5. Analysis of charcoal production systems in Guyana

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INTRODUCTION

It is estimated that approximately 1.5 billion people in developing countries derive at least 90% of their energy requirements from wood and charcoal. Another one billion people meet at least 50% of their energy needs this way. In most developing countries, 90% of the people depend on fuelwood as their chief source of fuel and each year the average user burns anywhere from a fifth of a ton, in extremely poor, wood short areas such as India, to well over a ton in parts of Africa and South Asia (GFC, undated).

In 1999, it was estimated that 1.9 billion m^3 of wood was burned for cooking, to provide heat or to manufacture charcoal for later burning (FAO, 1999). Globally, there is a marked trend for developed countries to have a high per capita usage of energy as a whole, of which wood is a minor component compared with developing countries with a low per capita energy input but a high proportion consisting of fuelwood (firewood and charcoal).

Global fuelwood consumption is dominated by Asia and Africa (> 75% of total volume) with South America ranking third at 10%. Five countries: China, India, Indonesia, Nigeria and Brazil, account for about half the fuelwood and charcoal produced and consumed each year (Matthews, 2000).

Unfortunately, analyses of woodfuel consumption are complicated by a dearth of current, comprehensive data. The FAO woodfuel data, for example, are based largely on estimates derived from scattered 1960s household consumption surveys, which are updated annually in line with population and income growth. These estimates substitute for information on actual woodfuel consumption in most developing countries (Matthews, 2000).

In global terms, Guyana, with its small population (< 1 million), tropical climate and readily available fossil fuels for cooking, is not a major producer or consumer of charcoal. However, the production, transport and combustion of charcoal do constitute a small but locally significant source of energy and income. Furthermore, despite the country's high forest cover (>75%), the source of the wood raw material and the production units are rather localized along the main road transport arteries in the near interior.

It is therefore critical to assess the sustainability of the current charcoal production cycles and develop long-term policies to mitigate any negative impacts. The environmental and socioeconomic impacts of charcoal production are intertwined and this study uses published statistics on charcoal production and use to provide a baseline from which further work can provide more in-depth information to identify issues related to charcoal production.

OBJECTIVES

The specific objectives of this preliminary desk based study are:

- To identify supply sources for charcoal.
- To describe process units involved with charcoal production and analyse production statistics.
- To identify and discuss the key environmental, socioeconomic, cultural, institutional and legal aspects associated with production of charcoal.
- To make recommendations to future actions.

BACKGROUND

Charcoal is an alternative energy source which has been produced in Guyana for a number of decades and for periods in the latter half of the 20th century, was a significant local industry that also supplied a substantial export demand. A general period of decline in the industry followed the increase in availability and use of alternative fuels (especially kerosene and liquid petroleum gas for cooking) though there has been recent upsurge in production to feed a small but important export market and a reliable local demand primarily for domestic and commercial barbeque use. In the pre-independence period exports of charcoal form British Guiana were primarily to the United Kingdom. Currently, however, exports are almost exclusively destined for Caribbean countries.

Charcoal production methods in Guyana have traditionally utilised simple technologies and the pit method of production is still the most prevalent. Readily available tree species is found on the white sand forest types that are common in the accessible near interior areas. Charcoal production has therefore contributed to large areas of degraded forests, especially along the main road arteries for some 100 miles south of the capital Georgetown.

CHARCOAL PRODUCTION IN GUYANA

Production cycle

Charcoal is the solid residue remaining when wood is carbonized under controlled conditions in a closed space (FAO, 1987). Control is exercised over the entry of air during the carbonization process so that the wood does not burn away to ashes, as in a conventional fire, but decomposes chemically to form charcoal. The pyrolysis process, once started, continues by itself and gives off considerable heat. However, this pyrolysis, or thermal decomposition of the cellulose and lignin of which the wood is composed, does not start until the wood is raised to a temperature of about 300° Celsius.

In traditional methods of production, some of the wood loaded into the kiln is burned to dry the wood and raise the temperature of the whole of the wood charge, so that pyrolysis starts and continues to completion by itself. The wood burned in this way is lost. All carbonizing systems give higher efficiency when fed with dry wood, since removal of water from wood needs large inputs of heat energy.

The pyrolysis process produces charcoal which consists mainly of carbon, together with a small amount of tarry residues, the ash contained in the original wood, combustible gases, a number of chemicals mainly acetic acid and methanol and a

large amount of water which is given off as vapour from the drying and pyrolytic decomposition of the wood. When pyrolysis is completed the charcoal, having arrived at a temperature of about 500° Celsius, is allowed to cool down without access of air; it is then safe to unload and is ready for use.

There are two main methods used in the production of charcoal: the pit tumulus method and the portable kiln method. The pit method involves digging a pit of various sizes, stacking the wood and burning under conditions of restricted oxygen. It is the most prevalent method in use in Guyana.

The pit (typically 3m long by 1.2m wide and 1.2m deep) is loaded with lengths of small round-wood logs which will fit easily across the pit. When the pit is full, an airtight layer of leaves and then earth is placed on top. To ensure that the wood is properly heated for carbonization, the hot gas is allowed to pass along the floor of the pit, beneath the charge, by placing the charge on a crib of logs. The hot gases, produced by partial burning at one end of the pit, travel to the flue at the opposite end. These hot gases slowly dry out the earth and heat up the rest of the wood to the carbonization initiation point, about 280300°C.

Depending on the size of the pit and the species used, a batch of charcoal takes approximately 14 weeks to produce. The nature of carbonization in a pit makes it difficult to achieve a uniformly carbonized charge. The charcoal at the firing end is normally low in volatiles and the last formed charcoal near the smoke flue is high in volatiles, since it was subjected to carbonizing temperatures for only a short time.

The pit method has several advantages, namely: less initial investment; small production costs relative to the other methods; higher density (and better quality) charcoal and a relatively low level of fines produced.

The portable kiln method involves stacking small air-dried billets in a metal kiln, covering and burning. The main advantages of transportable metal kilns compared with the traditional earth pit are:

- raw material and product are in a sealed container giving maximum control of air supply and gas flows during the carbonization process,
- unskilled personnel can be trained quickly and easily to operate these units and less supervision of the process is required compared to the constant attendance necessary with pits,
- mean conversion efficiencies of 24% including fines (dry weight basis) can be consistently achieved. Pits can give erratic, often lower yields,
- all of the charcoal produced in the process can be recovered. With pit methods some of the charcoal produced is lost in the ground and that which is recovered is often contaminated with earth and stones,
- transportable metal kilns, if designed to shed water from the cover, can be operated in areas of high rainfall, providing the site has adequate drainage. Traditional methods of charcoal production are difficult to operate in wet conditions and
- the total production cycle using metal kilns takes two to three days.

Location of raw material and production units in Guyana

Raw material collection and charcoal production are concentrated in what are now secondary forest areas accessible to the main population concentrations along the coast. Charcoal activities occur in significant quantities along the Soesdyke Linden Highway, the Ituni and Mabura Roads and the upper Berbice River.

Typically, the secondary forests are those that have been logged-out or high-graded over a period of years and whose restoration to high forest condition is prevented by continual exploitation and recurrent fires. Typically, these forest types occur on the white sands of the Berbice formation. These soils are typically excessively drained and very infertile. Dominant species and those used for charcoal production are Wallaba (*Eperua spp.)* and Dakama (*Dimorphandra conjugata*). Intensive exploitation combined with the soil conditions and fire can result in the development of degraded low forest and scrub vegetation.

Charcoal produces generally fall into one of the three main categories:

- farmers who are clearing their land convert some of the wood resources to charcoal,
- sawmillers and loggers who produce charcoal as part of their general operations and
- professional charcoal producers.

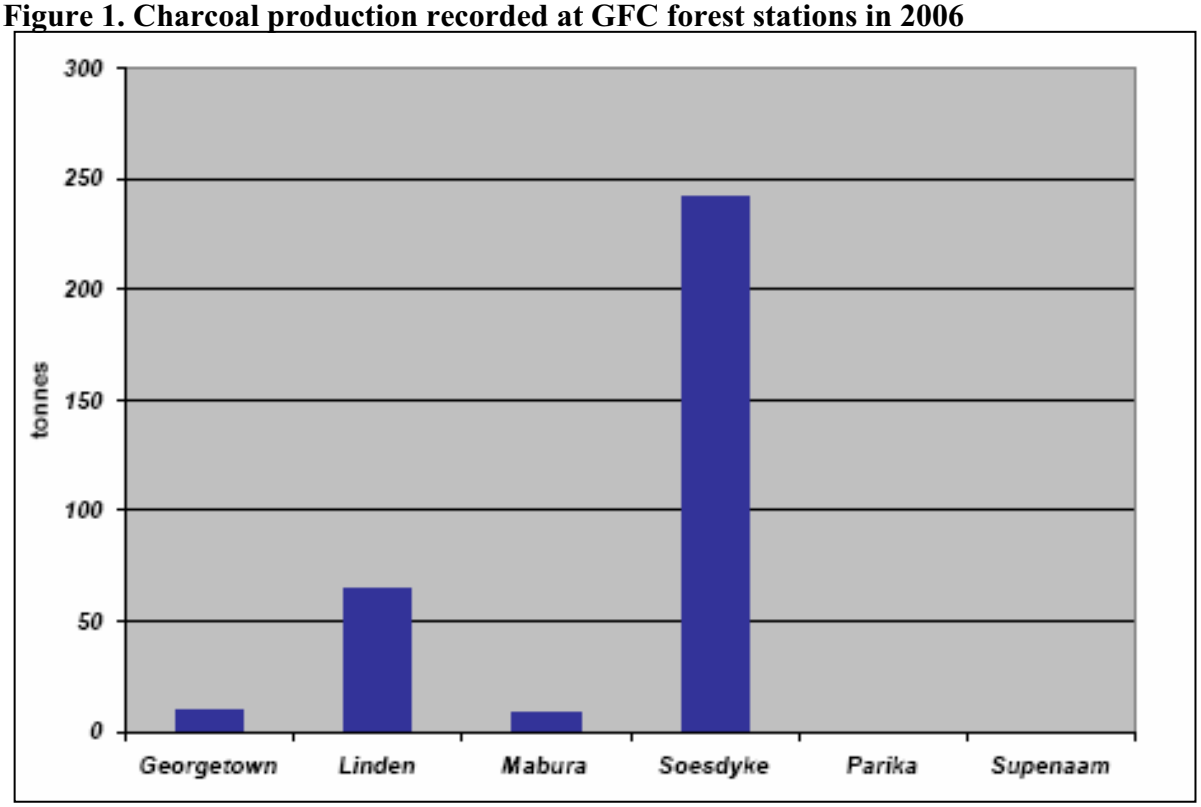
According to an internal GFC study conducted in the mid 1980s there were, at that time in Guyana, a total of 163 charcoal producers, 78% using the earth pit, 13% using a kiln and 9% using both methods (Table 1). Figures from 2002 indicate that there had been a dramatic drop to eleven charcoal producers at that time which fell again to just six by 2003 (Thomas, *et al,* 2003). In 2005, there were still six licensed producers (all within Demerara County) and in 2006 ten licensed producers (four in Georgetown, two on West Coast Demerara, two on the Linden Highway and two on East Bank Demerara; GFC pers. comm.). Of the total recorded production in 2006, the majority (75%) was recorded at Soesdyke forest station, with smaller amounts at Linden, Georgetown and Mabura (Figure 1).

Table 1. Charcoal production areas, number of producers & type of production

Area	# of producers (kiln)	# of producers (pit)	# of producers (both)	Total
East Coast Demerara	1	-	-	1
East Bank Demerara	1	-	-	1
Soesdyke Linden highway (Lower Dem R)	9	46	5	60
Soesdyke Linden highway (Upper Dem R)	-	23	3	26
Ituni Road	-	4	1	5
Wismar	-	5	-	5
Wismar Rockstone	3	25	4	32
Mabura Hill	2	2	2	6
Bartica Triangle	2	8	-	10
Essequibo Coast	1	11	-	12
North West District	1	1	-	2
Berbice River	1	2	-	3
Total	**21**	**127**	**15**	**163**

Source: undated GFC report, estimated mid-1980's

Figure 1. Charcoal production recorded at GFC forest stations in 2006



Source: undated GFC report

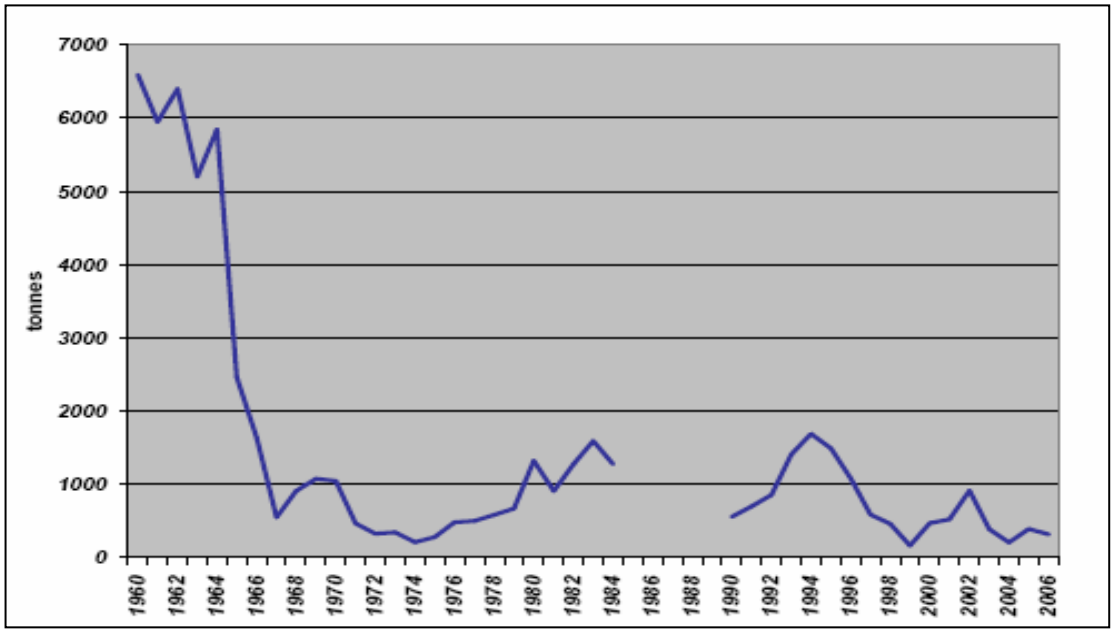
Production statistics

Production statistics are based on declarations made to the GFC. Unfortunately, there is not a complete annual record from 1960 to the present. However, from various sources (GFC undated report, GFC annual market summaries and GFC pers. comm.) data series from 1960–1984 and 1993–2006 have been compiled (Figure 2). Over the years between 1946 and 1964 production averaged about 6 600 tons annually (GFC, undated). This was a significant amount for relatively small producer country, but small (around 2%) in comparison with, for example, total world imports of charcoal (which in 1961 was 295 000 tons).

There followed a significant decline in production between the years 1965 and 1974 when production averaged about 980 tons. From 1974 to 1984 there was a small recovery though subsequently there was another decline. Following another brief recovery in 1994, over the period 1994 to 1998 charcoal production again declined steadily from 1 717 tonnes in 1994 to the 1998 level of 461 tonnes, which has been approximately equal to the average annual production over the last five years. In 2006 production fell 18.6% from the 2005 level, volume being 319 tonnes compared with 392 tonnes previously. Annual levels have fluctuated over the past four years and have not recovered to 2000–2002 levels.

The decline over the years has been attributed to shrinking export markets, a national strategy of de-emphasizing the industry (at least during the 1960s) and a reduction in domestic consumption following successful promotion of kerosene and, latterly, liquefied petroleum gas as fuel for cooking purposes.

Figure 2. Charcoal production in Guyana (tonnes equivalent: from 1960-1984, converted from imperial tons; 2004 converted from m^3 using GFC conversion of lm^3: 0.133t).



Sources: 1960-1984-GFC undated report: 1990-1993, GFC via GoG, 2002; 1994-2003 GFC Market Report 2003: 2004-2006 - GFC personal communication No data available between 1985-1989)

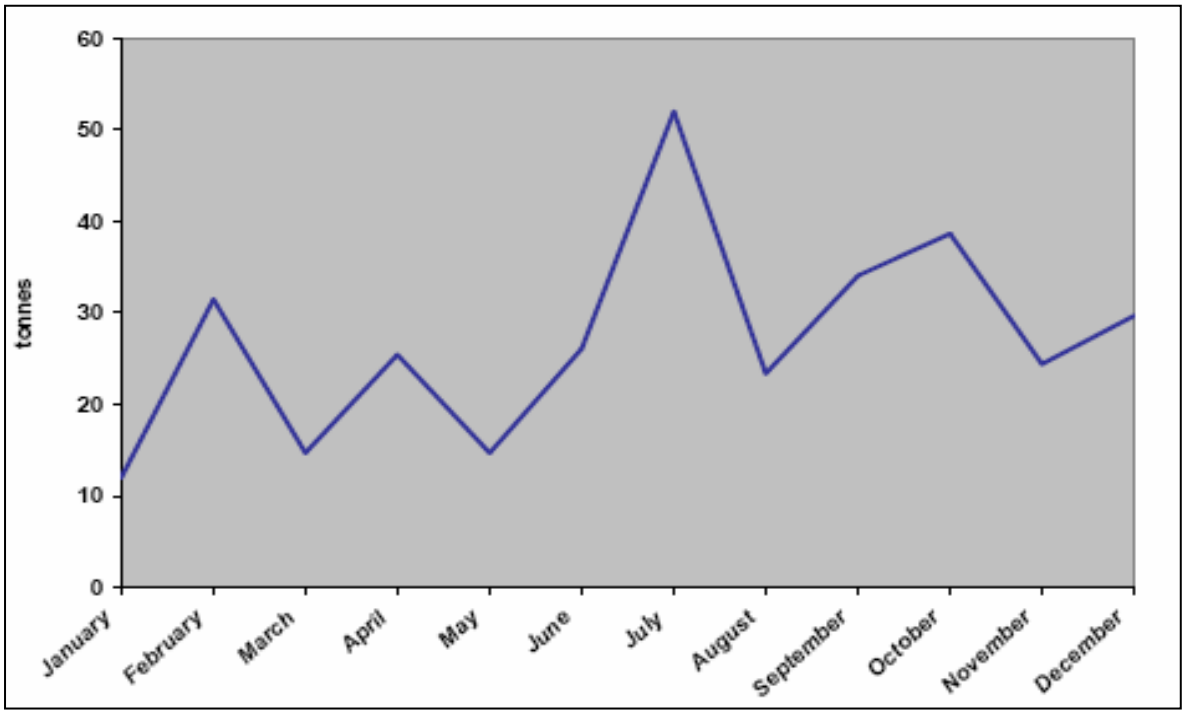
Within general trends, there are noticeable fluctuations between years. One possible reason for this is changes in weather patterns. The decline in 1998 (compared with 1997 figures) was attributed, in part, to the exceptionally hot weather in the third quarter of 1998 which made it difficult for charcoal pits to cool off in the usual length of time (GFC, 1999). There are also marked fluctuations in monthly production through individual years. For 2006, peak production occurred in July, October and February which may be a weather-related phenomenon as these months generally occur during the drier parts of the year (Figure 3).

Use of charcoal and charcoal markets

The principal primary sources of energy in Guyana are imported petroleum products, bagasse (a by-product of sugar production) and fuelwood. In 1992, they accounted for 48.7%, 25.9% and 25.4%, respectively, of the energy produced in the country (ITTO, 2003). From 1974–1984 there was a rise in domestic consumption of charcoal, though there is a gap in data until 1994 after which consumption dropped to around 600 tonnes (Figure 4). Though there are no figures available since 1998, it is believed that most charcoal dealers cater to the local market (primarily for domestic and commercial barbeques) though there are occasions for quantities to be exported, mainly to the Caribbean (Thomas *et al*., 2003*;* see also Table 2).

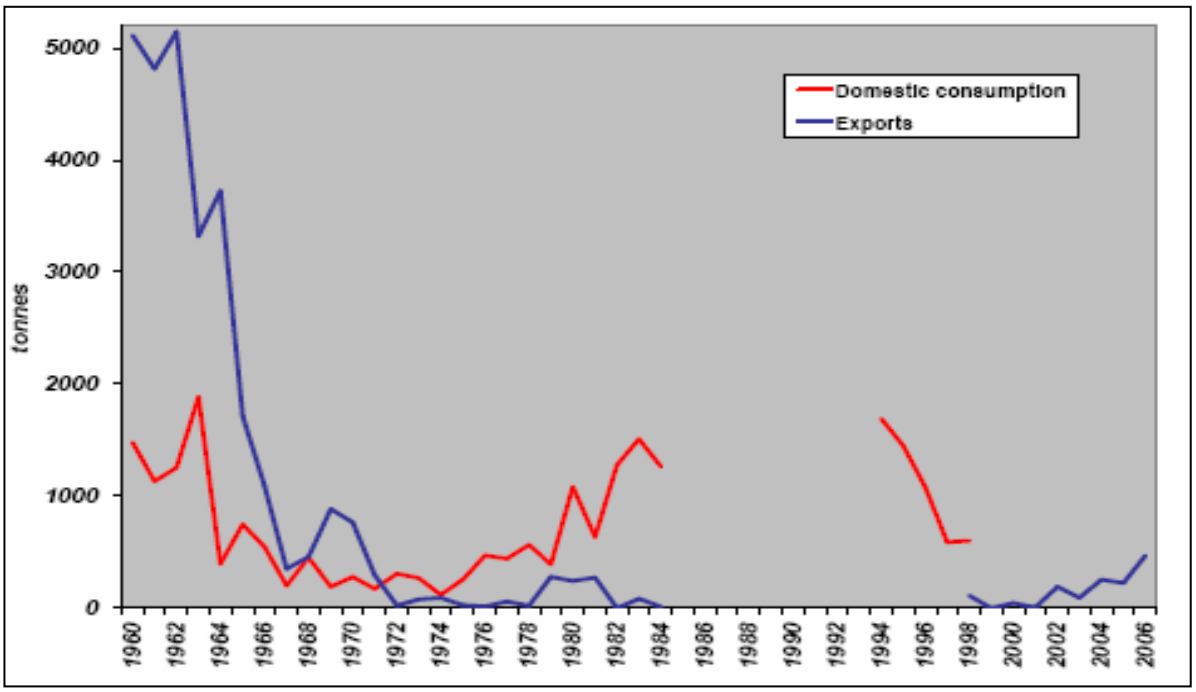
From the then British Guiana, in 1960 exports of charcoal amounted to 5 052 tonnes and had a value at the time of $248 133 and in 1961, 4 814 tonnes were exported at a value of $236 500 (Orescanin, undated). The United Kingdom was the main buyer. From then until 1970, there was a steady decline in exports and since that time until present in most years there was less than 300 tonnes exported, though in 2006 there was a rise to almost 470 tonnes.

Figure 3. Production by Month (2006) (data converted to tones from M^3)



Source : GFC pers. comm.

Figure 4. Domestic consumption and export (tones equivalent), 1960-1984; 1994-1998 & 1998-2006. No data 1985-1993; 1999.



Source: GFC, undated, Energy Agency and GFC market reports and pers. comm.

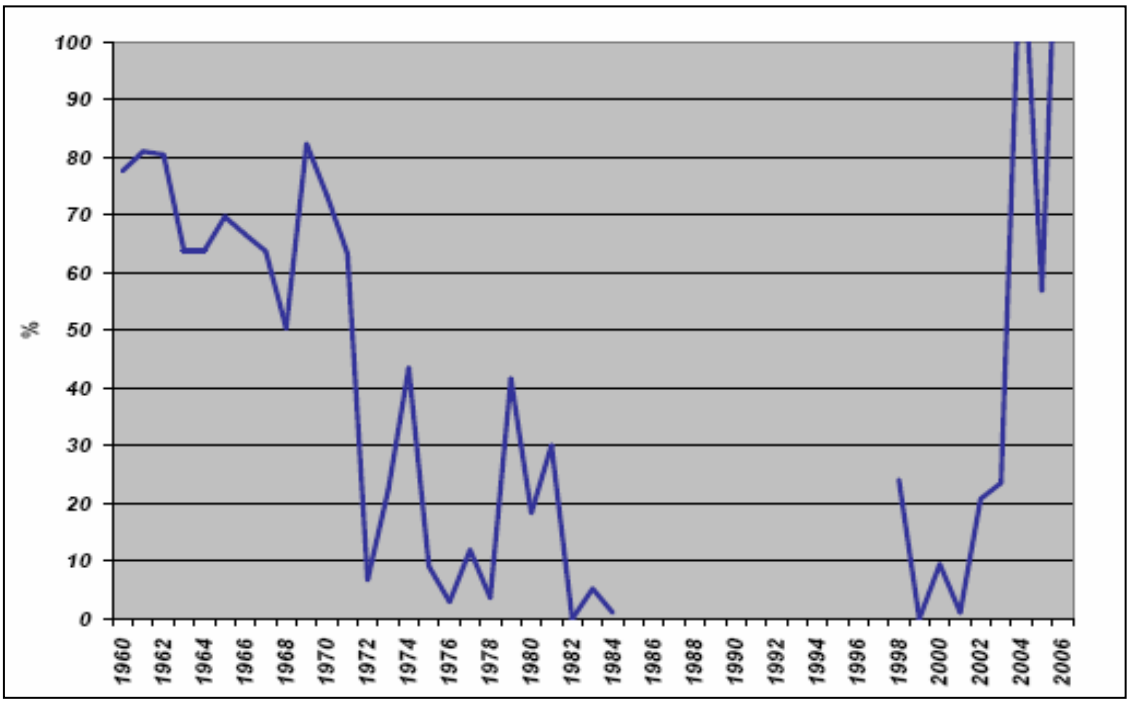
From 1960–1984, the proportion of charcoal production exported showed a general decline from around 80% to less than 10% (**Figure 5**). Recent figures suggest a potential rise in the proportion of exports, though there are small fluctuations (Note that the published export figures for 2004 and 2006 suggest a higher level of export than recorded production. The possible reasons for this anomaly are being investigated).

Table 2. Charcoal Exports for 2005-2006

Region/Country	**2005 (m^3)**	**2006 (m^3)**
Caribbean		
Antigua/Barbuda	-	15.54
Barbados	2.42	-
St Vincent and the Grenadines	103.64	-
Trinidad and Tobago	897.90	2257.89
British Virgin Islands	-	31.09
French West Indies	666.44	1045.99
Total Caribbean	1670.40	3350.51
Africa		
Togo	-	154.76
Total	**1670.40**	**3505.27**

Sources: GFC, pers. comm.; GFC, 2006

Figure 5. Exports proportion of total production: 1960-2003 (no data 1985-1997)



Sources: GFC undated report, GFC market reports (not that there is an anomaly for 2004 and 2006 when exports apparently exceeded recorded production

ANALYSIS OF KEY ASPECTS

Environmental

In the 19th century the Wallaba (*Eperua spp*.) forests of the white sandy plains behind the coastal belt began to be exploited intensively for fuelwood and charcoal, roofing shingles, fence posts and staves. This exploitation continues up to the present and has led to severe degradation of this forest type in the mid and lower Demerara River area. The National Development Strategy has recognized this and states that, in particular, development policies for the wallaba forests should take into account the vulnerability of that environment in relation to charcoal burning, sand mining and logging for timber and timber products.

The main species of these forests is Soft Wallaba (*Eperua falcata)* though Dakama (*Dimorphandra conjugate)* is dominant at early pioneering stages following severe disturbances such as repeated logging, land-clearing for agriculture, fires (caused by nature or man) and wood cutting for fuelwood and charcoal. The white-sand forests represent a globally unique ecosystem and are especially vulnerable to overuse because they are located immediately inland from the coast, where most of the population resides. They are easily accessed via the main highway system (GoG, 2001) and exist on excessively drained soils with very low nutrient content.

Socioeconomic and cultural

Estimates of total employment in the forest and wood product sector vary widely because of the composition of the industry and the nature of its employment. Firstly, the industry comprises formal and informal sectors. Secondly, employment in some areas of the industry is seasonal or sporadic in nature such as; the production of charcoal, shingles, joinery, wood and nibbi furniture, wooden crafts and the collection of latex and medicinal plants (ITTO, 2003). Nevertheless, estimates of employment in the charcoal industry in Guyana do exist for the period 1992–1997 (Table 3) and for the whole fuelwood sector, for 2001 (244 persons according to Hunter, 2002).

Table 3. Employment 1992-1997

Year	Number employed
1992	186
1993	234
1994	245
1995	225
1996	165
1997	180

Source: GFC, 1999

The NDS recognizes that micro-enterprises that produce lumber, millwork, lianas (nibbi and kuffa articles), crafts, charcoal and shingles are becoming a most significant source of income and employment.

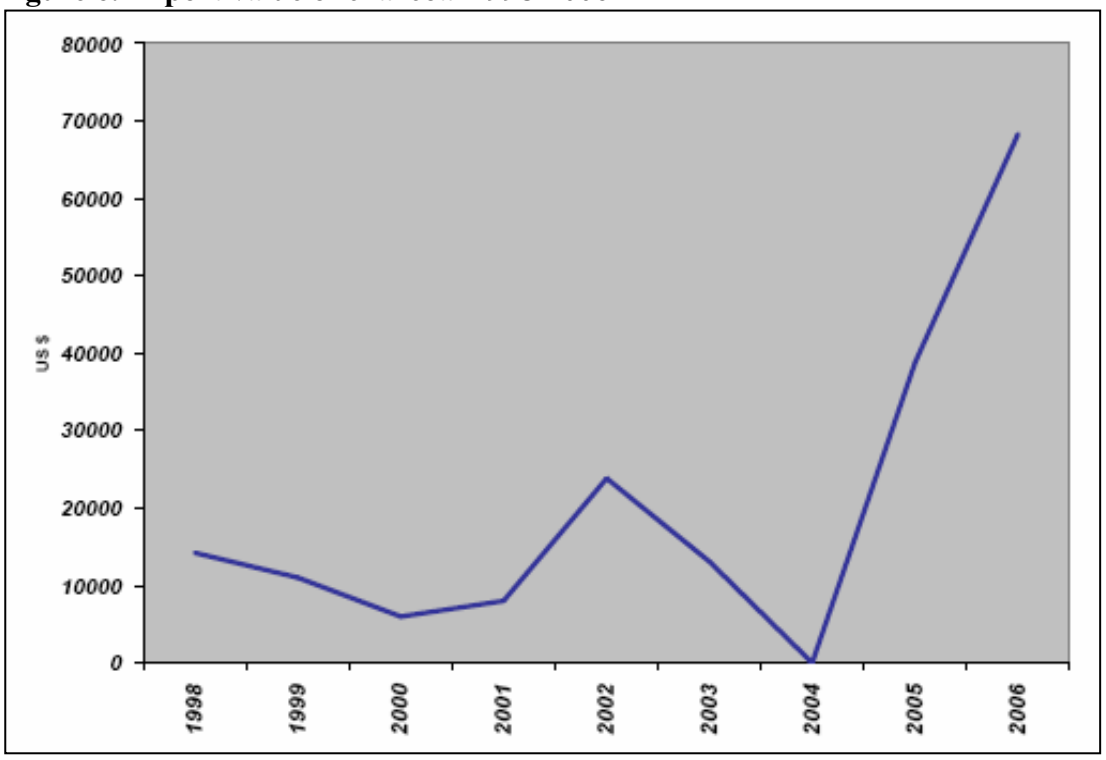
Royalty on charcoal is charged at G$1.32/kg which in the years between 1999 and 2003 yielded the modest amount of around US$5 000 for the period (Table 4). The value of exports is more impressive, reaching US$70 000 in 2006 (Figure 6).

Table 4. Royalties from Charcoal

Year	US$
1999	930
2000	1170
2001	1225
2002	1125
2003	825

Source: GFC market reports, US$ equivalent

Figure 6. Export value of charcoal 1998-2006



Source: GFC market reports: no figure for 2004

The forestry sector has been a beneficiary of loans from the Institute of Private Enterprise and Development (IPED). Between 1986 and 1999, IPED provided 73 loans or 0.4% of its loan portfolio to logging, sawmilling and charcoal producing groups/individuals. However, it has been noted that there is a reduction in borrowing from this institution by logging and sawmilling companies (Thomas *et al.,* 2003). The NDS recognizes a link between poverty and environment exists to some extent, despite the low population density, in Guyana and cites examples of cutting of trees for charcoal and the reaping of mangroves for household use.

Institutional and legal

In the 1953 Forests Act, "forest produce" is defined to include fuelwood and charcoal, though no other specific mention of charcoal is made in the Act. In the 1953 Forestry Regulations, it is stated that recognized "commercial" trees shall not be used for fuelwood or charcoal (though branches may be used for fuelwood) without permission of a forest officer. Also, charcoal removed must be accompanied by the appropriate paperwork (removal permit for State Forest; removal declaration from private lands).

The charcoal industry is not specifically mentioned in the National Forest Plan (2001), the Draft Forest Policy (1997) or the Guyana Poverty Reduction Strategy Paper. Timber dealers, sawmill, sawpit, charcoal and fuelwood producers are all required by law to obtain licences from the Guyana Forestry Commission before any operation can start. However, charcoal licences, at a modest cost of around US$15/year, are only needed when the producer has intent to sell on a large scale basis or for export. Most producers are persons who have agriculture lands and/or private lands and do not come under the regulations of the Guyana Forestry Commissions so they do not need licences for production or to sell. In some cases, when private persons are selling in large quantities, only removal permits are required. Application for licences can be made at any of GFC forest station location and must be accompanied by the following documents:

- proof of ownership of the land – lease, tenancy agreement, concession agreement, etc.,
- no-objection letter from Central Housing and Planning Authority,
- no-objection letter from the Environmental Protection Agency,
- permission letter from the Town Council or Neighbourhood Democratic Council or Regional Democratic Council,
- Public Health & Safety Certificate,
- in the case of an individual application – National Identification Number and
- Company Certificate of Registration.

As mentioned above, charcoal production is mainly done by persons having agricultural lands and/or private land and as such they are not operating illegally. However, the removal of the product without a permit is an offence and produce can be detained by the GFC once an offence is detected. In 2006, a total of 20 tonnes was detained (see Table 5) for one or more of the following reasons.

- The stakeholder did not possess the required permit to remove said forest produce.
- The person in charge did not deliver permit within 24 hrs of arrival at destination.
- Persons tried to evade payments of royalty.
- Persons failed to declare correctly whether produce was legally obtained and the correct quantity.
- Persons altered the documents issued.

Table 5. Quantity of illegal charcoal seized/detained in 2006 and related offences

Quantity (kg)	Offences
6,123.6	Illicit operations
1,632.96	Chapter 67:01 Sec 42 Reg. 3
1,814.37	Chapter 67:01 Sec 42 Reg.25
4,535.92	Chapter 67:01 Sec 22 (b) & (c)
902.18	Chapter 67:01 Sec 42 Reg. 20
4,354.48	Chapter 67:01 Sec 42 Reg. 25
290.30	Chapter 76:01 Sec 22 (1)
362.87	Chapter 67:01 Sec 42 Reg. 23

Source: GFC pers. comm. Guyana Forest Act, 1953

CONCLUSIONS AND RECOMMENDATIONS

Status and impact of charcoal production in Guyana

Charcoal production remains a very small sub-sector of the forest industry in Guyana, contributing in 2006 less than one-half percent of both total timber production and export earnings. Nevertheless, from the limited statistics available, charcoal production does appear to have local socioeconomic significance, especially in rural areas where alternative livelihoods are limited. The environmental impact of current levels of charcoal production is difficulty to quantify though it is widely acknowledged that, over the decades, the sub-sector has contributed to the degradation of certain forest types. Since these forests are typically relatively fragile, have wider ecological value and are generally quite accessible, the proportionate impact may be quite significant.

Topics for further in-depth studies

There is a need for further base-line studies on the current socioeconomic and environmental status of charcoal production in Guyana. Important questions that need to be addressed are the exact location of raw material sources; environmental impacts of current production levels and regeneration of the white sand forests after exploitation; importance and value of charcoal production to local communities and individual livelihoods, costs and revenue with a typical charcoal operation.

The very recent trend for charcoal exports suggests that there is potential for an expansion of the sub-sector to meet a potential market in the Caribbean and beyond. It has been recognized that a more developed charcoal industry in Guyana could benefit the public and private sector and the country as a whole in achieving some goals such as provisions of job opportunities, generation of suitable energy substitute, provisions of a suitable export product, provision of a chemical and fuel base for industries and increasing the total profitability of the forest by maximum utilization (Branche, undated). However, an expansion would need to be premised on an evaluation of the resource especially, its economic accessibility and sustainability. Though fuelwood does not currently play a major part in the security or economy of Guyana, thought could be given to drafting a fuelwood energy policy which would consider, as suggested by FAO (1987), the present size and characteristics of the wood resource and its future development; the present consumption pattern of fuelwood and charcoal and probable future development; how the present supply is produced and distributed and what the possibilities are for its rationalization and improvement. The policy framework could lay the foundations for a national management plan for fuelwood production.

Specifically for the white sand forest areas, as recommended by the Climate Change Action Plan (2001), possible actions could include exploring the feasibility of establishing reserve areas for the conversion of this unique ecosystem and at the same time safeguard the water supply; the rehabilitation of the forest cover and recovery of site productivity; development of a plan for forest fire protection.

In the medium term, subsequent to further baseline studies and development of a policy and plan, criteria and indicators for fuelwood production areas should be developed along with protocols for monitoring and feedback.

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