

WOOD ENERGY IN SURINAME

“Contribution of Forest Sector to the Energy Supply”



Foundation for Forest Management and Production Control

Forestry Economic Services

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PREFACE

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CHAPTER 1. INTRODUCTION

Traditionally, wood has been the source from which human always has fulfilled his need for energy. It has been used to prepare food and heat their dwellings. Throughout the years, with the introduction of fossil fuels the use of wood as a source of energy has declined.

The current development trend and the growing global climate change concerns intensify the call to use biomass as renewable energy.

Biomass is living and dead organic material that is found above the ground as well as below the ground, originating from plants and animals. It is renewable because it continually grows and regrows.

According to the United States Energy Information Administration (IEA)¹ there are currently about 2.4 billion people in the world who depend on traditional biomass, mainly for cooking and heating. An important observation is that a large part of the users of traditional energy live in developing countries, in rural areas, and belong to the low-income group that has no access to alternative, modern forms of energy.

Wood is a clear example of biomass that is found everywhere.

Even in these modern times it is one of the most important renewable sources of energy in the world. Annually about 1.8 billion m³ of wood is produced to be used as a form of energy. This is more than 50% of the total wood production in the world. It is a remarkable fact that the global energy wood production is higher than the global industrial roundwood production. The per capita global energy wood consumption is 0.27 m³ and the per capita global industrial roundwood consumption is 0.24 m³.

With 75% of the total production, the Asia & Pacific Region and Africa are the most important producers and consumers of energy wood. According to the FAO, wood contributes about 9% to the global total energy consumption.

Table 1. Production of global energy wood per region in 2012

Region	Volume in m ³	%
Asia & Pacific	762,000,000	41
Africa	644,000,000	34
Latin America & the Caribbean	280,000,000	15
Europe	130,000,000	7
North America	56,000,000	3
World	1,872,000,000	100

Source: FAO Statistics 2013

¹FAO Forestry Paper; Rome 2008. Forests and Energy, Key issues 154

Also in the current development stage of the world, forests can contribute significantly to the sustainable development of the global community. The call to develop a green economy to minimize or to prevent the negative effects of economic activities on the environment is growing louder. It is a well-known fact that forests can produce a wide range of products and services that can bring about socio-economic benefits for man. However, these have to be produced sustainably. In this regard we think of wood and wood products, food (fruit and game), medicinal plants and various ecological services. To quantify the benefits that forests offer, the availability of data is very important. A look at the Surinamese wood production statistics, shows that the availability of data on industrial roundwood production is reasonable. However, these statistics provide insufficient data on the production of wood for energy supply, energy wood or fuelwood. This data gap was one of the reasons why the survey research into the status of energy wood (fuelwood) in Suriname was conducted. This study will also assess the contribution of the forest sector to the energy supply of Suriname. In this study the use of charcoal for cooking and barbecueing is not included.

Defining and categorizing energy wood.

If we consider the place of production, energy wood can be categorized into²:

- Direct energy wood; this is wood from the forest (natural or planted forest), trees and shrubs outside the forest. It includes wood residue from logging or thinning activities.
- Indirect energy wood; this is wood or sawdust (waste and rejects) from the wood processing industry. In this case the primary processing industry such as sawmills, plywood-, chipboard-, veneer- and paper factories, but also the secondary processing industry such as joinery works and furniture companies and other wood processing companies are included.
- “Recovered” energy wood; this is wood derived from economic and social activities outside the forest sector.

Taking as criterion the form (state) in which the wood is converted into energy, we can make the following distinction:

- Solid energy wood: wood in its raw form – for example: roundwood, branches, chips, sawdust and pellets. Charcoal also belongs in this category.
- Liquid energy wood; black liquor (liquid wood fuel is a by-product of the pulp industry) and pyrolysis oil.
- Gas; wood gasification.

The survey research was conducted in the period of February 2013 – February 2015.

² FAO Unified Bioenergy Terminology.UBET

CHAPTER 2. METHODOLOGY

The aspects taken into consideration are:

- The quantity of energy wood consumed by households (families) and small scale enterprises in different sectors.
- Source of the energy wood.
- Type of energy wood.
- The timber species that are used as energy wood.
- The technology applied during the consumption process.
- Available quantity of wood for the generation of energy.
- Emission of carbon by the consumption methods.
- Substitution of gas for cooking by energy wood.

The survey research began with a desk study using literature to gather the necessary information. A questionnaire was designed to collect the data. The data was gathered from two groups of users of energy wood, namely households (families) and small scale enterprises.

By the latter we mean entrepreneurs in various sectors who use wood to generate energy for their operations. In this case we tried to gather data from 100% of the population. The sectors using wood to generate energy were identified. The identification of these small scale enterprises were conducted per district.

For the households (families), data has been collected at random.

Determining the sample size for the households.

To determine the sample size the following factors are important:

- Population size
- Reliability
- Desired accuracy and admissible margin of error.

The formula for establishing a sample size is³:

$$n \geq \frac{N \times z^2 \times p(1-p)}{z^2 \times p(1-p) + (N-1) \times F^2}$$

where:

n = number of respondents (sample size)

z = standard deviation at certain percentage of confidence

N = the size of the population

p = probability for giving a certain answer (in most cases 50%)

F = margin of error, often 3%, 5%, or 7% is used.

³www.marktonderzoek.nl

For this study:

N = Determined from the results of the 8th census of General Bureau of Statistics (ABS) (in 2012). This census shows that 15,999 households (families) in Suriname use energy wood for cooking.

F = A 5% margin of error was chosen.

P = The chance of someone giving a certain answer was determined at 50%

Z = Reliability can be 90%, 95%, or 99%

For this survey research a reliability of 99% was chosen, with a sample size of 637. This is approximately 4% (639) of the total population of households in Suriname who use energy wood for cooking.

Table 2. Population size and sample size per district

District	Number of households in Suriname	Number of households in Suriname using energy wood	n at a sample size of 4%
Brokopondo	4.658	601	24
Commewijne	8.344	854	34
Coronie	1.091	58	2
Marowijne	4.358	258	10
Nickerie	9.827	1.063	43
Para	5.750	509	20
Paramaribo	62.160	2.035	81
Saramacca	4.840	1.142	46
Sipaliwini	10.400	4.400	176
Wanica	28.939	5.079	203
Total	140.367	15.999	639

The results of the 8th census held in 2012 by ABS show that there are 140,367 households in Suriname of which 15,999 (11%)⁴ use energy wood for cooking. By cooking is meant the preparation of food and the heating of water. On the basis of a 4% sample, 639 households throughout Suriname using energy wood for cooking were surveyed. The survey was conducted per district and the districts were divided into jurisdictions or regions. In every district, the jurisdictions or regions were randomly selected and the data was collected. We also tried to use a 4% sampling per district. Table 2 gives an idea of the total number of households that use energy wood for cooking and the number of surveyed households per district.

Data analysis

For the analysis of the data, the districts were clustered, using the following criteria:

- Degree of forest coverage
- Extent of woodcutting licenses
- Level of wood production

⁴ General Bureau of Statistics (ABS)

Wood energy in Suriname

- Presence of tribal communities

Cluster A districts are districts with relatively large number of tribal communities, high forest cover, presence of wood cutting licenses and relatively high wood production. **Cluster A districts are Sipaliwini, Para, Brokopondo and Marowijne.**

Cluster B districts are districts with relatively few tribal communities, few forests and wood cutting licenses with a low wood production level. **Cluster B districts are Commewijne, Coronie, Nickerie, Paramaribo, Saramacca and Wanica.** It is expected that factors like the source of energy wood and the consumption pattern of the households in the clusters are the same.



Photo 1. Concrete oven on an iron barrel



Photo 2. Pile of energy wood.



Photo 3. Pile of energy wood.

CHAPTER 3. GATHERING DATA FROM THE HOUSEHOLDS

Based on the designed sample, 639 households across Suriname would have to be surveyed. The field work for the data gathering was conducted per district.

3.1 Sipaliwini

In the district of Sipaliwini there are 10,400 households, of which 4,400 (42%) use energy wood for cooking. The sample size calculated for this district is 176 households (2% of the total number of households and 4% of the households that use energy wood for cooking). A total of 170 households was surveyed, which more or less concurs with the calculated percentage.

In this district the data gathering was conducted as follows.

In the period 17 to 19 September 2013 data gathering was conducted in the tribal communities of Apoera and surroundings, consisting of the settlements of Apoera, Washabo, Section, and Sandlanding. The settlements are situated in the western part of Suriname, along the Corantijn River. Apoera, Washabo and Section are settlements with Arowak natives and Sandlanding is a Trio settlement.

On 19 September 2013 data was gathered in Witagron, a maroon community situated in the western part of the district of Sipaliwini, along the road to Apoera.

In the Trio settlement of Sipaliwini, situated in the south of Suriname, data gathering was conducted on 14 and 15 August 2014.

In Tèpu, a Trio settlement in the south of Suriname, data gathering was conducted on 22 August 2014.

Apetina is a Wayana settlement in the south of Suriname, and data gathering was conducted here on 27 and 28 August 2014.

In Langatabbetje and surroundings, in the east of Suriname, which is inhabited by maroon communities, data was gathered in the period of 9 to 11 September 2014.

The Pokigron area, in the upper Suriname region, is inhabited by maroon communities. In this area data gathering was conducted on 16 and 17 September 2014.

In the maroon settlements of Kajapati and Abenaston in Upper Suriname, along the Upper Suriname River, data gathering was conducted on 19 December 2014.

Table 3. Surveyed households in the district of Sipaliwini

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Apoera, Washabo, Section en Sandlanding	16	4	12
Witagron	1	1	
Sipaliwini	10	4	6
Tèpu	20	6	14
Apetina	27	1	26
Langatabbetje	25	2	23
Pokigron	21	3	18
Kajapati	40		40
Abenaston	10		10
Total	170	21	149

Wood energy in Suriname

All the households surveyed appeared to belong to tribal communities. The majority of the respondents (88%) is female. The families vary in size from 1 to 12 members, with an average of 6 persons per family. It can be said that the majority of the respondents are housewives. Some of them are farmers. There are also laborers from timber- and goldmining companies and old age pensioners. About 44% of the households use only energy wood for cooking and 56% of the households use a combination of energy wood and gas. The wood is gathered by the households themselves from their agricultural plots, community forests, surrounding forests, gardens and yards. A small percentage of the households said that sometimes they buy the wood. A trade in energy wood has started.

Looking at the type of energy wood used in the communities, we found that it is mainly direct energy wood.

Below are the timber species used for cooking with their local names:

- Paripo, akïkipï, kakaimë, kuikëpen, kakawiru, tamara, utujuï, manuïpke, makaraimë, and kutari (Trio names).
- Mawuka, kalïpoïma, luwë-luwë, and kolosimëu (Wayana names).
- Kape pau, sakiki penpe, kwa kwa and takuba (Saramacca names)
- Fungu, (faya-mama), red-wood, swieti-boontje, rode fungu, riemhout, kimboto, kwasiba, kwepi, watrakanu and ingi-pipa.

Apart from preparing their daily meals, these communities also bake cassava bread and kwak and smoke meat. Energy wood is also used to make kasiri and to heat water.



Photo 4. Baking Cassava Bread



Photo 5. Gathering energy wood

3.2 Para

In the district of Para there are 5,750 households. Of this number 509 households (9%) use energy wood for cooking. The sample size for this district is 20 households (0.3% of the total number of households and 4% of the households using energy wood for cooking). The required number of households to be interviewed in this district based on the sample size was realized.

Data gathering in the district of Para took place on:

15 June 2013 data was gathered in the mixed Arowak & Carib indigenous community of Redi Doti.

18 August 2013 data was gathered in the Carib indigenous settlement of Bigi Poika.

30 June 2014 data was gathered in the Carib indigenous settlement of Pikien Saron, the Carib indigenous settlement of Cabenda Dorp and the Arowak indigenous settlement of Powakka.

19 September 2014 data was gathered in the maroon settlements of Baling Sabana and Midjan Kampoe.

Table 4. Surveyed households in the district of Para

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Redi Doti	1	1	
Bigi Poika	4	1	3
Pikien Saron	3		3
Cabenda Dorp	4		4
Powakka	3	1	2
Baling Sabana	2	1	1
Midjan Kampoe	3	1	2
Total	20	5	15

In this district as well the households interviewed were from tribal communities. The majority (75%) of the respondents was female. The families vary from 1 to 12 members, on an average 6 persons per family. In these communities the respondents are housewives, farmers, students or old age pensioners. It turned out that 25% of the surveyed households only use energy wood for cooking, while 75% use wood as well as gas for cooking. In these communities the wood is gathered from the agricultural plots and community forests. The type of energy wood that is used in these communities is direct energy wood.

The timber species that are used are swieti-boontje, fungu, dakama, various savanna timber species, sabana-mangro, blaka beri/meri, krapa, pari-udu, sabana-udu, bebe and tafra-bon. Cooking is limited to preparing the daily meals.



Photo 6. Cooking on a cast iron tripod



Photo 7. Storage of energy wood

3.3 Brokopondo

In the district of Brokopondo there are 4,658 households, 601 (13%) of which use energy wood for cooking. The sample size for this district was determined at 24 households (1% of the total number of households and 4% of the households that use energy wood for cooking. The required number of households was interviewed.

The data gathering in Brokopondo took place on:

24 June 2014 data was gathered in the Stuwmeer jurisdiction and the settlement of Kadjoe.

25 June in the communities of Nw. Ganzee and Marchalkreek.

26 June in the jurisdiction of Centrum Brokopondo and the community of Klaaskreek, and 11 July 2014 in Kwakoegron. These places are all inhabited by maroon communities.

Table 5. Surveyed households in the district of Brokopondo

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Stuwmeer	4	1	3
Kadjoe	3	1	2
Nw.Ganzee	3	1	2
Marchalkreek	4		4
Centrum Brokopondo	3		3
Klaaskreek	3		3
Kwakoegron	4		4
Total	24	3	21

The majority of the surveyed households in this district belong to tribal communities. About 88% of the respondents in this district is female. The families vary from 1 to 10 members, on an average 5 persons to a family. In these communities the respondents are housewives, civil servants, farmers, students, teachers or cleaning ladies. All the surveyed households in this district use wood as well as gas for cooking. 50% of the surveyed households gather the wood in the forest. The other 50% said that the wood is ordered from a fuel wood seller. In this district as well a business in energy wood has started.

Wood energy in Suriname

The type of energy wood that is used is direct energy wood. The timber species in this district are: fungu and swiet-boontje. Some of the surveyed households say that all available timber species are used for cooking. The cooking activities include the preparation of the daily meals and the heating of water.



Photo 8. Tray to bake cassava bread



Photo 9. Cast iron tripod

3.4 Marowijne

In the district of Marowijne there are 4,358 households, 258 (6%) of which use energy wood for cooking. The sample size for this district was determined at 10 households (0.2% of the total number of households and 4% of the households that use energy wood for cooking). The required number of households was interviewed.

In the district of Marowijne the gathering of data went as follows. On 23 October 2013 data was gathered from the maroon communities of Morakondre, Kraboe-Olo, Agnes Kamp and Ovia-Olo and on 24 October from the maroon communities Solega Kamp, Adjoema Kondre and Moengo Tapoe.

Table 6. Surveyed households in the district of Marowijne

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Morakondre	1	1	
Kraboe-Olo	2		2
Agnes Kamp	1	1	
Ovia-Olo	1		1
Solega Kamp	1		1
Adjoema Kondre	1		1
Moengo Tapoe	3		3
Total	10	2	8

All the surveyed households belong to tribal communities. In this district 80% of the respondents are female. The families vary from 1 to 9 members, on an average 4 persons per family. The majority of the respondents are housewives. Farmers, cleaning ladies and unemployed women were interviewed as well.

All the surveyed households in this district use wood as well as gas for cooking. In this district as well the wood is gathered by the households themselves from community forests.

The type of energy wood that is used is direct energy wood. The households say that they use all available timber species for cooking, but they prefer fungu, rode pinya, redi-udu, sabana-fungu, pinto-kopi, weti-udu and swieti-boontje. The cooking activities are the preparation of the daily meals and the heating of water.

3.5 Coronie

On 19 April 2014 data was gathered in the district of Coronie, in the town Totness.

In this district there are 1,091 households, 58 (5%) of which use energy wood for cooking. The sample size for this district was determined at 2 households (0.2% of the total number of households and 4% of the households that use energy wood for cooking). Five households were interviewed, 3 of which were male and 2 female. The families vary from 1 to 4 members per family, on an average 2 per family. They work as fishermen, security guards, civil servants or housewives. All the surveyed households use wood as well as gas for cooking. The wood is gathered by the families from their gardens, yards and the surrounding forests. Rejected building materials are also used for cooking. The types of energy wood that are used in Coronie are direct energy wood and recovered energy wood. The primary timber species used for cooking is parwa.

3.6 Commewijne

There are 8,344 households in the district of Commewijne. Of these households 854 (10%) use energy wood for cooking. The sample size for this district was determined at 34 households (0.4% of the total number of households and 4 % of the households using energy wood for cooking). The required number of households to be surveyed on the basis of the sample size was reached.

In the district of Commewijne the gathering of data went as follows.

On 28 May data was gathered in Nieuw-Amsterdam and Alkmaar, on 29 May in Tamanredjo, De Hulp and Meezorg and on 3 September 2014 in Johanna Margaretha.

Table 7. Surveyed households in the district of Commewijne

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Nieuw-Amsterdam	3	1	2
Alkmaar	7	3	4
Tamanredjo	3	2	1
De Hulp	7	6	1
Meezorg	7	2	5
Johanna Margaretha	7	4	3
Total	34	18	16

In Commewijne 47% of the respondents are female. The families vary from 1 to 7 members, on an average 4 members per family.

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The respondents work as civil servants, machine operators, farmers, housewives or are retired. The majority (96%) of the surveyed households use wood and gas for cooking. Only 6% of the surveyed households use solely energy wood for cooking. The wood is collected from their gardens, yards, the surrounding forests, the sawmill, the furniture factory or comes from the building sector. Some of the wood is bought. The types of energy wood used in this district are direct energy wood, indirect energy wood and recovered energy wood.

The timber species that are used for cooking are mira-udu, swieti-boontje, djamoen, kromoko, guave, sumaruba, wana, kabbes spp, manja, kopi, gele kabbes, parwa, and mangrove.



Photo 10. Chulha



Photo 11. Pile of energy wood

3.7 Paramaribo

In Paramaribo there are 62,160 households. Of this number 2,035 use energy wood for cooking. The sample size for Paramaribo was determined at 81 households (0.1% of the total number of households and 4% of the households using wood energy for cooking). The required number of households on the basis of the sample size was interviewed.

In Paramaribo the gathering of data was conducted as follows:

On 23 April in the jurisdictions of Kwatta and Ringweg, on 24 April in the jurisdictions of Munder and Uitvlugt, on 25 April in the jurisdiction of Livorno.

On 28 April at De Goede Verwachting, on 29 April at Dijkveld and on 30 April 2014 at Blauwgrond.

Table 8. Surveyed households in Paramaribo

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Kwatta	9	5	4
Ringweg	11	2	9
Munder	15	6	9
Uitvlugt	5	4	1
Livorno	28	13	15
De Goede Verwachting	5	3	2
Dijkveld	3	1	2
Blauwgrond	10	4	6
Total	86	38	48

In Paramaribo 56% of the respondents are female. The families vary from 1 to 10 members, on an average of 4 persons per family. The occupations of the respondents include civil servant, teacher, student, self-employed person, merchant, electrician, housewife, farmer, and driver. Just 1 of the surveyed households uses only wood energy for cooking and the remaining 85 use wood as well as gas for cooking. The wood is collected from their gardens, yards, or comes from the building sector, sawmills, timber markets, and furniture factories. Wood is also bought from the sawmill and the timber market. The types of energy wood used in this district are direct energy wood, indirect energy wood and recovered energy wood. The respondents said that all available timber species are used for cooking. Some of them said they do not know which timber species they use.



Photo 12. Combination Chulha and tripod



Photo 13. Iron cooking oven

3.8 Wanica

In Wanica there are 28,939 households. Of these households 5,079 (18%) use energy wood for cooking. The sample size for this district was determined at 203 (1% of the total number of households and 4% of the households using energy wood for cooking). The required number of households was interviewed.

In Wanica the gathering of data was conducted as follows:

On 2 May in Frederikslustweg and Hannaslustweg, on 5 May at Beekhuizen and Nieuwe Grondweg.

On 5 May and 15 October at Welgedacht A and B.

On 6 May at Santodorp and Koewarasan.

On 6 May and 15 October at Bomapolder.

On 7 May at Houttuin and the part of Dijkveld that lies in the district of Wanica.

On 8 May at Lelydorp.

On 9 May at Sophiaslustweg and on 16 October 2014 on the Leidingen.

Table 9. Surveyed households in the district of Wanica

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Frederikslustweg	16	4	12
Hannaslustweg	10	2	8
Beekhuizenweg	1		1
Nieuwe Grondweg	10	6	4
Welgedacht A en B	19	7	12
Santodorp	12	5	7
Koewarasan	15	4	11
Bomapolder	50	13	37
Houttuin	8		8
Dijkveld	5	3	2
Lelydorp	4	1	3
Sophiaslustweg	5	2	3
Leidingen	48	8	40
Total	203	55	148

In Wanica 73% of the respondents are women. The families vary from 1 to 13 members with an average of 5 persons per family. The respondents are civil servants, teachers, students, entrepreneurs, merchants, electricians, housewives, farmers, old age pensioners, security guards, soldiers, tailors, or taxi-drivers. The majority of the households in Wanica use wood and gas for cooking. 8% use only energy wood for cooking.

The wood is collected from gardens, yards, surrounding forests, building sites, sawmills, and timber markets. The types of energy wood that are used in this district are direct energy wood, indirect energy wood and recovered energy wood.

The timber species used are swieti-boontje, djamoen, mira-udu, manja, fungu, sumaruba and pommerak. Some of the households said that they did not know what timber species they used.



Photo. 14. Tripod and an old hub cap serving as cooking oven



Photo 15. Storage place for energy wood (djamoen)



Photo 16. Storage place for energy wood (swieti-boontje)

3.9 Nickerie

In Nickerie there are 9,827 households. Of these households 1,063 (11 %) use energy wood for cooking. The sample size for this district was determined at 43 households (0.4% of the total number of households and 4% of the households that use wood energy for cooking). The required number of households was interviewed.

In this district the data gathering was carried out as follows.

On 24 July at Paradise, Bacovendam, and Boonackerpolder, on 25 July at Sawmillkreekpolder, Nieuw-Nickerie and Van Drimmelpolder.

On 26 July in Beatrixweg and Stalweide and on 27 July 2013 at Gemaalweg, Clarapolder and Corantijnpolder serie C.

Table 10. Surveyed households in the district of Nickerie

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Paradise	4	3	1
Bacovendam	4	3	1
Boonackerpolder	4	2	2
Sawmillkreekpolder	4	1	3
Nieuw-Nickerie	3		3
Van Drimmelpolder	4	1	3
Beatrixweg	4		4
Stalweide	4	2	2
Gemaalweg	4	4	
Clarapolder	4	3	1
Corantijnpolder serie C	4	4	
Total	43	23	20

In Nickerie 47% of the respondents are women. The families vary from 1 to 9 members, with an average of 5 per family. The occupations of the respondents include: civil servants, fire fighters, teachers, housewives, farmers, old age pensioners, machine operators and soldiers. The majority of the households in Nickerie use wood as well as gas for cooking. Just 2% use only energy wood. The wood is collected from their gardens, yards, the building sector, sawmills and timber markets. Some buy wood from the sawmill. The types of energy wood that are used in this district are direct energy wood, indirect energy wood and recovered energy wood. The timber species used are djamoen, swieti-boontje, parwa, manja and knippa. Some households said that they do not know what timber species they used.



Photo 17. Dual Chulha



Photo 18. Single Chulha



Photo 19. Chulha with chimney

3.10 Saramacca

In Saramacca there are 4,840 households, of which 1,142 (24%) use energy wood for cooking. The sample size for this district was determined at 46 households (1% of the total number of households and 4% of households using energy wood for cooking). The required number of households was interviewed.

The data gathering in Saramacca was conducted on 17 June in the jurisdiction of Jarikaba, Aitnoch and Uitkijk, on 18 June in Groningen and Calcutta, on 19 June in Grankreek and Columbia and on 20 June 2014 in Vijfderijweg and Wayamboweg.

Table 11. Surveyed households in the district of Saramacca

Region/Jurisdiction	Number of surveyed households	Gender of the respondents	
		Male	Female
Jarikaba	6	1	5
Aitnoch	5	4	1
Uitkijk	5	1	4
Groningen	5	3	2
Calcutta	5	2	3
Grankreek	6		6
Columbia	3	2	1
Vijfderijweg	5	4	1
Wayamboweg	6	4	2
Total	46	21	25

Wood energy in Suriname

In Saramacca 54% of the respondents are female. The families vary from 1 to 10 members, with an average of 5 per family. They are civil servants, teachers, housewives, farmers, old age pensioners, truck drivers or bus owners. About 96% of the households in this district use wood and gas for cooking. 4% use only wood energy for cooking. The wood is collected from gardens, yards, and the building sector. Some also buy their wood at the sawmill and the timber market. The types of energy wood used in this district are direct energy wood, indirect energy wood and recovered energy wood.

The timber species that are used are swieti-boontje, mira-udu, djamoen, krapa, doifi-siri, babun, guave and orange. Some households said that they use all available timber species.



Photo 20. Cast iron tripod



Photo 21. Chulha

3.11 Population of energy wood users in Suriname

The determined sample size for whole Suriname is 639 households. This is about 4% of the population of 15,999 households who use energy wood. As the interviews were carried out per district, a 4% sample was also used. A total of 641 households were surveyed. According to the sample size for Coronie 2 households had to be surveyed, but 5 were interviewed instead. In Paramaribo 86 households instead of 81 were surveyed. So, in these two districts more households were surveyed than necessary. In the district of Sipaliwini 176 households should have been surveyed, but only 170 households were. In the remaining 7 districts the numbers are the same as the sample sizes.

In Suriname there are 140,367 households. Data was gathered from 641 households. This corresponds with 0.5 % of the total.

Table 12. Gender of the respondents

Sex	Number	Percent
Male	184	29
Female	457	71
Total	641	100

Of the 641 respondents 71% are women and 29% men. Most of the respondents (57%) are housewives, 8% are old age pensioners, 7% are civil servants, 5% are farmers, and 3% are students.

As for the family sizes: 20% of the families have 5 members; 19% have 4 members and 15% have 3 members. The average family size is 5 persons. In all, there are 76,000 persons in Suriname who use energy wood for cooking. This is about 14% of the total population of the country.



Foto 22. Stack of energy wood (Swieti-boontje)

CHAPTER 4. GATHERING DATA FROM THE SMALL SCALE ENTERPRISES

As for the small scale enterprises that use energy wood in their production processes, we have been able to find information on the sectors, the number of operating companies in some of the sectors and their locations. In Suriname the sectors using energy wood for their operations are cassava bread production, fish processing, bread production, generation of electricity and cremation. During the field survey we tried to find as many Enterprises as possible. Table 13 shows the number of small scale Enterprises surveyed per sector, per district.

Table 13. Number of surveyed small scale enterprises per sector and per district

District	Sector	Number of surveyed small scale enterprises
Brokopondo	-	-
Commewijne	Fish processing	8
Coronie	Fish processing	4
Marowijne	Cassava bread	10
Nickerie	Cremation	1
	Fish processing	4
Para	Cassava bread	13
Paramaribo	Cremation	2
Saramacca	Fish processing	4
Sipaliwini	Electricity	1
	Cassava bread	11
Wanica	Bakery	2
Total		60

We surveyed sixty entrepreneurs or agencies that use energy wood for production activities. These are 20 self-employed persons who process fish, 34 self-employed persons who produce cassava bread, 3 entrepreneurs and/or agencies related to the cremation activities, 2 bakeries and 1 entrepreneur who uses wood to generate electricity. It is very likely that there are more entrepreneurs in Suriname who undertake activities using energy wood.

4.1 Cassava bread

Cassava bread is made from cassava by communities who live in the interior. Most of the time it is prepared in the traditional way on a wood fire. In the district of Sipaliwini data was gathered in the settlements of Apoera and Witagron, about the use of energy wood for the production of cassava bread. Data from Apoera was gathered in the period of 17 to 20 September 2013. Nine producers were surveyed. They use only wood for the production of cassava bread. The operating activities take place twice a week. Each time an average of ¼ stacked m³ of wood is used. One (1) stacked⁵ m³ is about 0.7 m³ of wood. The wood is collected by the producers

⁵ ACBIOM; www.biomassstradecentres.EU; Wood Fuels handbook, Production, Quantity, requirements, Trading

themselves from the community forest, agricultural plots, yards and gardens in the vicinity of the settlement. The producers say that all timber species are suitable for the production process, but the preferred species is fungu.

On 20 September 2013 the basja (village authority) of Witagron was interviewed. According to him this community largely consists of 5 to 6 families and the production of cassava bread to commercialize is a joint venture.

On 23 and 24 October 2013 data was gathered in the district of Marowijne. Here 10 entrepreneurs who produce cassava bread were surveyed. They use only wood to generate energy for the production process. The operating activities take place once a week. Each time about a ½ stacked m³ of wood is used. The wood is collected from the surrounding forest and community forests. They say that all timber species are used for the production of cassava bread, but fungu, rode-pinya, weti-udu, and swieti-boontje are the preferred species.

In the district of Para data was gathered in the settlements of Matta and Bigi Poika.

On 8 February 2013 data was gathered in Matta. In this settlement 5 cassava bread producers were surveyed. The energy supply to carry out operations is completely based on wood. These operations take place once a week. Each time about 1 stacked m³ of wood is used. The wood they need is collected from the community forests of the settlement. The timber species that are used in this village are fungu (burada), sabana-mangro, kwaku, gawetri, kaiakaiadan, savanna-fungu (unikiakia) and kulishiri.

On 18 October 2013 data was gathered in the settlement of Bigi Poika. In this settlement 8 cassava bread producers were surveyed. They, too, use only wood. The production activities are carried out twice a week. All the entrepreneurs said that the volume of wood used depends on the amount of cassava bread that is produced each time. The production is different each time. On an average one stacked m³ of wood is used each time. The wood is collected by the entrepreneurs from the community forests of Bigi Poika. The timber species used are fungu, swieti-boontje, dakama, weti-udu, and all other savanna timber species.



Photo 23. Baking cassava bread

4.2 Fish processing

To improve the storage life of fish it must undergo a drying/smoking process in closed or self-constructed open drying ovens, at a certain temperature, for a certain period of time. The energy supply for these drying ovens comes from wood.

On 24 March 2013 data was gathered in Nieuw-Amsterdam in the district of Commewijne from 8 entrepreneurs who dry/smoke fish in drying ovens. Five self-constructed drying ovens – all with different dimensions- were found. The lengths vary from 2m to 6m, the widths are between 1.5m and 2m and the heights between 0.7m and 1m.

These ovens are constructed from wood, galvanized iron sheets and chicken wire netting. There were also 3 professionally constructed drying ovens with smoke exhaust systems. The lengths vary from 2m to 3m, the widths from 2 to 2.5m, but they had a uniform height of 2m. The construction materials are concrete and metal. The energy supply of the 8 entrepreneurs to carry out the production process is based on wood. On an average drying and smoking activities take place 4 times a week. Each time they use about 1.5 stacked m³ of wood. The wood is collected from nearby forests or sawmills. The timber species that are used are wana, gronfolo, parwa, mangrove, swieti-boontje, kopi and wanakwari.



Photo 24. Open fish smoking oven



Photo 25. Closed fish smoking oven

In the period of 24 to 27 July 2013 data was gathered in Nickerie from 4 entrepreneurs. They, too, use self-constructed open dry/smoke ovens to process fish. The dimensions of the ovens are: the lengths vary from 4m to 6m, the widths from 1m to 1.5m and the heights from 0.8 to 1m. These ovens are constructed from wood, galvanized iron sheets and chicken wire netting. The energy needed to operate these drying ovens is generated by means of wood. The 4 entrepreneurs said that the fish processing takes place once or twice (full days) a week, depending on the catch and supply of fish. The amount of wood needed for the processing depends on the amount of fish that has to be processed. From what they told us it became clear that about 2 stacked m³ of wood is used to process 200 kg of fish. The wood is supplied on order. Part of the wood is collected by the entrepreneurs along the Nickerie River. The timber species that is used is parwa.

On 19 April 2014 data was gathered in Coronie. In Coronie 4 entrepreneurs were surveyed who use self-constructed open drying/smoking ovens to process fish. The dimensions of the drying ovens are as follows: the lengths vary from 1m to 2,5m, the widths from 0.80m to 1.50m and the height is 0.80m. These ovens are made from wood, galvanized iron sheets and chicken wire netting. Two entrepreneurs said that they use a combination of wood and coconut husks for their energy supply. The other two use only wood for their energy needs. On an average the fish processing takes place once a week. Each time 1 stacked m³ of wood per entrepreneur is used.

The wood is collected by the entrepreneurs themselves from the mangrove forest along the coast. The timber species used are parwa and mangrove.



Photo 26. A pile of coconut husks and parwa wood

On 3 April data was gathered in the district of Saramacca, in Boskamp. In this fishing village 4 fish processing entrepreneurs were surveyed. Three self-constructed open drying ovens were seen. The dimensions were as follows: the length varies between 3.50m and 4m, the width between 1.20m and 2.50m and the height between 0.80 and 1m. The construction materials are wood, galvanized iron sheets and wire mesh. There was also one closed drying oven with a chimney. The dimensions of this drying oven is: length 3m, width 2.50m and height 4m. The materials used for this oven are concrete and metal. Wood is used to dry the fish. On an average fish is being processed 3 times a week. Each time an average of 1.5 stacked m³ of wood is used. The wood is collected by the entrepreneurs themselves from the surrounding forests. Some of the wood is ordered from third parties. The timber species used are zwamp-panta, parwa, mangrove, djamoen, swieti-boontje and watragrin.

4.3 Bakeries

In the district of Wanica the data was gathered on 12 February 2014. Two bakeries were seen here. The energy supply for the operating activities is based on wood.

The dimensions of the two ovens are as follows: length 3m, width 3m, and height 3.50m. The ovens are made from concrete and metal. The bakeries bake bread 7 days a week. One bakery uses 3 stacked m³ of wood each day, while the other two uses 5 stacked m³ of wood a day. The wood is delivered on order. It is mainly sawmill waste and only hardwoods are used.



Photo. 27 Concrete oven in the Bakery

4.4 Electricity generation

The timber company Greenheart Company Limited N.V. has added a bio-energy unit to its wood processing company in Apoera, for the generation of electricity for the production chain of the company. The wood waste of the company is used to generate steam to feed the turbo generator for electricity. The steam turbine has a capacity of 1.5 mega-watt. With wood waste of the processing unit (5 m³ per hour, 16 hours per day and 250 working days per year) about 20,000 m³ of wood waste is converted into electricity in the bio-energy unit each year. (Dean Chase, Sawmill Operations Manager Greenheart Group Limited N.V.).

4.5 Cremation

There are 2 locations in Suriname where corpses are cremated on the traditional way, in open funeral pyres. In Paramaribo it is done at the Oedairadjsingh Varma cremation site at Weg naar Zee and in Nickerie at Rijdsdijksluis along the Corantijn River. According to statistics of the Permits Department of the District Commissioner's office in Nieuw-Nickerie around 100 corpses are cremated in Nickerie every year. According to the owner of the cremation site at Weg naar Zee, Mr R. Oediet, annually around 500 corpses are cremated at Weg naar Zee. The average number of cremations in Suriname is estimated on 600. This system of cremation requires 75 poles with a length of 1.35m and 35 poles with a length of 2.30m to build a funeral pyre. The poles are of the timber species walaba. On the basis of a density of 0.89 g/cm³ for walaba and an average weight of 15 kg per pole, the volume of 1 funeral pyre comes to about 1.9 m³. Therefore 1,140 m³ of walaba posts are used annually as a source of energy for the cremation of corpses in Suriname.



Photo 28. Wood for cremation (Walaba)



Photo 29. Wood for cremation (Walaba)

CHAPTER 5. THE CONSUMPTION OF ENERGY WOOD IN SURINAME

5.1 Energy wood consumed by households

As stated in Chapter 2 the data of the districts was clustered for the analysis, into A cluster districts and B cluster districts. The A cluster districts are: Sipaliwini, Para, Brokopondo and Marowijne. The B cluster districts are: Commewijne, Coronie, Nickerie, Paramaribo, Saramacca and Wanica. Table 14 shows the consumption of energy wood by the households per cluster districts per year.

Table 14. Energy wood consumption by households per cluster districts per year

Consumption per year in m ³	Number of households	
	A cluster districts	B cluster districts
<1	16	177
1 – 5	50	178
5 – 10	30	54
10 – 15	34	8
15 – 20	40	
20 – 25	15	
25 – 30	15	
30 – 35	5	
35 – 40	3	
>40	16	
Total	224	417

In the A cluster districts 244 households were surveyed. It turned out that 50 households have a consumption of 1 m³ to 5 m³ of energy wood per year. It is worth noting that 89% of the households use less than 30 m³ of energy wood per year. **The average consumption of energy wood per household per year in the A cluster districts is 13 m³.** In the B cluster districts 417 households were surveyed. In this cluster of districts 85% of the households have a consumption of less than 5 m³ of energy wood per year. In these districts not one household was found with a consumption of more than 15 m³ per year. **The average consumption of energy wood per household per year in the B cluster districts is 3 m³.**

With a total number of 5,768 households for the A cluster districts and an average consumption of 13 m³ energy wood per household per year, the total estimated consumption for these districts is 74,984 m³ of energy wood per year.

With a total number of 10,231 households for the B cluster districts and an average consumption of 3 m³ energy wood per household per year, the total estimated consumption for these districts is 30,693 m³ of energy wood per year.

Thus the total estimated consumption of energy wood across Suriname comes to 105,677 m³ per year. *(for the calculation of the average consumption per household per year for the cluster districts see appendix 1 and 2).*

Table 15. Energy wood consumption of the households per district per year

District	Number of households	Fuel wood consumption in m ³
Brokopondo	601	7.813
Commewijne	854	2.562
Coronie	58	174
Marowijne	258	3.354
Nickerie	1.063	3.189
Para	509	6.617
Paramaribo	2.035	6.105
Saramacca	1.142	3.426
Sipaliwini	4.400	57.200
Wanica	5.079	15.237
Total	15.999	105.677

For the calculation of the consumption of energy wood for the various districts the factors: number of households per district that use energy wood and the average consumption per household of the cluster districts have been used. It is obvious that the district of Sipaliwini has the highest consumption of energy wood for the households. This district consumes 57,200 m³ energy wood per year. This can be explained by the consumption pattern (average consumption per household is 13 m³ a year) and a very high number of households (4,400 or 28%) that use energy wood. With 15, 237 m³ a year Wanica is second in energy wood consumption. Other important energy wood consuming districts are Brokopondo, Para, and Paramaribo, using 7,831 m³, 6,617 m³, and 6,105 m³ a year respectively.

5.2 Energy wood consumption by small scale enterprises

Sixty entrepreneurs or agencies that use energy wood for their operating activities were surveyed: 20 of them process fish, 34 produce cassava bread, 3 entrepreneurs and agencies are in the cremation business and 2 have a bakery while 1 entrepreneur uses wood to generate electricity. These sectors consume about 24,998 m³ of energy wood per year. Table 16 shows the consumption per sector in the various districts.

Table 16. Energy wood consumption per sector per year

District	Sector	Number of surveyed small scale enterprises	Consumption per year in m ³
Brokopondo			
Commewijne	Fish processing	8	737
Coronie	Fish processing	4	178
Marowijne	Cassava bread	10	338
Nickerie	Cremation	1	190
	Fish processing	4	208
Para	Cassava bread	13	1.415
Paramaribo	Cremation	2	950
Saramacca	Fish processing	4	312
Sipaliwini	Electricity	1	20.000
	Cassava bread	11	379
Wanica	Bakery	2	291
Total		60	24.998

5.3 Total energy wood consumption

The total energy wood consumption for whole Suriname, for the households as well as the small scale enterprises, is about 130,675 m³ per year. A look at the districts shows that Sipaliwini with 59% has the highest consumption. The second highest consumption is in the district of Wanica. For the A cluster districts the total energy wood consumption is 97,116 m³ per year (about 74%), while for the B cluster districts this is 33,559 m³ per year (26%).

Table 17. Total energy wood consumption in Suriname

District	Consumption per year in m ³
Brokopondo	7.813
Commewijne	3.299
Coronie	352
Marowijne	3.692
Nickerie	3.587
Para	8.032
Paramaribo	7.055
Saramacca	3.738
Sipaliwini	77.579
Wanica	15.528
Total	130.675



Photo 30. Pile of energy wood

5.4 Consumption intensity

Table 18. Consumption intensity by the households in the A and the B cluster districts

Intensity	A cluster districts		B cluster districts	
	Number of households	Times / day	Number of households	Times / day
Each day	181	3 to 4	177	1 to 2
6 days/week			1	1
5 days/week	2	2	3	1
4 days/week	3	2	24	1
3 days/week	12	1 to 2	65	1
2 days/week	7	1 to 2	52	1
1 day/week	10	1	34	1
1 to 2 days/month	9	1	61	1
Total	224		417	

Looking at the consumption intensity of energy wood in the A cluster districts (**Brokopondo, Marowijne, Para, Sipaliwini**) it appears that the majority (81% of the households) use energy wood for cooking 3 to 4 times a day. In 15% of the households consumption varies from 1 to 5 days a week to once a day. A very small part of the households (4%) uses energy wood just once or twice a month.

About 42% of the households in the B cluster districts (**Commewijne, Coronie, Nickerie, Paramaribo, Saramacca and Wanica**) use wood for cooking once or twice a day. For 43% of the households in this area the consumption varies from 1 to 6 days a week to once a day. 15% use wood for cooking once or twice a month.

The consumption intensity of the households of the A cluster districts is higher than that of the B cluster districts.

CHAPTER 6. SOURCE OF THE ENERGY WOOD

6.1 The source of energy wood for the households

Most of the energy wood that is consumed by the households in the A cluster districts (**Brokopondo, Marowijne, Para, Sipaliwini**) is harvested by the households themselves. It is cut or collected in the surrounding forests, often community forests, when the communities have these at their disposal. Some of the wood comes from the gardens and the agricultural plots. It is worth noting that a number of communities in Brokopondo and Sipaliwini have the wood delivered on order. A business in energy wood has started, with traders collecting the energy wood from the surrounding forests. Part of the wood comes from the wood industry (waste from logging and wood processing) while some is building waste, discarded furniture and other wooden objects.

For the B cluster districts (**Commewijne, Coronie, Nickerie, Paramaribo, Saramacca and Wanica**) the situation is as follows. In Coronie all the energy wood is collected by the households themselves. The wood is collected from the mangrove forests along the beach and from their garden and yards. So, some of the wood comes from outside the forest. Also waste of building sites is used as energy wood. In the districts of Commewijne, Wanica, Nickerie and Saramacca the households collect the wood and sometimes they buy it. The energy wood that is collected by the households comes from the surrounding forests, the forests along the beach, the gardens, the yards and from the house building sector. Wood is purchased from furniture factories, the sawmills, and timber markets. In the districts of Nickerie and Commewijne the wood -from sawmills and timber markets- is also supplied on order by the energy wood traders. We were told that some of the traded wood is derived from the forests along the beach. In Paramaribo most of the wood is bought from the sawmills, the timber markets and the furniture factories, while some comes from the building sector, the gardens and yards. In Paramaribo the energy wood does not come directly from the forest, but wood is collected from trees outside the forest. The households in these districts situated in the coastal zone said that pallets, packing material, bean sticks, tomato sticks and crow legs are used as energy wood. They also said that wood from demolished houses, discarded furniture and coconut husks are used as energy wood.

Table 19. The source of energy wood for households

Source	Energy wood in m ³	
	A cluster districts	B cluster districts
Forest	59.987	3.069
Trees outside the forest	7.498	15.960
Industrial waste	7.498	11.664
Total	74.984	30.693

Wood energy in Suriname

It can be said that 80% of the energy wood (59,987 m³) annually consumed by the A cluster districts comes directly from the forest. About 10% of the wood (7,498 m³) comes from trees shrubs and plants outside the forest. The remaining 10% (7, 498 m³) is waste from in as well as outside the forest sector.

It is estimated that 10% (about 3,069 m³) of the energy wood consumed by the B cluster districts comes from the forests, including mangrove forests along the sea and rivers. About 52% (15,960 m³) of the energy wood comes from trees outside the forests, such as gardens, yards, agricultural plots. The wood industry (sawmills, timber markets and joinery works and furniture factories), the building sector, other industrial waste as well as household waste supply 38% (11,664 m³) of the energy wood.

6.2 The source of energy wood for small scale enterprises

As for the small scale enterprises, about 85% (21,248 m³) of the wood comes from the wood industry (logging, sawmills and timber markets). About 10% of the wood (2,500 m³) comes directly from the forest and 5% (about 1, 250 m³) comes from trees outside the forest. Table 20 shows the source of the wood.

Table 20. The source of energy wood for small scale enterprises

Source	Energy wood in m ³
Forest	2.500
Trees outside the forest	1.250
Wood industry	21.248
Total	24.998

The entrepreneurs who process fish collect the wood themselves. The wood comes from the parwa and mangrove forests along the seashore and the rivers. They also buy wood from sawmills and timber markets. The people who produce cassava bread collect the wood themselves from community forests and agricultural plots.

The wood for cremation is supplied by timber producing companies to the undertakers. The wood for the generation of electricity comes from the company's own sawmill.



Photo 31. Energy wood from the forest



Foto 32. Energy wood from the sawmills

CHAPTER 7. TYPE OF ENERGY WOOD AND TIMBER SPECIES USED

7.1 Type of energy wood used

Table 21. Consumption of type of energy wood by households and small scale enterprises

Type of energy wood	Households		Small scale enterprises	Total
	A cluster districts	B cluster districts		
Direct	67.486	18.416	4.362	90.264
Indirect	4.499	9.208	20.636	34.343
Recovered	2.999	3.069		6.068
Total	74.984	30.693	24.998	130.675

As said before in Chapter 2, based on its source, energy wood can be classified into direct energy wood, indirect energy wood and recovered energy wood. The energy wood that is consumed in the A cluster districts (**Brokopondo, Marowijne, Para en Sipaliwini**) is primarily (approx. 90%) direct energy wood. This is wood from the forest, the agricultural plots, gardens and yards that is harvested from trees and shrubs in the form of tree parts, parts of the trunk, branches, twigs, etc. requiring minimal transformation. This wood is chopped into smaller pieces, making it easier for use. Part of the energy wood of these districts (about 6%) coming from the wood industry is regarded as indirect energy wood. This is waste from logging companies, sawmills and other types of wood processing companies. A small portion, about 4%, comes from other sectors and can be classified as recovered energy wood.

In the B cluster districts (**Commewijne, Coronie, Nickerie, Paramaribo, Saramacca and Wanica**), which are primarily situated in the coastal zone of Suriname, about 60% of the energy wood for the households comes from the forest, gardens and yards. Just like in the A cluster districts, which are situated in the forest area, this is wood that is harvested from trees and shrubs in the form of tree parts, parts of the trunk, branches and twigs, etc. and it undergoes hardly any transformation. The wood is derived from fruit trees and trees outside the forest, which is categorized as direct energy wood. It is estimated that about 30% of the energy wood used by the households of the districts in the coastal area is obtained from sawmills, timber markets, furniture factories or from joinery works. About 10% of the energy wood comes from the building and construction sector. Furthermore, we have found that discarded packing material (pallets and crates) and old wooden furniture are also used as energy wood, as well as unusable crow legs, bean sticks and tomato sticks. This wood can be categorized as recovered energy wood.

Wood energy in Suriname

Looking at the energy wood consumption for business purposes we see that the fish producers obtain the wood from the parwa and mangrove forest along the seashore and the rivers and from the sawmills and the timber markets. About 50% of the energy wood used by these small scale enterprises can be categorized as direct energy wood and 50% as indirect energy wood.

The cassava bread producers collect their wood from the community forest and agricultural plots. This is only direct energy wood.

The wood for cremation is supplied by logging companies and can be categorized as direct energy wood. The wood for electricity generation comes from the company's own sawmill. This can be categorized as indirect energy wood.

Of the total wood consumption in Suriname about 90,264 m³ can be categorized as direct energy wood, 34,343 m³ as indirect energy wood and 6,068 m³ as recovered energy wood.

As for the form, it can be said that all the energy wood currently consumed in Suriname can be categorized as solid energy wood. There is no transformation to convert the wood into a liquid or gaseous form prior to use.



Photo 33. A pile of energy wood

7.2 Timber species used

Table 22. Timber species used by households in the A cluster districts

Local trade name	Traditional name	Scientific name	Times mentioned
Fungu, Faya mama	Burada (<i>Arow</i> ¹), Paripo (<i>Trio</i> ²)	Licania spp.	132
Swieti-boontje		Inga spp.	64
Kwepi		Licania apetala	33
	Kakawiru (<i>Trio</i> ²)		24
	Kalipoïma (<i>Way</i> ³)		19
Kop-kopi, Kapu-weri kopi	kape pau (<i>Sar</i> ⁴), Redwood, Redi-udu	Trema micrantha, Casearia arborea	14
Tamaren-prokoni, Wasipa	Kakaimë (<i>Trio</i> ²)	Elisabetha aff.princeps	11
	Kolosimëu (<i>Way</i> ³)		11
Santi-udu	Santi-udu	Licania ovalifolia	11
	Sakiki penpe (<i>Sar</i> ⁴)		11
	Luwë-luwë (<i>Way</i> ³)		8
	Mawuka (<i>Way</i> ³)		8
Bofro-udu, Kwata-siri	Makaraimë (<i>Trio</i> ²)	Sacoglottis guianensis	7
Riemhout (Witte)		Mycropholis guyanensis	6
Kutari	Kutari (<i>Trio</i> ²)	Candolleodendron brachystachym	5
	Manuïpkë (<i>Trio</i> ²)		5
Kleinbladige rode kwepi	Akïikipi (<i>Trio</i> ²)	Exellodendron barbatum	3
Ingi-pipa		Couratari spp.	3
Busi-tamaren		Hydrochorea spp.	3
Kwasiba	Kwasiba	Pouteria spp.	2
Pari-udu	Pari-udu	Aspidosperma spp.	2
Walaba		Eperua falcata	2
Bebe		Pterocarpus officinalis	1
Babun		Virola spp.	1
Dakama		Dimorphandra conjugata	1
Doifi-siri		Guarea spp.	1
Kimboto		Pradosia spp.	1
Soro-sali	Kuikëpen (<i>Trio</i> ²)	Trichilia quadrijuga	1
Kwaskwaw-udu	Kwa kwa (<i>Sar</i> ⁴)	Ampelocera edentula	1
Redi-pinya		Vismia spp.	1
Sabana-mangro		Clusia fockeana	1
Tafra-bon		Cordia alliodora	1
Makraka	Takuba (<i>Sar</i> ⁴)	Cynometra hostmanniana	1
Tingimoni		Protium spp.	1
Watra-biri-udu, Walatapa	Tamara (<i>Trio</i> ²)	Macrolobium spp.	1
	Utujui (<i>Trio</i> ²)		1
Watrakan	Watrakanu		1
Manari-tiki	Weti-udu	Rinorea spp.	1
Savanna timber species			10
Various			34

Note:

*Arow*¹ = Arowak

*Trio*² = Trio

*Way*³ = Wayana

*Sar*⁴ = Saramaca

The surveyed households in the A cluster districts have mentioned more than 38 timber species that are used as energy wood. Fungu is the species most mentioned. Other timber species that have also been mentioned often are swieti-boontje, kwepi, kop-kopi and tamaren-prokoni. The indigenous communities have indicated that especially savanna timber species are suitable to be used as energy wood. Some of the households said that all timber species can be used as energy wood.

Table 23. Timber species used by households in the B cluster districts

Local trade name	Traditional name	Scientific name	Times mentioned
Swieti-boontje		Inga spp.	70
Jambolan, Djamoen		Syzygium cumini	61
Mira-udu		Tripilaris weigeltiana	22
Parwa, mangrove		Avicennia germinans	13
Sumaruba		Simarouba amara	5
Fungu		Licania spp.	3
Manja		Mangifera indica L.	3
Gele kabbes		Vatairea guianensis	2
Krapa		Carapa guianensis	2
Babun		Virola spp.	1
Bruinhart		Vouacapoua americana	1
Doifi-siri		Guarea spp.	1
Guave		Psidium guajava	1
Kabbes soorten			1
Knippa		Melicoccus bijugatus	1
Kopi		Goupia glabra	1
Kromoko		Eugenia spp.	1
Pinto-kopi		Laetia procera	1
Pommerak		Syzygium malaccense	1
Sinasappel		Citrus sinensis	1
Wana		Ocotea rubra	1
Various			150

The households in the B cluster districts have mentioned more than 20 timber species that are used as energy wood. Quite a large number said that all timber species can be used as energy wood. Timber species that have often been mentioned are swieti-boontje, djamoen, mira-udu, and parwa. It is remarkable that tree species that are cultivated in agricultural areas were also mentioned as being suitable for energy wood.

Table 24. Timber species used by small scale enterprises

Local trade name	Traditional name	Scientific name	Times mentioned
Fungu (sabana)	Burada (<i>Arow¹</i>), unikiakia (<i>Arow¹</i>),	Licania spp.	20
Swieti-boontje, Blaka swieti-boontje, prokoni	Kaikai (<i>Arow¹</i>),	Inga spp.	14
Parwa, mangrove		Avicennia germinans	13
Gronfolo		Qualea spp.	4
	Kaiakaiadan (<i>Arow¹</i>),		4
Gawetri	Kulishiri	Cupania spp.	5
Wanakwari		Vouchysia tomentosa	4
Sabana-udu			3
Manari-tiki	Weti-udu	Rinorea spp.	3
Dakama		Dimorphandra conjugata	2
Walaba		Eperua falcata	2
Jambolan, Djamoen		Syzygium cumini	1
Kopi		Goupia glabra	1
Busi-guyaba	Kwaku	Marlierea montana	1
Pegreku		Xylopia spp.	1
Kop-kopi, Kapu-weri kopi	Red-wood	Trema micrantha, Casearia arborea	1
Redi-pinya		Vismia spp.	1
Sabana-mangro		Clusia fockeana	1
Tingimoni		Protium spp.	1
Wana		Ocotea rubra	1
Watragrin		Acosmium nitens	1
Zwamp-panta		Tabebuia fluviatilis	1
All hardwood species			2
Various			10

Note:

Arow¹ = Arowak

The entrepreneurs have mentioned more than 22 timber species that are used to carry out their operations. Here as well, the timber species most mentioned is swieti-boontje. Other timber species that have been mentioned are parwa, gronfolo and gawetri. Ten of the small scale enterprises said that all timber species can be used to carry out their operations.



Photo 34. Energy wood for households



Photo 35. Energy wood for small scale enterprises

CHAPTER 8. COOKING/DRYING FACILITIES AND OVENS

Table 25. Cooking facilities used by households

Type of cooking facility	Number	
	A cluster districts	B cluster districts
Chulha	1	377
Iron tripod	123	26
Stone tripod	97	4
Discarded truck wheel hub		3
Iron barrel	1	
Coal pot	2	2
Oven made of 2 stones		4
Oven made of 4 stones		1
Total	224	417

As for the A cluster districts (**Brokopondo, Marowijne, Para and Sipaliwini**), it was clear that most of the surveyed households (55%) use an iron tripod as cooking facility; second comes the stone tripod (43%).

The cooking facility most used (90%) in the B cluster districts (**Commewijne, Coronie, Nickerie, Paramaribo, Saramacca and Wanica**) is the chulha. The iron tripod is used by 6% of these households.



Photo 36. Chulha



Photo 37. Iron tripod

Table 26. Cooking/drying facilities used by small scale enterprises

Sector	Type of facility	Quantity
Fish processing	Self constructed open drying ovens	15
	Closed drying ovens	5
Cassava bread	Iron tripod	21
	Iron oven with four supports	8
	Stone oven with four supports	4
	Self constructed open oven	1
Bakery	Closed oven	2
Cremation	Open-air pyre	2
Electricity	Bio-energy power plant	1

In the fish processing sector 15 entrepreneurs use self-constructed open drying ovens to process fish. The materials with which the ovens are constructed are wood, chicken wire netting and galvanized sheets. The dimensions of the ovens vary: length between 1m and 6m, width between 0.80m and 2m and height between 0.80m and 1m.

We also saw 5 professionally constructed closed drying ovens with smoke exhaust systems, made from bricks and iron. The dimensions of these ovens vary; length between 2m and 3m, width between 1.70m and 2m, height between 2m and 4m.

Most of the cassava bread producers (21) use an iron tripod. Ovens with 4 iron or stone supports are also used. One entrepreneur bakes cassava bread on a self-constructed open oven with the following dimensions; length 1m, width 1m, and height 1m. The breads bakeries use closed ovens with smoke exhaust systems.



Photo 38. Baking cassava bread



Photo 39. Smoking fish



Photo 40. Baking bread

CHAPTER 9. ENERGY CONSUMPTION FOR COOKING

Table 27. Use of energy by the A cluster and the B cluster districts

Type of energy	Number of households	
	A cluster districts	B cluster districts
Wood	79	18
Combination of gas and wood	145	399
Total	224	417

In the A cluster districts 35% of the households use only wood for cooking, while 65% of the households use a combination of gas and wood. In the B cluster districts only 4% use wood for cooking and 96% use a combination of gas and wood. For the whole of Suriname it was found that 15% of the households use only wood and 85% use a combination of gas and wood.



Photo. 41. Cooking in combination with gas and wood

CHAPTER 10. TOTAL ROUNDWOOD PRODUCTION IN SURINAME

Table 28. Total roundwood production 2003-2013 in m³

Year	Industrial roundwood	Energy wood	Total roundwood
2003	155,000	116,500	271,500
2004	159,000	113,100	272,100
2005	181,000	109,800	290,800
2006	193,000	107,200	300,200
2007	166,000	104,600	270,600
2008	197,000	102,000	299,000
2009	207,000	99,500	306,500
2010	246,000	97,100	343,100
2011	366,000	94,700	460,700
2012	436,000	92,400	528,400
2013	394,000	90,200	484,200

In 1980 there were 77,757 households⁶ who used energy wood for cooking. In 2004 there were 19,941 households⁷ who used energy wood for cooking, and in 2012 that number was 15,999⁸. This clearly shows that the number of households using energy wood for the activities mentioned constantly decreases.

In the period of 1980 to 2004 the number of households using energy wood for cooking has decreased by 3% on an average. In the period of 2004 to 2012 the decrease was 2.5% on an average.

It is assumed that commensurate with the decrease in the number of households using energy wood, the consumption volume of energy wood has also decreased.

This survey shows that in 2013 the energy wood consumption was 130,600 m³. About 70% of this wood came from forests and from trees outside the forest. About 30% was industrial waste from inside as well as outside the forest sector. This includes the utilization of wood waste that came from the processing and use of industrial roundwood. So, approx. 90,200 m³ of energy wood was produced, while about 40,400 m³ wood came from industrial processing waste.

Historical data and estimates show the total production of roundwood for the period 2003 to 2013 in table 28. The average total roundwood production per year in the period 2003 to 2008 was 284,000 m³ and the average in the period 2009 to 2013 was 424,000 m³. The total roundwood production in 2013 was about 484,200 m³.

⁶ ABS; Census result 1980

⁷ ABS; Environment Statistics, 6th publication

⁸ ABS; Results of the 8th census, 2012

Wood energy in Suriname

In the period 2003 to 2008 a yearly average of 98,000 m³ of wood waste came from the processing of industrial roundwood and in the period 2009 to 2013 that quantity was 153,000 m³. The wood waste of industrial roundwood processing in 2013 was estimated at 179,000 m³. If all of the consumed indirect and recovered energy wood of 40,400 m³ had come from the wood processing industry alone, the utilization rate of all the waste coming from that industry would have been 23% in that year.



Photo. 42 Cluster A districts stack of energy wood



Photo. 43 Cluster B districts stack of energy wood

CHAPTER 11. BIO-ENERGY POTENTIAL FROM WOOD

Table 29. Wood waste from the wood industry per year

Activity	Roundwood volume in m ³	Wood waste volume in m ³
Roundwood production	400,000	
Waste from logging 50%		400,000
Roundwood input sawmill	300,000	
Waste from sawmill		180,000
Total		580,000

The provisional results from a study conducted in the Kabo area concerning the CELOS Management System (CMS) suggest that it is allowed to cut 25 m³ of roundwood per hectare per year from forests in Suriname, based on a cutting cycle of 25 years, without jeopardizing the natural regeneration. Because a lot of timber species cannot be commercialized for a variety of reasons, the possibility exists to extract an additional 7 – 10 m³ of roundwood per hectare per year from the production forests, which could be used as energy wood.

With an annual coupe/cutting area of 60,000 ha. per year and a cutting volume of 10 m³ of wood per ha., additionally 600,000 m³ of roundwood becomes available.⁹

Measurements have shown that there is a loss of 50% in forest exploitation (SBB; R. Matai dated 2013; provisional results; Study Felling Losses). With a production volume of 400,000 m³ of roundwood per year, about 400,000 m³ of wood becomes available in the form of logging waste. Wood processing in the sawmill industry in Suriname has a loss of 60%. With a processing volume of 300,000 m³ of roundwood per year about 180,000 m³ of wood becomes available as waste.

Taking all these factors into consideration, the estimated bio-energy potential from the forest sector is approx. 1,180,000 m³ on an annual basis.

According to <http://greenecon.net/>, 1 lb of wood generates 1.9 kwh of energy. Thus with a generation efficiency of 70% per lb of wood 1.3 kwh energy is available. For the calculated volume of potential energy wood of 1,180,000 m³, it is estimated that a total of 3.3 billion kwh of energy is available.

With the available wood of 1,180,000 m³, it is basically possible to put 59 power plants into operation, each with a capacity of 1.5 mw of electricity (see Bio-energy power plant Greenheart Group Limited N. V.) This offers the possibility to generate 88.5 mw of electricity from energy wood.

⁹ SBB; Surinamese Forest Sector 2013

Wood energy in Suriname

A technical and financial feasibility study must show whether it is feasible to set up 1 or more energy generating power plants for the production of sustainable bio-energy from wood, taking the Surinamese conditions into consideration.



Photo. 44 Wood waste after felling a tree

CHAPTER 12. ECONOMIC VALUE OF ENERGY WOOD AND ENVIRONMENTAL ASPECTS

Price of energy wood

Table 30. Price of energy wood per m³ in SRD

Price of energy wood per m ³ in SRD		
A cluster districts	B cluster districts	Small scale enterprises
350	500	375
210	200	175
160	175	150
150	160	120
145	140	100
130	100	80
100	90	75
70	85	50
60	80	45
50	65	
	60	
	55	
	50	

Note: SRD = Surinamese dollar

While the data was collected, information was also gathered on the prices of the energy wood, that is if the wood was bought.

In the A cluster districts it was reported that the wood is supplied on order by the energy wood seller. The prices vary enormously, from SRD 50,- to SRD 350,- per m³

In the B cluster districts it was reported that waste wood can be collected free of charge at sawmills, timber markets, furniture factories and construction & building sites, but there is a fee for transport. In cases where a third person is hired to collect the wood a fee must be paid. There are also cases where the wood must be paid for. If the wood is obtained from a energy wood seller, the price is made up of the following components: value of the wood, transport costs and a fee for the seller. Here as well the prices indicated are different and vary from SRD 50.- to SRD 500.-- per m³.

The small scale enterprises that use energy wood have reported prices varying from SRD 45.-- to SRD 375.-- per m³. With an average energy wood price of SRD 100.-- per m³, a turnover of SRD 13 million per year is realized through the production and consumption of energy wood.

Substitution of gas by energy wood

The caloric value of 1 kg dry wood with a moisture content of 20% is 14.40 mega joule¹⁰. The caloric value of 1 kg of propane gas (cooking gas) is 50 mega joule¹¹. This means that 1 kg of propane gas has the same caloric value as 3.5 kg of wood.

One (1) m³ of wood has a weight of about 1 ton and has the same caloric value as about 285 kg of propane gas. The consumption of 130,000 m³ of energy wood will save about 37,000 ton of propane gas. In 2013, 16,600 ton of propane gas was consumed¹² in Suriname. If propane gas had been used to meet the total energy demand from the surveyed households and small scale enterprises, that would have come to 53,600 ton of propane gas in that year.

Taking into consideration the price of SRD 1.80 per lb of propane gas¹³, about SRD 200 million worth of propane gas was saved on a yearly basis by use of energy wood.

Emission of carbon dioxide by the use of energy wood

Every year 130,000 m³ of energy wood is used by households and small scale enterprises to generate energy. By combustion of this energy wood an emission of 213,000 ton of carbon dioxide a year takes place.

Factors that are used for the calculation of the carbon dioxide emission¹⁴:

- Default biomass conversion and expansion factor (BCEF), from humid tropical natural forest = 0.9
- Carbon fraction of aboveground forest biomass, default value for all parts of the tree = 0.47.

¹⁰ ACBIOM; www.biomassstradecentres.eu

¹¹ US National Institute of Standards and Technology (NIST)

¹² ABS; Environment Statistics, 6th publication

¹³ www.nvebs.com/thuis/ogane-gas/gas-aanvrager/

¹⁴ 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Forestry Economic Services/SBB

CHAPTER 13. INDICATORS

Per capita energy consumption:	0.25 m ³
Per capita industrial roundwood consumption:	0.31 m ³
Per capita total roundwood consumption:	0.56 m ³
Number of persons depending on energy wood for cooking:	76,000
Average energy wood consumption per year for households in A cluster districts:	13 m ³
Average energy wood consumption per year for households in B cluster districts:	3 m ³
Highest energy wood consumption districts:	Sipaliwini and Wanica
Source of energy wood from the forest:	56%
Source of energy wood from trees outside the forest:	19%
Source of energy wood from industrial waste:	25%
Direct energy wood:	69%
Indirect energy wood:	26%
Recovered energy wood:	5%
Households who use energy wood for cooking every day:	
- Of all households in Suriname:	0.3 %
- Of households that use energy wood for cooking:	2 %
Important cooking facilities:	Iron tripod and Chulha
Potential of energy wood per year:	1,180,000 m ³
Carbon dioxide emission per year by using energy wood:	213,000 ton CO ₂
Annual savings of gas by the use of energy wood:	SRD 200 million
Turnover per year by the production and use of energy wood:	SRD 13 million

APPENDICES

Appendix 1. Calculation of the average energy wood consumption per household per year for districts with relatively abundant forests.

Class	Number of households	Class middle	Class middle x number of households
<1	16	0.5	8
1 - 5	50	3	150
5 - 10	30	7.5	225
10 - 15	34	12.5	425
15 - 20	40	17.5	700
20 - 25	15	22.5	337.5
25 - 30	15	27.5	412.5
30 - 35	5	32.5	162.5
35 - 40	3	37.5	112.5
>40	16	20	320
Total	224		2,853.00

The average consumption of energy wood per year for districts with abundant forests is $2,853 : 224 = 13 \text{ m}^3$ per household.

Appendix 2. Calculation of the average energy wood consumption per household per year for districts with relatively few forests.

Class	Number of households	Class middle	Class middle x number of households
<1	177	0.5	88.5
1 - 5	178	3	534
5 - 10	54	7.5	405
10 - 15	8	12.5	100
15 - 20		17.5	
20 - 25		22.5	
25 - 30		27.5	
30 - 35		32.5	
35 - 40		37.5	
>40		20	
Total	417		1.127,50

The average consumption of energy wood per year for districts with relatively few forests is $1,127.5 : 417 = 3 \text{ m}^3$ per household.

Appendix 3.



Questionnaire Survey Research into Wood Energy Consumption by Households

A. GENERAL

1. Name:.....
2. Age:.....
3. Sex:.....
4. Occupation:.....
5. Main source of income of the family.....
6. Address:.....
District:.....
Region:.....
Village:.....
Other:.....
7. Number of family members.....

B. ENERGY WOOD CONSUMPTION

1. Cooking.....
 - 1.1 What is the main fuel for cooking?.....
 - 1.2 Do you also use wood for cooking(Yes/No)?.....
If yes:
How often (1. daily, 2. weekly, 3. monthly).....
If daily (how many times).....
 - 1.3 Amount: Per day.....
Per week.....
Per month.....
 - 1.4 Cooking method (technology) used
Open cooking method.....
Open fire.....
Cooking oven.....
Other.....

C. SOURCE OF ENERGY WOOD

1. Do you collect the energy wood yourself or do you buy it?.....
 - 1.1 If collecting:
Where? (Yard/Garden, village, community forest, forest, other)
.....
Do you encounter difficulties while collecting the energy wood? (e.g. not enough wood, access to the forest, transport of the wood, other).....
.....
 - 1.2 If buying:
Where do you buy?.....
.....
What is the unit price?.....

Appendix 4.



Questionnaire Survey Research into Wood Energy Consumption by Small scale enterprises

A. GENERAL

1. Name of company/owner:.....
2. Type of company:.....

3. Address:

- District:.....
Region:.....
Village:.....
Other:.....

B. ENERGY WOOD CONSUMPTION

1. What is the main fuel you use for your activity?.....
1.1 Do you also use wood? (yes/no)

.....
If yes:

- For what process do you use wood?
- How often (1.Daily, 2.Weekly, 3. Monthly).....
- If daily (how many times?).....

- 1.2 Amount: Per day.....
Per week.....
Per month.....

1.3 Method (technology) for using energy wood

- Open cooking method.....
- Open fire.....
- Cooking oven.....
- Other.....

1.4 Number of installations?.....

1.5 Dimensions of the installations?.....

C. ENERGY WOOD SOURCE

1. Energy wood: Do you collect or buy?
.....

1.1 If collecting:

Where do you collect (yard, village, community forest, forest, other)
.....

Do you encounter difficulties while collecting the energy wood? (not enough wood, access to the forest, transport of the wood, other)
.....

1.2 If buying:

Where do you buy?.....

How much do you pay?.....

Appendix 5. Schedule of field research at households

District/Region/ Jurisdiction	Period	Number of surveyed households
Sipaliwini:		
Apoera, Washabo, Section en Sandlanding	17/09/ 2013 – 19/09/2013	16
Witagron	19/09/2013	1
Sipaliwini	14/08/2014 – 15/08/2014	10
Tëpu	22/08/2014	20
Apetina	27/08/2014 – 18/08/2014	27
Langatabbetje	09/09/2014 – 11/09/2014	25
Pokigron	16/09/2014 – 17/09/2014	21
Kajapati	19/12/2014	40
Abenaston	19/12/2014	10
Para:		
Bigi Pioka	18/08/2013	4
Redi Doti	15/06/2013	1
Pikien Saron	30/06/2014	3
Cabenda dorp	30/06/2014	4
Powakka	30/06/2041	3
Baling Sabana	19/09/2014	2
Midjan Kampoe	19/09/2014	3
Brokopondo:		
Stuwmeer	24/06/2014	4
Kadjoe	24/06/2014	3
Nw.Ganzee	25/06/2014	3
Marchalkreek	25/06/2014	4
Centrum Brokopondo	26/06/2014	3
Klaaskreek	26/06/2014	3
Kwakoegegron	11/07/2014	4
Marowijne:		
Morakondre	23/10/2014	1
Kraboe-Olo	23/10/2014	2
Agnes Kamp	23/10/2014	1
Ovia-Olo	23/10/2014	1
Solega Kamp	24/10/2014	1
Adjoema Kondre	24/10/2014	1
Moengo Tapoe	24/10/2014	1
Coronie:		
Totness	29/04/2014	5
Commewijne:		
Nieuw-Amsterdam	28/05/2014	3
Alkmaar	28/05/2014	7
Tamanredjo	29/05/2014	3
De Hulp	29/05/2014	7
Meerzorg	29/05/2014	7
Johanna Margaretha	03/09/2014	7

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Paramaribo:		
Kwatta	23/04/2014	9
Ringweg	23/04/2014	11
Munder	24/04/2014	15
Uitvlugt	24/04/2014	5
Livorno	25/04/2014	28
De Goede Verwachting	28/04/2014	5
Dijkveld	29/04/2014	3
Blauwgrond	30/04/2014	10
Wanica:		
Frederikslustweg	02/05/2014	16
Hannaslustweg	02/05/2014	10
Beekhuizenweg	05/05/2014	1
Welgedacht A en B	05/05/2014 and 15/10/2014	19
Nieuwe Grondweg	05/05/2014	10
Bomapolder	06/05/2014 and 15/10/2014	50
Santodorp	06/05/2014	12
Koewarasan	06/05/2014	15
Houttuin	07/05/2014	8
Dijkveld	07/05/2014	5
Lelydorp	08/05/2014	4
Sophiaslustweg	09/05/2014	5
Leidingen	16/10/2014	48
Nickerie:		
Paradise	24/07/2013	4
Bacovendam	24/07/2013	4
Boonackerpolder	24/07/2013	4
Sawmillkreekpolder	25/07/2013	4
Nieuw-Nickerie	25/07/2013	3
Van Drimmelenpolder	25/07/2013	4
Beatrixweg	26/07/2013	4
Stalweide	26/07/2013	4
Gemaalweg	27/07/2013	4
Clarapolder	27/07/2013	4
Corantijnpolder serie C	27/07/2013	4
Saramacca:		
Jarikaba	17/06/2014	6
Aitnoch	17/06/2014	5
Uitkijk	17/06/2014	5
Groningen	18/06/2014	5
Calcutta	18/06/2014	5
Grankreek	19/06/2014	6
Colombia	19/06/2014	3
Vijfderijweg	20/06/2014	5
Wayamboweg	20/06/2014	6

Appendix 6. Schedule of field research at small scale enterprises

District/Region/Jurisdiction/Sector	Period
Sipaliwini: <u>Cassava bread</u> Apoera Witagron <u>Electricity</u>	17/09/2013 20/09/2013 June 2014
Para: <u>Cassava bread</u> Bigi Poika Matta	18/10/2013 08/02/2013
Coronie: <u>Fish Processing</u>	19/04/2014
Commewijne: <u>Fish Processing</u>	24/03/2013
Nickerie: <u>Fish Processing</u> <u>Cremation</u>	24/07/2013 – 27/07/2013 August 2013
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