume of charcoal used increased by over 200% (FEARNSIDE, IN PRESS). In the late 1990s, however, a number of smelters in Minas Gerais reverted to the former practice of using mineral coal. However, charcoal remains a major input to this industry. As the natural vegetation (*Cerrado* and Atlantic Forest) accessible to mills in Minas Gerais is progressively destroyed, one can expect that plantation expansion will provide much of the wood that had formerly been drawn from these sources.

SOCIAL IMPACTS

The major concerns regarding large-scale expansion of plantations in Brazil are social rather than environmental or technical (BARNETT, 1992; FEARNSIDE, 1996). Social impacts include displaced population and replacement food crop production, both of which result from small food-producing family farms being taken over for vast expanses of plantation demanding little labor. This is one of the concerns surrounding the FLORAM project that was put forward in 1990 by the University of São Paulo (INSTITUTO DE ESTUDOS AVANÇADOS, 1990) to subsidize an additional 20 million hectares of silvicultural plantations as a means of sequestering carbon to avert global warming.

The FLORAM project is envisaged as being composed of plantations divided into relatively small blocks so that the local population would have sufficient space for food production in the areas between the silvicultural blocks:

> "PLANTED FORESTS IN SPACES COVERING 100,000 OR 200,000 HA, IN THE CONTEXT OF RURAL BRAZIL, WOULD BE A CRIME COMMITTED AGAINST THE FUTURE OF A COUNTRY THAT NEEDS TO DEVELOP ITS AGRICULTURE AND DISCOVER THE CORRECT GUIDELINES FOR A PROCESS OF AGRARIAN REFORM. FOR THIS REASON, WE ENVISAGE THAT THE TECHNICAL RESERVES OF THE COMMERCIAL PLANTATIONS SHOULD NOT OCCUPY SPACES GREATER THAN 15,000 OR 20,000 HA, SEPARATED FROM EACH OTHER BY 25 TO 40 KM AT THE MINIMUM."
>
> (AB'SABER, 1997)

It is obvious that this vision differs from the present pattern, where a number of companies have over 200,000 ha of continuous plantations. The present spatial pattern is not a random event: it is the result of economies of scale and minimization of costs for transport and management. If the spatial pattern adopted is the one recommended by the FLORAM project, this would imply an additional financial cost, which would be the price of avoiding the social impacts provoked by vast expanses of continuous eucalyptus that the expansion of silviculture produces in a *laissez faire* scenario (FEARNSIDE, 1997).

Charcoal manufacture in Brazil is closely linked to a system of debt slavery that has been the subject of domestic and international outrage. In 1994 public attention was drawn to the existence of slavery in Brazil when denunciations were brought before the International Labor Organization in Geneva (SUTTON, 1994; ISTO É, 1994). Charcoal is frequently manufactured by families, including children, who work for an intermediary who supplies charcoal to legitimate businesses such as pig iron mills. The charcoal workers are obliged to buy all supplies from their employer and, given the high prices charged for the supplies and the small amounts credited per unit volume of charcoal produced, the debts grow inexorably and become impossible to settle. In practice, workers never receive any payment in cash—only credit towards paying off past debts. Gunmen assure that the workers cannot run away, the only exit from the system being death.

The debt slavery system violates Brazil's labor legislation, but is tolerated in practice. In 1997 Brazil began a pilot project to combat the use of child labor by charcoal-making operations in the state of Mato Grosso do Sul, but no such program has begun in the Carajás region of Pará and Maranhão where much of the future expansion of silvicultural plantations for charcoal manufacture is likely to be located.

CHARCOAL AND MITIGATION OF GLOBAL WARMING

Charcoal manufacture has a potential role in efforts to combat global warming that has made this a subject of intense interest. The accumulation of carbon dioxide and other greenhouse gases in the atmosphere has spurred a frenetic search for ways to remove these gases and to avoid the

burning of fossil fuels. Charcoal is a substitute for mineral coal, and this substitution can be seen as accounting a "permanent credit" for the carbon that would have been released to the atmosphere as carbon dioxide had coal been used instead. The carbon in charcoal is also released, of course, but this carbon is reabsorbed by the vegetation as it grows back on the harvested sites. Providing charcoal from plantation-grown wood assures that this reabsorption occurs in full (assuming that natural forest has not been cut to make way for plantations); if the wood comes from natural vegetation, one must know what proportion will be allowed to grow again, how fast this occurs, and what proportion of the cutting would have occurred in the absence of harvesting for charcoal.

The carbon benefits of plantations depend heavily on the end use of wood produced. Substitution of fossil fuel has much greater potential benefit than stocking carbon in standing biomass in plantations or in wood products made from harvested trees. This is because each ton of fossil fuel carbon replaced is considered to be a permanent gain, whereas the flux of carbon to biomass or wood-product pools reverts to the atmosphere later, so that the net flow is zero after the size of these stocks reaches an equilibrium. This is what gives plantations for charcoal a great advantage in terms of carbon benefits over other types of plantations. The global-warming benefit from substituting charcoal for a ton of mineral coal is considered permanent because the fossil carbon emission that is avoided in any given year cascades forward indefinitely, even though the ton of mineral coal that would have been burned were charcoal not used may be dug up and burned the following year.

The December 1997 Kyoto Protocol has often been criticized for allowing "sinks", such as plantations, to earn carbon credit, thereby permitting industrialized countries to emit more fossil carbon in trade for an ephemeral benefit (LASHOF & HARE, IN PRESS). However, this criticism does not apply to the substitution of coal by charcoal, as the gains are just as permanent as those achieved through energy efficiency or reduced consumption.

Very substantial sums of money could soon become available to subsidize charcoal production as a global-warming mitigation measure. The "Clean Development Mechanism" foreseen in the Kyoto Protocol is to allow those countries that have agreed to limit their emissions (such as the U.S.) to meet part of their commitment by financing mitigation projects in countries such as Brazil. Credits from the Clean Development Mechanism can be earned beginning in 2001. Assuming that the Kyoto Protocol is ratified, the U.S. Government is expecting to spend US$ 8 billion annually on projects under the Clean Development Mechanism and other "flexibility mechanisms."(SEABRIGHT, 1998). The effect of such money flows could radically alter the Brazilian landscape.

Despite the real benefits that plantations for charcoal have for global climate, the benefits would be substantially greater if funds were applied instead to slowing Amazonian deforestation. In addition to greater carbon benefits, avoiding deforestation brings benefits in other spheres, such as maintaining biodiversity, water cycling, and forest peoples — whereas subsidizing charcoal gives only carbon. The social effects are also very different: unless strong safeguards are devised, the expansion of charcoal manufacture could perpetuate some of Brazil's worst social abuses.

One of the major issues yet to be decided in assigning credit to different mitigation actions is what (of any) value will be given to time. The most common way of giving a value to time in financial decisions is by applying a discount rate, that is, by devaluing future costs and benefits by a constant percentage for each year that passes. Discount rates greater than zero reduce the attractiveness of options that accumulate carbon slowly over the period, such as accumulation as fossil fuel substitution from charcoal plantations or, to a lesser extent, in wood-product pools in sawlog plantations (FEARNSIDE, 1995; MARLAND ET AL.,1997). Charcoal plantations can displace so much fossil carbon over the course of a century that their average stocks approach that of maintaining the forest, but only if the discount rate is zero. At a 5% discount rate the average carbon stock for charcoal plantations falls to almost half this value, while the benefit of forest maintenance remains unchanged.

Brazil's proposals for mitigating global warming have tended heavily to silvicultural plantations, and proposals to maintain the forest are so far conspicuously lacking. Best known is the "FLORAM" project. As Brazil's silvicultural plantations expand, one can expect the location of the plantations to shift from central and Southern Brazil to the Northeast region (especially Bahia), and then to move rapidly into Amazonia (FEARNSIDE, 1995). Indeed, this rapid movement into Amazonia has already begun in the Carajás

announcement seriously and believed that this kind of development would not materialize in practice (GOODLAND, 1988). The bulk of the Bank's investment in the iron project, paid for by taxpayers in the United States and other contributing countries, took place between the July 1982 announcement of the charcoal plan and completion of the railway in February 1984. The charcoal scheme made possible by the iron project's infrastructure soon became the focus of intense criticism (FONSECA,1987; SECRETT,1987; SIMONS,1987). The scheme illustrates four problems in controlling the environmental impact of development projects:

1) The environmental safeguards of the World Bank-financed iron project apply to a "zone of influence" that is much more limited than the zone really affected by the undertaking and its offshoots. The Bank's "Carajás Iron Project" applies only to the 489,000 ha area around the mine, a 40-km strip along the Carajás-Ponta da Madeira Railway and a small area around the port near São Luís; most of the Grande Carajás Program that the mine and railway made possible lies outside of this zone. However, most of the pig iron smelters are right beside the railroad, and so fall in the restricted geographical area covered by the World Bank's loan agreement.

2) The total impact of many relatively small operations,such as the pig iron smelters, may be tremendous even though each one is smaller than the undertakings usually considered in World Bank loan agreements.

3) While the environmental program and procedures established under the World Bank's "Carajás Iron Project" were designed to minimize the damage caused directly by the loan recipient (Companhia Vale do Rio Doce), the impacts of third parties was not covered by these safeguards. Because the smelters are located within the strip along the Carajás-Ponta da Madeira Railway, environmental requirements in the World Bank loan agreement for the Iron Project may apply to these third parties. While the issue remains unresolved as to whether the letter of the agreement was violated, its spirit was undeniably flaunted.

4) The World Bank's procedures so far give it little leverage in inducing compliance with the environmental clauses in its loan agreements. As long as the maximum penalty for noncompliance continues to be only suspension of disbursements of the loan in question, the consequences of noncompliance dwindle rapidly as completion of loan disbursements approach and evaporate almost completely after the last installment is received. Environmental safeguards would be taken much more seriously if noncompliance for any given loan resulted in loss of other unrelated projects throughout the country.

CONCLUSIONS

Charcoal manufacture has serious environmental and social impacts that escape from existing safeguards both in Brazil and in international financing organizations. The impacts of charcoal manufacture dramatize the need to strengthen Brazil's licensing procedures at both federal and state levels, and to institute effective penalties for noncompliance with international loan agreements. Plans to subsidize charcoal production as a means of combating global warming need to be accompanied by measures to avoid unacceptable impacts. The possibility of substantial monetary flows to the charcoal industry, for example through the Clean Development Mechanism foreseen under the Kyoto Protocol, represents a potential motivation to end the debt slavery system — but only if effective provisions for independent certification and monitoring are required. In addition, charcoal manufacture as a response to global warming needs to be compared with other options; in the case of Brazil, avoiding further clearing of tropical forest holds much greater potential benefit for the climate as well as for biodiversity and other priorities.

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