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The tropical rain forests of Suriname: exploitation and management 1600-1975
First, an introduction of the geomorphology of Suriname and the characteristics of its forests is given. Then, the author explains how it is possible that Suriname still has a high proportion of tropical rainforest while it has been a plantation economy for centuries. He looks at the usual sources of destruction of wooded areas, government policy, role of the Forest Service, and Western enterprise.
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In 1975, the year Suriname became an independent nation, slightly under 150,000 of its total surface area of somewhat more than 165,000 km² was covered by forests. Ninety percent of this forest area consisted of mesophytic tropical rain forest (Bruijning, Voorhoeve & Gordijn 1977:78-80). This makes Suriname one of the few countries in the modern world with a surface area that is largely taken up by "primary" forest.

In this article, I trace the reasons behind the persistence of this extraordinarily high proportion of forest cover, in a country that has been a plantation economy for centuries. As a rule, plantation economies do not have a good reputation regarding the preservation of forests (Tucker & Richards 1983:xiii, xvii; Simmons 1989:207-8). Also, I advance some explanations as to why Suriname seems to be an exception to this rule. I will be looking at the usual sources of destruction of wooded areas, such as land-clearing for subsistence agriculture and the laying out of plantations, forest fires, timber felling for fuel and construction, and at export of timber and other forest products. Government policy, including the role of the Forest Service, will be another topic. Finally, the role of Western enterprise will be discussed.

First, however, the reader should be briefly familiarized with the geomorphology of Suriname and the characteristics of its forests.
"Suriname can be divided roughly into four landscape types: the young coastal plain; the old coastal plain; the Zanderij or cover landscape; and the basement complex or interior uplands" (De Graaf 1986:3). An impression of the surface areas involved is presented in Table 1.

| Name                  | Area (km²) | Relief                      |
|-----------------------|------------|-----------------------------|
| Young Coastal Plain   | 16,200     | flat                        |
| Old Coastal Plain     | 4,300      | flat to slightly undulating  |
| Zanderij Belt         | 8,750      | level to undulating         |
| Interior Uplands      | 135,000    | rolling to hilly            |

This has been the usual typology of the Suriname landscapes since the 1950s (Van der Voorde 1957:32-34). In the older literature we normally encounter a division into three landscapes, under varying designations, in which the two "modern" types of coastal plains are not distinguished (Berkhout 1903:13-15; Gonggryp & Burger 1948:9). A breakdown regarding land use and forest cover in the four landscape types, as they were around 1970, produces the following typology.

Young Coastal Plain
This is the main agricultural region of Suriname, which also comprises its capital, Paramaribo, where 80% of its population is concentrated. Its non-agricultural vegetation consists mainly of mangrove forests, open herbaceous swamp, and swamp forests.

Old Coastal Plain
In this zone we find some farming and animal husbandry. Its vegetation consists of rain or marsh forests on ridges, and swamp forest or swamp vegetation.

Zanderij Belt
Here we encounter the shifting cultivation of a few thousand Amerindians. The remaining vegetation is made up of open savannah, shrub savannah, xerophytic forest types, and mesophytic forest on the unbleached soils.

Interior Uplands
Rapids in the major rivers mark the transition between this area and the former. Some 30,000 Maroons – formerly called Bush Creoles or Bush Negroes – and Amerindians, practicing shifting cultivation, are the sole inhabitants of this vast area. It contains evergreen mesophytic (high tropical lowland) forest, and some hydrophytic and xerophytic forest types. The area comprises about 80% of Suriname's surface area and is almost entirely covered with forests.

The nomenclature regarding Suriname's main (mesophytic) forests has never really been standardized, although recently "tropical rain forest" seems to carry the day. In the literature of the 1940s and 1950s we find a
preference for Beard’s term “evergreen seasonal forest”. J.P. Schulz preferred “rain forest,” J.H.A. Boerboom followed J.F. Richards in using the term “tropical rain forest,” and A.T. Vink adopts a lonely stance in employing a more complex terminology, to wit “high tropical lowland forest.”

In a recent general textbook (Whitmore 1990:9), we are given a choice between “(tropical) rain forest,” where every month is wet (100 mm rainfall or more), and “(tropical) seasonal forest,” where there are several dry months (60 mm rainfall or less). This does not solve the problem, because Suriname experiences, on average, two months with less than 100 mm but more than 60 mm rainfall on average (Schulz 1960:16), and would therefore qualify for (n)either type. Whitmore himself seems to regard Suriname as part of the tropical rain forest area (see his map on p. 11), which tallies nicely with recent usage by Suriname experts.

The pre-World War II literature often employed the Dutch term oerwoud, from the German Urwald, which means original, primary, pristine, undisturbed “virgin” forest. Since we have been taught that undisturbed forests do not exist. Forests are in a continuous state of flux and are subject to all sorts of natural disturbances, such as floods, fires started by lightning, earthquakes, and cyclones. It is also possible that a “climax” cover has re-established itself after human interference such as slash-and-burn agriculture, a disturbance that can only be detected after a careful study of the surrounding area or by taking soil samples. There are some “giveaways” in the seemingly “pristine” forests of Suriname, such as kankantri (Ceiba pentandra), kopi (Goupia glabra), and local bamboo varieties (Guadua sp.). These “disturbance indicators” are light-tolerant or even light-demanding (pioneer) species that dominate the successional vegetation in a large – often man-made – gap in the forest cover (Schulz 1960:182; Bubberman 1988:162).

Nevertheless, there still are large tracts of forest that have been left more or less alone for long periods, and it is this kind of forest that we come across in Suriname’s upland areas. Such a landscape is in a “state of dynamic equilibrium,” or a “shifting mosaic steady state,” and we could call it a “mature” forest (Simmons 1989:15; Whitmore 1990:23-24).

Most of Suriname's recorded history took place in the first three zones which are mentioned above. In the past, the only feasible means of access to the the Upland Interior was by way of river transport, and even that was quite difficult because one had to clear the rapids which mark the transition from the Zanderij Belt to the interior.

This story of forest exploitation and management is therefore necessarily largely confined to the 20% or so of Suriname’s surface area formed by the lowlands.
Around 1600, the English and the Dutch began to arrive on the “Wild Coast.” In 1650, the British founded a colony here, which in 1667 was conquered by the Dutch. With some short interruptions, Suriname was a Dutch “possession” between 1667 and 1975.

Although a lasting Dutch presence would not be established until 1667, Dutch traders had already been visiting the coast of Guiana for many decades. During these early encounters, wood was mentioned as a commercial product of some importance. When David Pietersz de Vries arrived here in 1634, he came across a merchant from Flushing who, during a four-month stay at the mouth of the Commewijne River, had accumulated 30 tons of snakewood (*Piratinera guianensis* ssp *Brosimum guianense*). De Vries himself had arrived too early for the “new harvest” of snakewood, which would not start until the onset of the rains in November. The Arawak living near the mouth of the Marowijne River promised him a shipful if he returned after a year (Colenbrander 1911:203-6).

This brief glimpse of one of the earlier European sources on the “proto-colonial” Suriname timber trade seems to indicate two things. In the first place the Amerindians were willing to fell the required amount of timber but did not have large stocks at their disposal. This suggests that a large-scale timber trade was not one of the customary features of Arawak commerce. Second, they had to wait for the rains before they could provide the foreign merchants with a fresh load of timber. As far as I can see, this can only mean that snakewood grew in areas somewhat higher up the river, from where it had to be rafted or – as in the case of snakewood – shipped down-river, which was only possible after the onset of the rains. This form of timber transport would remain in use up to the present.

Snakewood remained an export commodity during the eighteenth century, but at the end of the century it was already becoming scarce in the inhabited parts of the country. At the end of the nineteenth century, new stands of snakewood must have been discovered because it was once more being exported in considerable quantities. In 1975 it had again become rather rare, at least in those parts of the forests that were accessible to commercial exploitation.

Other commercial products from the forests mentioned by early north-western European merchants were gums, honey, wax, beefwood (*Manilkara bidentata*), “redwood” (probably *Guilandina* sp. [“brazil”] and *Hae- matoxylon* sp.) and fustic (*Chlorophora tinctoria*, a dyewood). Some of these products were still being exported during the eighteenth century. In the eighteenth century, Suriname quassia or bitterwood (*Quassia amara*)
was mentioned as a "new" export commodity, employed by physicians as a febrifuge. From time to time it was exported in considerable quantities.\textsuperscript{11}

It is highly unlikely that the gathering or cutting of any of these products did much environmental damage. This observation also applies to the conuco agriculture (slash-and-burn) and the hunting and gathering activities of the local Amerindians, predominantly Arawak and Carib \citep{Watts1987:41-70}. Hunters and gatherers appeared some 8,000 years ago in this area, and slash-and-burn cultivation probably started some 5,000 years later. The shifting agriculturists are supposed to have applied a 20-30 years fallow period \citep{Bubberman1988:161-62, Hendrison1990:5}. In the late 1960s, \cite{Vink1970:43} calculated that

\begin{quote}
[s]hifting cultivation in the interior mesophytic forest involves burning of an estimated 14,000 ha per year. Generally speaking the nomadic agriculture revolves within the same area in the vicinity of the settlements. After the first clearing only secondary forest with little value is burnt at each subsequent rotation.
\end{quote}

Even though the Amerindian population of the Upland Interior was possibly larger in the remote past, given these estimates the quantities of rain forest destroyed cannot have been considerable.

Potentially much more damaging was the cutting of timber for export to Barbados in the 1660s. Around 1625, Barbados had been settled by the British who had started by growing tobacco and cotton, but had switched to sugar shortly after 1640. The success of sugar-cane cultivation led to a rapid depletion of the forested areas, and fairly soon timber had to be imported for the construction of houses in Bridgetown \citep{Watts1987:156-205}. As Suriname had been recently settled by the British, its proximity to Barbados and its virtually untapped resources of excellent timber led to an incipient export trade in timber. After 1667, when the Dutch took over Suriname, this trade came to an end, and henceforth Barbados had to import its timber from New England, which removed a potential threat to the forests of Suriname. From then on, developments inside the colony itself largely determined the fate of the forests.

\section*{A Buoyant Plantation Economy (1667-1775)}

As in Barbados, sugar took root in Suriname after a short experimental tobacco phase. The technology of sugar plantations was imported from Brazil and Barbados, where Dutch, Portuguese Jewish, and British settlers had experimented with this form of production. The first settlers founded their plantations somewhat upstream along a number of rivers of north-east
Suriname, namely the Suriname (with the Para), the Commewijne, the Cottica, and the Perica. They were mainly located in the Old Coastal Plain and the Zanderij Belt. The downstream areas, although more fertile and of course nearer to the coast and therefore better situated for export to Europe, were too wet to be settled without major technological improvements in the laying out of a plantation. Fear of British, French, and Spanish naval raids was another reason for plantation owners to avoid the coast.

After 1700, however, some planters started to establish themselves in the downstream areas along the rivers, in the Young Coastal Plain. The required technology for the permanent drainage of these wet areas was imported from Holland. There, agriculture on polders, or areas surrounded by dikes and permanently drained by windmills, had been a feature of the landscape for centuries. With some adaptations (e.g. no windmills, and a more elaborate system of drainage ditches), this polder model could be used for the plantations in the swampy areas. Between 1700 and 1740, some plantations were still being laid out in the inland areas, but after 1740 all new plantations – now mostly coffee instead of sugar – were established downstream. Between 1740 and 1800, some of the old plantations were abandoned.

The gradual shift from inland to coastal areas can be attributed to various motives. In the first place, the inland soils were less fertile than the original settlers had expected, and certainly less fertile than the downstream soils. Second, the threat posed by European naval powers to the coastal establishments of the plantation economy turned out to be less formidable than the dangers from the hinterland. Inland plantations were raided by Amerindians and, as time went by, also by Maroons whose numbers increased in proportion to the growth of the plantation area (Van Stipriaan 1991:50-53).

Planters, working on tiny islands of clearings in a sea of forests, had very few incentives to use their wooded environment sparingly. Large areas were cleared for sugar and coffee, and only some of the timber felled in this way would be used for the buildings on the plantation. In Suriname, as in most countries with rain forest vegetation, the variety of species per hectare was – and is – high and only a small number of these species were used for construction purposes. Around 1900, it was calculated that one hectare of forest did not contain more than eighty trees of over forty centimeters in diameter, belonging to more than forty different species, of which perhaps not more than four had any commercial value. In terms of volume, therefore, a hectare would not yield more than 10 m$^3$ squared timber with commercial value, compared to 100 m$^3$ in Germany around the same time (Berkhout 1903:19-21; Plasschaert 1910:55). A few years later, Pfeiffer was even more pessimistic. He estimated that the average harvest of commercially valuable
wood in the forests below the rapids (the first three zones) was approximately 10 m³ roundwood per ha, which is not more than 2 m³ expressed in squared logs.12

Of course, these figures depended heavily on what was considered as commercially valuable wood. In the course of the twentieth century, the number of species of wood that were regarded as valuable increased. Examples of such “new” species are baboen (Virola sp.) for plywood and somaroeba or simarouba (Simarouba amara) for light construction. This development naturally led to an increase in the estimated average yield per hectare. Therefore, J.W. Gonggryp and D. Burger (1948:82-90) estimated that the forests below the rapids contained on average 100 m³ useful timber, expressed in branchless boles of more than 30 cm dbh, or ten times as much as Pfeiffer had estimated twenty years earlier. Oddly enough, in more recent research we find lower estimates, comparable to those quoted around 1900. The recent figures are the product of carefully studied series of actual harvest figures (Boerboom 1965:3, 10-18; Vink 1970:12). As an approximation of eighteenth-century ideas of what was valuable, the 1900 figures are probably nearer to the mark than the 1948 estimates.

Planters, therefore, had only limited use for the trees they had to cut before they could start planting sugar or coffee. In publications and archival sources dating from the eighteenth century, particularly in probate inventories, we come across a fairly limited number of species which were used for construction purposes. Often mentioned were basralocus or angelique (Dicorynia guianensis sv paraensis), brownheart or wacapou (Vouacapoua americana), bolletri, bullet-tree wood or beefwood (Manilkara bidentata), cedar (Cedrela odorata), greenheart (Tabebuia serratifolia), kopi, goupie, or kabokali/kabukalli (Goupia glabra), kwarie or iteballi (Vochysia sp.), locus(t), courbaril, or kawanari (Hymenaea courbarill), purpleheart (Pellogynia paniculata), wana, red louro, or determa (Ocotea rubra), and wassie wassie or gronfoeloe (Qualea sp.).13 The pina palmtree (Euterpe oleracea) was used for the construction of dwellings for the slaves.14

It might surprise the modern silviculturist that some of these trees were used for construction purposes, but one has to remember that planters often had to make do with locally available material. Although some of these species of timber could resist Suriname’s hot, wet climate and the concomitant insects for a long time, all plantation buildings, mills, vessels, and carts had to be renewed regularly. This, of course, meant that new patches of forest had to be cleared from time to time. Only a limited amount of non-timber obtained by clearing could be set aside for fuel, employed for the production of sugar. The remainder was left to be burned (Herlein 1718:67; Blom 1786:21).
Planters regularly had to clear forested areas to plant new sugar cane. This product could be harvested from the same cane stool for a number of years (ratooning). In Suriname in the eighteenth century, ratooning up to and including the fourth crop was considered to be optimal, and only approximately 20% of all crops consisted of fifth ratoons and over (Van Stipriaan 1989:100). This practice implies that plantation owners had to clear part of their still forested areas for additional cane fields after four years. The original cane fields were then left to lie fallow. From then on, the cane could rotate between fields from which the original forest cover had already been cleared. Nevertheless, many a planter had to resort to additional clearings, because the fallow period had been too short owing to exhaustion of the soil. This may have been largely the result of the insufficient application of manure during the cane-growing period.

Moreover, if the plantation owner could dispose of sufficient capital or credit, he would be able to buy more slaves, and could, therefore, expand the area under cane at any one time. In times of high and rising sugar prices most owners would be tempted to do so. In combination, rotation and expansion could exhaust the plantation’s timber supply within a few decades. If we add the recurrent demand for fuel and timber for maintenance mentioned above, it will be clear that fairly soon after the laying out of their estates, most planters had to look for sources of wood outside their plantations. There is no evidence that planters set aside part of their estates for sustainable wood production, as was done in Saint Domingue in the eighteenth century (Debien 1952:43). For the nineteenth century, Van Sijpesteyn (1851:18) explicitly denied that planters used part of their arable lands to plant trees.

**Production of Timber and Firewood**

The quest for timber and fuel from sources other than the plantation itself provoked trespassing on forested domain lands, which had already been recorded in a Government Resolution of 1718. At least as early as 1736, planters acquired additional lands in the neighborhood of their estates. These timber estates15 (Dutch: *houtgrond* or *houttuin*) had only one purpose, namely the production of timber and firewood for the export crop plantations. If no suitable lands could be found in the immediate neighborhood, planters sought to acquire pieces of forest further away, preferably along the same river. These timber estates functioned as annexes of the “mother”-plantation and had no economic life of their own, or even a name of their own. Such a timber estate, belonging e.g. to the plantation Hanover, was simply called “to Hanover” (Quintus Bosz 1954:77).
Soon, however, some planters started to specialize in the production of timber and firewood on independent timber estates. Certain areas such as the Para region in the 1760s were reserved for the granting of such estates. Some of the new timber estates were converted export crop plantations, particularly sugar plantations in the upland areas that had stopped producing cane when the downstream plantations with their higher yields per hectare came into production.

A good example is the plantation Han(n)over, located upstream along the Para River. The plantation, with a surface area of 2,200 akkers or 940 hectares, was mentioned for the first time in 1737 but it was probably older. Hanover started out as a sugar plantation, but switched to the production of timber around 1750, during a period of low sugar prices. Ten years later the estate had been almost entirely stripped of its forest cover, and the owners had to acquire an additional 1,000 akkers in the neighborhood. In an inventory dated 1784, Hanover was reported to have a total surface area of 5,422 akkers (2,320 ha), so that apparently yet another expansion had taken place, probably for the same reasons. There are several indications that it was not a profitable enterprise. From time to time, the owners tried to diversify their production and experimented with various export crops, such as coffee in 1772, cotton in 1784, indigo in 1829, Bromelia-flax in the 1830s, and tobacco in 1845. None of these experiments seem to have been successful. Somewhere in the late-nineteenth century, the owners abandoned Hanover, and the estate was taken over by its former slaves. In 1903, it was still being exploited as a timber estate.16

Other timber estates, particularly the ones in the downstream areas, started out as such. Much more archival research will have to be done before we can establish the ratio between converted and original timber estates. It is also uncertain when the timber estates of any description began to appear in considerable numbers. Pistorius (1763:26) mentions the existence of 10 to 12 houtzagerijen (sawmills), which in all probability should be read as timber estates, in 1761. In 1780-85, 139 properties were timber estates and foodcrop estates (Dutch: kostgronden). If we may assume that the ratio timber : foodcrop estate was similar to the 1827 ratio, this implies that there were some 90 timber estates. At the end of the eighteenth century, we find 112 timber estates mentioned, with a total surface area of 181,000 akkers, almost 78,000 ha, or 700 ha per estate.17

If these figures are reliable, the growth of the number of timber estates during the late-eighteenth century was impressive. It must be supposed, however, that this was not caused by a vigorous demand for wood. It is more likely that the owners of a fair number of estates that went out of business as export crop plantations had no other alternatives open to them than to turn
these into timber estates. In 1771, Government decreed that timber estates should pay a higher acknowledgement per *akker* than other properties (Quintus Bosz 1954:78). This move might have been related to the unwanted proliferation of – probably largely unsuccessful – timber estates.

Little is known about the technology of timber production. Sawmills were introduced at an early stage, the first one probably in 1677. In 1716, a sawmill was erected on the government owned estate Andresa (Oudschaans Dentz 1949:13, 20). Oddly enough, Blom (1786:340) seems to suggest that all timber from the estates was sawn by hand. So either the sawmills mentioned had remained a rarity or they had gone out of business.

There are no indications that owners of timber estates ever planted trees when they had felled the original stands (Blom 1786:345; Van Sijpesteyn 1851:18; Kappler 1854:1, 43). As was the case with Hanover, they just added another piece of “virgin” soil to the estate, which then was stripped of its forest cover. If no expansion was possible or desirable, the estate was abandoned.

Timber estates were not the only ones involved in lumbering. They had competition from the Maroons. By the end of the eighteenth century Maroons numbered probably between 5 and 10,000. Felling timber for sale to the plantations or to Paramaribo was an important economic activity for the Maroon population, after the conclusion of peace treaties with the colonial government (1760, 1762, 1767). Among the annual gifts to the Maroons, specified by the peace treaties, we encounter hundreds of steel axes and carpenter’s tools, which facilitated the felling of trees and enabled them to produce squared beams; they do not seem to have used saws (Pfeiffer 1929:28).18

Although tree felling was an individual (male) activity, the axmen had to rely upon each other and their families in order to haul the trees from the forest to the bank of the nearest river. "[W]hole kin groups would team up for this arduous work, and as many as forty people would cooperate in dragging the logs to the river" (Thoden van Velzen & Van Wetering 1988:141). This feature of their relations of production limited the amount of timber enterprising Maroons could cut. Another limiting factor was that wood cutting was only one part of their economic life. The men often went on hunting and fishing expeditions and the women tended the garden plots. In fact it was only their *monetary* income that depended largely on their lumbering activities. Timber merchants, therefore, often complained that they could not rely on a regular supply of squared logs from the Maroons (Van Sijpesteyn 1851:21). The treaties guaranteed them free passage to the coast, and henceforth they shipped their timber or floated it down the river on rafts.19
How much damage was being done to the forests by the Amerindians, the Maroons, the timber estates, the plantations, and the town-population? Exact figures are lacking, but we can safely assume that the environmental impact of their activities was limited. A few thousand Maroons, a few thousand Amerindians, 60,000 slaves and under 5,000 Europeans, free blacks and mulattoes, and about 600 plantations comprising some 250,000 hectares cannot have had all that much influence. Apart from this, most of the potentially harmful activities—shifting agriculture, and tree felling by the Maroons "above the falls" being the exceptions—took place in the three lowland zones that comprised only 20% of Suriname's total land-area. In so far as damage was done, it was therefore largely concentrated in a fairly restricted area. Large forest fires, lasting for a month or more, such as occurred in 1746, 1769, 1779, 1797, and 1825, may have destroyed more forest vegetation than all these activities taken together (Oudschans Dentz 1949:24-7; Van Stipriaan 1991:85). I will return to this topic in more detail later on.

THE LONG NINETEENTH-CENTURY RETREAT (1775-1900)

Around 1775 the plantation economy of Suriname had been at the peak of its prosperity. Thereafter, high debts forced many a planter into bankruptcy. After the turn of the century, the number of plantations declined, as did the total surface area under plantation agriculture. This development was speeded up by the abolition of the slave trade in 1808. As slave deaths exceeded births, the number of slaves gradually decreased. This is not to say that all plantations fared badly. Cotton—a newcomer—and sugar did rather well from time to time, and although the number of sugar plantations declined, their average surface area increased, which might be interpreted as a sign of economic vigor (Van Stipriaan 1991).

Nevertheless, as a whole, the plantation area was shrinking continuously, as was the population. The final blow to the system came with the abolition of slavery, in 1863, followed by an "apprenticeship" period, when slaves were still under the obligation to work on the plantations albeit now for wages, ending in 1873. The timber estates shared in the general downward trend, although somewhat belatedly, as can be seen in Table 2. It is clear that the timber estates were doing badly at least from 1800 onwards, and perhaps even earlier. Originally, the government did not do much to alleviate their burdens. Their recognition fees were already higher than those of other properties. After 1774 they also had to pay export duties on their snakewood yield, which in 1791 was expanded to all timber sold.
Furthermore, from 1821 onward domain lands for the laying out of a plantation or a timber estate, up to then given out for free, had to be paid for, in addition to the existing recognition fees, now regarded as a tax. Small wonder that interest in the acquisition of a timber estate was slight. The situation did not improve when the export-duties on timber and the purchase price for a timber estate were abolished, in 1834 and 1835 respectively (Quintus Bosz 1954:88, 98, 120).

Kappler, traveling through Suriname in the 1840s in search of rare butterflies, recorded the sorry state – at least from the owners’ point of view – of these properties along the Suriname and Para Rivers. Although their average area was relatively large, there were only two timber estates with a large slave-population, namely Berg en Dal (300 slaves) and Berlijn (over 300), and a few medium-sized estates, such as Overtoom (190), Hanover (180), and Osembo (130). The other ones were small to very small, with sometimes no more than two or three slaves. On all the timber estates along the Para River the original forest stands had been exhausted, and the slaves had to fell trees three or four hours away, along the Saramacca River. They went there on Mondays and came back on Saturdays. The felling, squaring and hauling was done in piece-work, owing to the fact that it was almost impossible to supervise this kind of labor. According to Kappler, of all the plantation slaves those of the timber estates had the best of it.

However advantageous this situation may have been for the slaves, the owners saw their costs increasing in proportion to the growing distance between their mansion on the estate itself and the actual felling place. Moreover, they had to compete with the Maroons, who were able to produce at much lower costs. None of these properties, therefore, was run at a profit, and many were under sequestration. Interestingly enough, almost all directors, and many owners of the timber estates were mulattoes. Apparently it
was the poor man's plantation. It might perhaps even be supposed that colored owners kept these properties for reasons of prestige more than anything else (Kappler 1854:I, 41-43; Kappler 1881:27-83).

This situation did not obtain in the recently colonized Nickerie area in north-western Suriname. During the two British interludes, a number of predominantly British entrepreneurs had settled in this area in order to produce cotton. When the short cotton boom was over, a number of the new colonists started the exploitation of the "fresh" forest stands in this area. They had many advantages over the "old" timber estate owners, because there was more commercial timber available, nearer to the coast and the river, for the felling of which they paid lower piece-rates. Nickerie, therefore, was the only plantation area where during a large part of the nineteenth century timber was produced (and exported to Caribbean islands) at a profit.22

As a rule, however, timber estates were doing badly and were barely competitive. This development may have boosted the lumbering activities of the Maroons, some of whom – particularly Ndjukas – had moved nearer to the plantation area during the first decades of the nineteenth century. They had come to depend more on their timber trade anyway, because in 1849 government had stopped sending the annual gifts which had been part of the eighteenth-century peace treaties. Given the restricted nature of demand, however, this increase in production – if any – must have been limited. When there was a shortlived drop in timber prices during the early 1850s, some of the "coastal" Ndjukas temporarily moved back to their villages further inland, only to return when prices went up again (De Beet & Sterman 1981:14-15; Thoden van Velzen & Van Wetering 1988:12-13).

After 1880, when gold was found in the hinterlands of Suriname and French Guiana, the Maroons largely lost their interest in the timber trade because they could earn much more transporting the gold-diggers and their luggage. Only after 1920, when the goldrush petered out, did they return to logging (Thoden van Velzen & Van Wetering 1988:21-23).

Maroons were also involved in a most curious venture at Albina, a village on the estuary of the Marowijne, in the north-east corner of Suriname. The same Kappler whom we met traveling through the old plantation area in the 1840s had established himself here as a timber merchant, naming the place after his future wife. At some distance from Kappler, a Corsican by the name of Monte-Cattini (or Montecatini) had also settled with the same purpose. Both merchants bought large quantities of squared logs from the Maroons (and Amerindians?) of the Upper Marowijne for export to the Caribbean islands and to Europe. Kappler, who obtained a land-grant for a timber estate at Albina – probably the last one in the nineteenth century –
also attempted to establish a colony of German woodcutters and carpenters on his estate, in order to produce higher quality beams and sawn boards for export. Difficulties with his “indentured laborers,” the lukewarm reception of his timber in Holland, high freight costs, low returns, and the death of his Dutch patron militated against his enterprise becoming a success. Nevertheless, when he left Suriname in 1879, in thirty years he had sent twenty-three large shiploads of timber to Amsterdam, beside occasional shipments to Paramaribo, French Guiana, Barbados, and Guadeloupe (Van Sijpesteyn 1851:21-22; Kappler 1881:223-486).

Not all demand, therefore, was generated locally. Throughout the nineteenth century, timber in various forms was being exported to the Netherlands and the Caribbean islands, most of it as round logs or squared beams. However, this never amounted to more than 2 or 4,000 m$^3$ per year, with a monetary value that fluctuated between 0.5 and 1.5% of total export earnings (Koloniaal Verslag). Export to Europe failed for a number of reasons. The quality of the timber produced left much to be desired, owing to primitive methods of felling (trees were not girdled before being felled), improper treatment (no drying), and a general lack of quality control. Labor was often scarce and frequently ill (malaria) and therefore expensive, and freight costs were high as well. The high quality hardwoods of Suriname were largely unknown in Europe, which made it difficult to penetrate the established commercial timber channels. Carpenters complained that various species were difficult to work with (even teak had to overcome this kind of conservatism), and important firms of timber merchants had vested interests in other hardwoods. Finally, no one in Suriname could assure prospective buyers of a regular supply of the required species and dimensions, because supply was too irregular. The export of squared timber consisted predominantly of cedar and smaller quantities of purpleheart, brownheart, greenheart, locus, and beefwood (Berkhout 1903:61-62). Domestic consumption of timber at the end of the nineteenth century was estimated at 9,000 à 10,000 m$^3$ per year (Berkhout 1903:70; Plasschaert 1910:72).

At the end of the century, the Suriname forests were in a paradoxical situation. On the one hand, most of the forests – predominantly but not exclusively those of the Interior Uplands – were not accessible to commercial exploitation, owing to lack of roads or navigable rivers. Only a few thousand Amerindians and Maroons used these forests for their fairly limited needs. In some areas, where settlers had moved away, forest cover was slowly encroaching on stretches of savannah vegetation (Berkhout 1903:9). On the other hand, most accessible forests had been ruined by Maroons or timber estate owners, who could not be bothered with sustainable exploitation. In the accessible forests some valuable trees, such as cedar, had

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become very rare (Plasschaert 1910:59). Suriname, therefore, had treated the fringes of its forests badly, but it had no part in the global deforestation of the nineteenth century (Tucker & Richards 1983).

**Government and Western Enterprise (1900-75)**

The role of government in forest management and exploitation had been negligible up to the end of the nineteenth century. In so far as fiscal measures (the above-mentioned decrees of 1821, 1834, and 1835) were employed as instruments of land-use policy, they do not seem to have had any influence. The creation of new timber estates had stopped almost entirely and the old ones were slowly but surely fading away.

In 1877, at the end of the apprenticeship period, government switched from a policy of alienation to one of concessions of forest lands. In 1914 and again in 1922, these regulations were revised in order to stimulate (foreign) investment, without losing sight of government revenue and – at least in theory – the quality of the forests. At the turn of the century, some 125,000 hectares had been given out in this way. In the late 1920s this area varied between 500,000 and 600,000 ha. It may have appeared to contemporary observers that the exploitation of Suriname's forests was finally taking off. We will see presently that these expectations were unfounded.

During the nineteenth century, various officials in the Netherlands and Suriname had attempted to stimulate the production of durable timber, to be used in the mother country for ship-building, sleepers for railways, and suchlike, largely because oak and other species of hardwood were getting more expensive. In 1836, with this end in view it was decided to start an experiment with government exploitation of a forest area. For this purpose, a forest range was established on the government-owned estate Andresa, on the Coppename River. The attempt failed because a considerable proportion of the timber shipped to the Netherlands left much to be desired and was, moreover, more expensive than oak. In 1842, the Navy stopped buying Andresa timber, and although other outlets were found, and a state-of-the-art steam-powered sawmill had been installed in 1846, the forest range was given up in 1849. Throughout its thirteen-year existence it had been run at a loss (Van Cleef 1841; Kessler 1989). Small wonder that the next attempt at government exploitation had to wait until 1904, when it was combined with the creation of an experimental Forest Service (*Dienst van het Boschwezen*), largely based on a report by the forester Berkhout, and published in 1903. In the meantime, Suriname had been lucky with its forests for once, when balata – a rubber-like substance from the bullettree –
was discovered in exploitable quantities. Exploitation started around 1890 and picked up pace after 1907, with record export returns of over 4 million guilders in 1911 and 1913, and fairly high export levels up to and including 1931 (Van Traa 1946:128-32).

The introduction of an experimental Forest Service, in 1904, featuring a combination of government exploitation and government management was copied from the teak forests of Java in the Netherlands Indies (now Indonesia), and the first foresters in Suriname all came from the experienced Netherlands Indies Forest Service. Nevertheless, government exploitation was stopped in 1910 owing to continuous financial losses. This was caused by high wages, difficulty in recruiting laborers, wastage of timber during the cutting and squaring operations, difficulties with the hauling of logs by buffaloes, high freight costs, and demand-side problems in the Netherlands. A skeleton – still experimental – Forest Service was, however, retained (during many years manned by only one forester), in order to continue the silvicultural research that the Service had initiated, and to supervise the exploitation of the forests by private entrepreneurs. In 1917, the experimental phase of the Forest Service came to an end. Finally Suriname had a real – albeit small – Forest Service.

This was certainly none too early, as since 1916 a number of enterprises from the U.S.A., the Netherlands, and Belgium had been given large concessions, sometimes amounting to hundreds of thousands of hectares. Names mentioned are the Surinam Extracts Cy., the N.V. Surinamische Hout- en Pulp Mij., the Broadhurst Lumber Cy. (W.L. Kann), all three American, the N.V. Westindische Houthandel (under the direction of the local firm Kersten) and the Indische Hout Import Mij., both financed by Dutch capital, the N.V. Algemeene Tropische Cultuur and Industrie Mij. (Tropica, Belgian capital), the N.V. Nieuwe Eendracht, and the firms Strang and Samson. It seemed as if the Suriname forests had been finally discovered by Western capital, and that the dawn of large-scale forest exploitation had arrived. The 1921 recession, however, put an end to these hopes. The enterprises had to limit or give up their operations, and the Forest Service was abolished in 1925 owing to budget cuts. Although better times – measured in terms of timber exports – returned in 1926, the 1929 crisis followed too soon for a revival of the Forest Service. Even government-income from balata was insufficient to save or revive the Forest Service.

Nevertheless, important insights had been gained during the period of its existence. In the first place, timber enterprises needed the Forest Service for its exploratory activities. The first foresters, fully aware of the fact that the Urwald of Suriname usually yielded very low amounts of valuable timber, had been searching for “pure stands” of useful trees or at least stands with a
high density of valuable trees. Plasschaert discovered some areas with a high density of Demerara greenheart (*Ocotea rodiaei*) and Gonggryp found large, almost pure stands of mora (*Mora excelsa*); exploitation by private enterprise followed in the wake of these discoveries. A stand of Possentri (Poison tree: *Hura crepitans*), discovered in 1922, was almost immediately worked by the American entrepreneur Kann; a good example of the trade following the flag.27

Second, the foresters discovered that they knew next to nothing about this type of tropical rain forest. All the early foresters came from Indonesia, where the Forest Service had ample experience with teak (*Tectona grandis*), but not with much else. Teak is a deciduous tree, usually found in pure or almost pure stands in monsoon forests, and the foresters were scarcely prepared for the highly varied evergreen forests of Suriname. Thus they started experiments with various felling-cum-regeneration methods. The earliest ones were carried out on forest ranges established along the recently constructed railroad from Paramaribo to the interior. The first method adopted was the *periodische Femelhieb*, a polycyclic system, under which all trees of 40 cm dbh and over were harvested periodically, nowadays called a “diameter limit felling system.” Forest regeneration was left to the natural powers of recuperation of the forests, only somewhat aided by girdling the larger undesirable trees. This method was soon found to be unsatisfactory, because it stimulated the growth of “worthless” fast-growing pioneer species instead of valuable hardwoods. The foresters then (1906) started with clear-felling, the usual practice in Java’s teak forests at that time, in combination with artificial plantations of desirable species such as mahogany and rubber (*Hevea brasiliensis* and *H. guyanensis*). Maize and cassava were cultivated between the saplings in order to suppress weeds. These methods were not very successful either. Although the experiments with “plantations” of desirable trees – including an arboretum in 1911 – were continued, the foresters returned to variations in natural regeneration, aided by cutting the undergrowth of “good” trees, burning “bad” trees, and strip-planting of desired species in gaps in the forest.28

Attempts were made to involve the black peasantry in forestry experiments. Slash-and-burn cultivators who had volunteered were told which trees they should save on the plot to be cleared; after clearing and burning they were paid a certain amount of money. The Forest Service then planted seedlings of valuable tree species before the cultivator planted his cassava. For the upkeep of these seedlings the peasant received another payment. After the cassava harvest, the Forest Service took over the maintenance of these plots (Berkhout 1917:63).

One wonders whether these “intercropping” methods were copied from
Java, where they had been introduced in the 1870s (and where they are still being used today under the name *taungya*), or whether they had been found locally among the Amerindians. The Brazilian Kayapó are supposed to have manipulated their wooded environment in a comparable way. In 1946-47, Gonggryp and Burger discovered an Amerindian timber concession near Wassiabo, on the Corantijn River, growing kopi (*Goupia glabra*) on a sustainable basis, with foodcrops between the trees.29

When in 1925 the Forest Service was abolished, none of these experiments could be deemed satisfactory, and it was clear that, whatever their silvicultural merits, expenses would never be recouped by government income from private enterprise. Some of these experiments survived into the 1940s, but most of them had been severely damaged by fires and neglect. Although some experience had been gained with silviculture in this part of the world, it is doubtful whether later foresters made full use of the results of the earlier experiments, as will be shown presently.

The resurrection of the Forest Service had to wait until after the Second World War. In 1947, the future of Suriname's forests was determined for a long period to come by two events, namely the reestablishment of the Forest Service and the arrival of the Dutch Bruynzeel Company, which received an initial 500,000 hectares in concession. In 1973, a total of 1.7 million hectares had been given out, with a production of 168,000 m$^3$, of which 56,337 m$^3$ was exported. This was approximately twice the quantity exported in 1950, when Bruynzeel had recently started its operations, and a quantum leap compared to the 4,000 m$^3$ of 1900 (Bruijning, Voorhoeve & Gordijn 1977:80-83, 104-105).

Again we find that the companies follow where the Forest Service leads, even more so than before the Second World War. The Service has been constructing all-weather roads to and skid-tracks into the exploitable forests in what is usually called the Forest Belt (parts of zone 3 and the northern fringes of zone 4). Without these roads, and the inventarization of the forests also carried out by the Service, the exploitation of the areas concerned would have been unthinkable for any company. Only the Bruynzeel Company had its own inventory and road-building program in its long-term timber concessions. Between 1953-54, when the Forest Service started with its management plans, and 1970 about one-third of the timber production of state lands – or almost the entire increase since 1954 – came from “managed concessions.”30

The Service was again involved in silvicultural research, which tried to optimize both yields and sustainable growth. Schulz was the first to initiate a regeneration experiment in 1956-57 by “refining” the areas under management plans before (polycyclical)31 exploitation, that is killing mature
unwanted species in order to help the saplings of desirable trees. This was exactly what the first foresters had attempted to do, with very limited success. In other words, the Forest Service was back to square one.

In the 1960s the Service adopted a monocyclical diameter limit felling system (the polycyclical system caused too much damage), and added periodical “liberation,” that is cutting the undergrowth in order to aid desirable species, to the already practiced “refinement.” This method led to satisfactory increment rates of commercial species, but it was much too expensive owing to its labor intensity. Therefore, “natural” regeneration work on a practical scale came to a standstill in the late 1960s, and experiments with strip-planting and enrichment-planting were started, particularly with Virola, Simaruba, and Cedrela. These experiments are still being carried out.

Throughout the whole period, the Forest Service had been laying out “monocultural” plantations, as they did between 1904 and 1925. Only this time they grew several species of pine, mainly Pinus caribaea. Owing to high labor costs, these experiments were stopped around 1975, although the pine cultures are still there.

At the end of the period under discussion, in 1975, a start was made with an extensive low-input-low-output polycyclic system with “refinement,” aiming at periodic harvesting of volumes equal to the increment of the commercial stock. This purports to be an economically justified sustained yield silvicultural system.32

Comparing the 1904-25 experiments with those of the period 1947-75 and beyond, one gets the impression that seventy or more years of silvicultural research have not led to much progress (cf Jonkers 1987:13). Much of the present “orthodoxy” can be regarded as a modified version of work done by people like Van Asbeck, Berkhout, Gonggryp, and Plasschaert between 1904 and 1925.33 Lack of lasting success with silvicultural research by the Forest Service certainly did not stop the timber companies from expanding their activities. One can only speculate to what extent these attempts at management of the exploited forests have delayed the growth of the logged-over areas.

More progress had been made in the field of technological development. Around 1900, almost all felling and squaring was done with axes, and squared logs were skidded manually over knuppelwegen (skid-tracks made of poles), sometimes many kilometers in length, to the river. Attempts by the Forest Service to haul timber by buffaloes from the logging camps to the timber depots along the river were less successful. From the depot, the logs were shipped or rafted to Paramaribo. Timber, cut at the forest ranges of the experimental Forest Service was transported by rail. The capital at the time
boasted of three (steam?) sawmills. In 1915, Suriname had six sawmills, one of which was located outside the town. On the timber estates hand saws had been used, but with the demise of these properties the saw may have fallen largely into disuse. Nevertheless, around 1925, the black peasantry of the Para and Suriname districts were again reported to be quite capable and willing to use hand saws.

Skidding remained a problem. In the 1920s, private entrepreneurs experimented with floating steam-winches (Lidgerwood) and tractors (Fordson), but the results were rather disappointing owing to a lack of experience, high costs, and low yields per hectare in relation to expenses. Most timber, therefore, was still being dragged out by human or animal power.

In 1925, there were at least two modern steam-sawmills. In 1947, however, all sawmills were regarded as “antiquated.” Demand being as high as it was after the war, several enterprises had by then ordered new machinery from abroad. In the meantime, the normal saw and the two-handed saw had also reached the Maroons and the Amerindians. Skidding with steam-winches and tractors and transport by steam-engines over short rail-tracks on forest ranges were seen side-by-side with human and animal traction over skid-roads or rails.

Around 1970, high forest logging had become largely mechanized. Felling was now partly done by chainsaw, and crawler tractors were being used for skidding. Transport by truck bridged the distance between the concessions and the factories. There were thirty sawmills, varying in capacity from 500 to 50,000 m³ roundwood per year. The Bruynzeel Company owned the largest mill as part of a large integrated timber complex, which included factories for plywood and particle-board, products which by then dominated exports in terms of volume.34

Summing up, it can be said that once the - second - Forest Service had enabled private enterprises to penetrate the inland areas away from the rivers by carrying out forest inventories and by constructing permanent roads and skid-trails, ongoing mechanization after the Second World War had made it possible to overcome many difficulties in felling, skidding, and transport which had troubled the timber companies before the war. It is hardly likely that the Service’s system of managed concessions did much to stop deforestation. The attack on the Suriname forests, at least those of the Forestry Belt, had been finally launched in earnest, albeit in a more or less controlled way. The interior, however, was still largely unexplored and unexploited.
Reliable figures of Suriname's forested area are hard to come by. I have presented a number of estimates in Table 3.\textsuperscript{35}

**Table 3. Estimates of Suriname's Forest Cover, 1903-90**

| Year | Area under forest (ha) | Source |
|------|------------------------|--------|
| 1903 | 14,500,000             | Berkhout 1903:11 |
| 1929 | 15,500,000             | Pfeiffer 1929:17 |
| 1948 | 15,000,000             | Gonggryp & Burger 1948:86 |
| 1955 | 14,860,000             | Lindeman & Moolenaar 1955:13 |
| 1970 | 14,850,000             | Vink 1970:12 |
| 1990 | 13,200,000             | Hendrison 1990:11 |

Most if not all of these figures are rough estimates, and their value must be regarded as very limited. The most detailed calculations are those of Lindeman & Moolenaar and Vink, whose estimates I am inclined to accept as rather reliable. If Hendrison's figure is equally accurate, the first large-scale attack on the forests would have taken place after 1970. This supposition is in accordance with my suggestion, presented above, that the combination of (second) Forest Service activities, the presence of Bruynzeel and other modern timber companies, and increased mechanization during the last decades have led to the first serious increase in logging. The pre-1970 figures do not suggest that logging activities before that year, or, for that matter, other potential sources of deforestation, had much impact on total forests cover.

Gonggryp and Burger would have disputed this conclusion. They regarded man made forest fires as an increasingly important threat to Suriname's forests, surpassing all other causes of deforestation in scope.\textsuperscript{36} Forest fires, indeed, occur rather frequently, as is demonstrated in Table 4.\textsuperscript{37} For the period covered by the data collected, in the eighteenth century there was a forest fire every seventeen years on average, in the twentieth century (counting from 1899) every sixteen years. I have insufficient data for the nineteenth century, and two years in the table are only mentioned in the source as "very dry" ones. Exceedingly dry years were not necessarily years of forest fires, as demonstrated by 1958 when it was very dry (Schulz 1960:18), but I have found no references to fires.

This is not the place to speculate at length whether we are dealing here with some sort of "El Niño" effect, or whether the suggested periodicity — partly of my own making by leaving blanks in the table where forest fires
might have occurred – is entirely spurious. The table and the calculations are presented here only because I want to demonstrate that the frequency of forest fires was not increasing in the twentieth century, as Gonggryp and Burger suggested. Of course, ideally we should have had data on the forested areas destroyed by these fires. Gonggryp and Burger supposed that hundreds of thousands of hectares were lost in dry years, and Vink gives a figure of 160,000 ha for the 1964 fires. For other years, however, I have no data. Nevertheless, it seems safe to conclude that Gonggryp and Burger were right as regards their suggestion that more forest was lost by fire than by other agents, at least before 1970.

Finally, we would like to know whether all forest fires – and even all savannas – were, indeed, anthropogenous, as was also stated by Gonggryp and Burger (1948:9). Vink (1970:42) seems to agree: “Forest fires in Surinam are virtually 100% man-caused.” Yet, regarding other tropical countries (Brazil, Kalimantan, New Guinea), scholars do not hesitate to argue that lighting has been causing forest fires since time immemorial. It is far from clear why Suriname should be an exception to the rule.

This is not to deny that many a forest fire was caused by man, either inadvertently or on purpose. Elsewhere, “firing” was used to create even-aged pure stands of certain trees and fresh grasses for grazing (Fiedel 1987:162; Simmons 1989:79; Hecht & Cockburn 1990:35). It would be truly amazing if Suriname’s forests had not been manipulated similarly, which takes us back to the non-virgin character of the tropical rain forest, even in Suriname.

Conclusions

Summing up this essay on the management and exploitation of the forests of Suriname, it can be said that, even in remote periods, these forests were certainly not undisturbed, either by natural or human agents. It is, however,
also clear that, at least until the 1960s, exploitation was limited to the accessible fringes, and management was virtually absent.

This state of affairs can be largely ascribed to a lack of people. Settlements of planters were concentrated in areas near the coast and along the rivers, and the vast hinterlands were left to the – often hostile – Amerindians and Maroons. Fear of these people was not the only reason the planters did not venture into the inland areas. Limited soil fertility, rapids in the rivers (which made transportation onerous), and the availability of sufficient amounts of timber in the lowlands also caused them to stay near the coast. Even in the coastal areas not all suitable lands were taken up by plantations for lack of roads or rivers.

Limited demand for Suriname timber in Europe also played a role. It was hardly known and too expensive, owing to high freight costs, high wages in Suriname, variable quality and quantity, and an inelastic supply. High prices were also related to levels of technological development. Only well-mechanized enterprises, which had solved the problems of logging, skidding, transport to the town or the factory, and sawing or other forms of processing, could produce at a profit.

The absence of a permanent Forest Service was another factor. Knowledge of the forests was virtually absent. Only after a thorough inventoryization of a forested area would a timber company move in, and then only when the Forest Service had constructed all-weather roads and skid-tracks. As Suriname was already heavily subsidized by the mother country since the beginning of the nineteenth century, money for a permanent professional Forest Service was not available until 1947.

"As the Second World War ended, the forests of the Amazon stretched almost as far as they had hundred years earlier. Yet within thirty short years the trees had begun to fall [...]" (Hecht & Cockburn 1990:104). This is also the story of Suriname, although compared to Brazil it is not doing so badly. In both areas, road construction in the 1970s opened the way to logging, but Suriname has no Trans-Amazonian highway as yet, and no landless peasantry and cattle breeders to follow the loggers. Deforestation in Suriname probably has increased more over the last twenty years or so than ever, but compared to Brazil – or, for that matter, Kalimantan – the scale is not alarming. In the meantime, one can only hope that the Forest Service finally comes up with an economically feasible system of regeneration.
NOTES

1. This is a rewritten version of a paper presented to the "Conference on Forests and Environmental History of Latin America," held at San José, Costa Rica, February 18-22, 1991. I am grateful to Rosemarijn Hoefte, W.S.M. Hoogbergen, and H.U.E. Thoden van Velzen for their comments, and especially to Alex van Stipriaan for a number of predominantly archival references.

2. Adapted from table 2.1 in Poels (1987: 7).

3. The following description has been taken, with some adaptations, from Vink (1970:4-5).

4. Xerophytic: on dry, leached soils; mesophytic: on well, but not excessively, drained soils; hydrophytic: on wet, water-logged soils. This is a typical 'Caribbean' terminology, in use after the Second World War for Suriname.

5. See e.g. the titles of three recent Ph.D. dissertations, namely those of De Graaf (1986), Jonkers (1987), and Hendrison (1990).

6. Gonggryp & Burger 1948:18; Lindeman 1953:v; Schulz 1960:190; Boerboom 1965:2; Vink 1970:6.

7. The population regarded the kankantri as “holy,” and therefore often spared them (Berkhout 1903:20).

8. Map II from Gonggryp & Burger locates snakewood in the Zanderij Belt and the Interior.

9. Snakewood (Dutch: letterhout; it has, however, nothing to do with printing) is used for cabinet-making and marquetry; data are taken from Blom 1786:340; Nassy et al. 1791:76; Berkhout 1903:58-59; Van de Voort 1973:238; Bruijning, Voorhoeve & Gordijn 1977:287.

10. These references are taken from Nassy et al. 1791:76; Berkhout 1903:60; Harlow 1925:135; Record & Hess 1944:274-79; Van de Voort 1973:238; Bruijning, Voorhoeve & Gordijn 1977:286-87. “Redwood” and fustic are no longer mentioned as commercial species in more recent publications (Japing & Japing 1960; Jonkers 1987:145-46). So either commerce is no longer interested in these dyewoods, or they have been cut out, or they came from inland areas that have not yet been inventoried.

11. Data on quassia are from Record & Hess 1944:512; Oudschans Dentz 1949:23-26; Van de Voort 1973: 238.

12. My own calculation, based on Pfeiffer 1929:22 and Gonggryp & Burger 1948:91. Most earlier calculations are expressed in squared logs, because most timber arrived in that state in Paramaribo. Later on, when more timber was shipped as roundwood, and in accordance with international usage, calculations and estimates were based on roundwood or, in the case of standing trees, on branchless boles above the buttresses, of which the diameter was measured at breast height or above the buttresses, often abbreviated to dbh.

13. Probate inventories of eighteenth-century plantations can be found in the Algemeen Rijks Archief (General State Archives; The Hague; ARA for short), 1st section, Bestuursarchieven Suriname, in the collection Oud Notariële Archieven (ONA for short). Details on the properties of these trees and their use in the eighteenth century can be found in Pistorius 1763:51-53; Hartsinck 1770:66-85; Fermin 1785:218-28; and Blom 1786:335-45. For the identification of wood species mentioned in the older literature and the archives, I have used Bruijning, Voorhoeve & Gordijn 1977:287; Gonggryp & Burger 1948; Japing & Japing 1960; Jonkers 1987: 145-46; and Record & Hess 1944.

14. See e.g. Blom 1786:9-10; Gonggryp & Burger 1948:22; and Bruijning, Voorhoeve & Gordijn 1977:133.
15. I have avoided the term plantation for these lands, because it carries the connotation of sustainable wood production, for which there is no evidence.

16. Data on Hanover can be found in ARA, ONA, 192, 211, 235, 703, 263, 832; ARA, 1st section, Bestuursarchieven Suriname, Onbeheerde Boedels & Wezen 1828-76 (Orphan Chamber; OB&W for short), 1949; Gemeente Archief Amsterdam (Municipal Archives Amsterdam), Particuliere Archieven 600, 544; Quintus Bosz 1954:429; Kappler 1881:40, 72-73; Berkhout 1903:9.

17. Pistorius 1763:26; Nassy et al. 1791:5; Surinaamsche Almanach 1797. In 1827, there were 64 timber estates and 36 foodcrop estates (together 100), and the total number of plantations was 443 (ARA, Archief Ministerie van Koloniën (AMK for short) 1813-49, 791: Verbaal 25.3.1831, No. 41).

18. For such a list of 'gifts', see De Beet & Price 1982:41.

19. On Maroons, peace treaties, and lumbering see Hartsinck 1770:780-806; Kappler 1881; De Beet & Sterman 1981; De Beet & Price 1982; Price 1983; Hoogbergen 1985; De Groot 1986; Thoden van Velzen & Van Wetering 1988.

20. Probably, I have somewhat overstated the number of plantations and hectares. Van Stipriaan (1991:56), who has carefully scanned the archival records for data on plantations, found approximately 400 sugar and coffee plantations in the period 1770-95, with total holdings in 1770 of 161,300 hectares. However, Nassy et al. (1791:5) report 591 plantations around 1785 and Oudschans Dentz (1949:33) 614 in 1793. These figures may include plantations that had already gone out of business. Van Stipriaan's figures do not include the timber and food-crop estates, which, according to Nassy et al., totaled 139 in approximately 1785. Given the surface area in 1797 of 78,000 hectares of 112 timber estates alone, we may add approximately 80,000 hectares to Van Stipriaan's total, which leads to a grand total of approximately 240,000 hectares. For population figures see Van Lier 1971:22-23; Van Stipriaan 1991:326-66.

21. Sources for 1761, 1780-85, 1797, and 1827 were given above; the other sources are Lammens 1982:25; ARA, AMK 1813-49, 1135; Kappler 1854:41; Koloniaal Verslag, relevant years.

22. ARA, Collection van Heeckeren, 69 [1826]; Collection Joh. van den Bosch, 108 [1828]; OB&W 1828-76, 834 [1841]; Heckers 1923:103 [1858].

23. See e.g. Van Sijpesteyn 1851:7-8, 19, 21; Berkhout 1903:38-40, 60-63, 71-72; Plasschaert 1910:25; Berkhout 1917:9-15; Van den Broek 1917:9.

24. Berkhout 1903:11; Plasschaert 1910:69-70; Pfeiffer 1929:25; Quintus Bosz 1954:307-09.

25. All references to forest management and exploitation in Indonesia have been taken from Boomgaard 1988.

26. Plasschaert 1910:109; Berkhout 1917; Pfeiffer 1929:7-8, 35-41; Van Traa 1946:116-26; Gonggryp & Burger 1948:68-69; Quintus Bosz 1954:308-09.

27. Berkhout 1917:40-50; Van den Broek 1917:25-26; Pfeiffer 1929:18, 35; Quintus Bosz 1954:309.

28. Plasschaert 1910:98-99, 109-28; Berkhout 1917:56-57, 62-66; Pfeiffer 1929:59, 66; Gonggryp & Burger 1948:185-91; Jonkers 1987:9-16; Hendrison 1990:16-23.

29. Hecht & Cockburn 1990:35-36; Gonggryp & Burger 1948:152, 191.

30. Schulz 1960:13; Boerboom 1965:2; Vink 1970:15-17; Hendrison 1990:5, 25.

31. Schulz 1960:241; Boerboom 1965:3-5; Vink 1970:59; Human interference 1982:12, 19, 26; De Graaf 1986:6-9; Jonkers 1987:14-15; Hendrison 1990:20-29.
32. For a thorough insight in the links between the old experiments and present day practice, see the four recent Wageningen dissertations: De Graaf (1986), Jonkers (1987), Poels (1987), and Hendrison (1990).

33. Berkhout 1903:71-75; Plasschaert 1910:72-75; Berkhout 1917:31-39, 70; Pfeiffer 1929:28, 35-44; Gonggryp & Burger 1948:76, 69, 130-37; Vink 1970:15-19; Hendrison 1990: 17-19.

34. Most of these figures are based on percentages given in the source.

35. Gonggryp & Burger 1948:17, 49, 55, 86, 93-94, 103, 120-23.

36. For 1746-1825 see the section titled “Production of timber and firewood”; for the other years, see Kappler 1881:48; Berkhout 1917:57; Gonggryp & Burger 1948:55, 103, 120; Lindeman 1953:20, 96; Schulz 1960:23; Vink 1970:43.

37. Johns 1988:104; Simmons 1989:175; Hecht & Cockburn 1990:32-38; Whitmore 1990:117.

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