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Verbruik van brandhout in de stad Monrovia (Liberia) in 1965

Polttopuun kulutus Monroviassa (Liberia) vuonna 1965

Yrjö Roitto

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FUELWOOD CONSUMPTION IN THE CITY OF MONROVIA (LIBERIA) IN 1965

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YRJÖ ROITTO

HELSINKI 1970

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This paper deals with fuelwood consumption in the city of Monrovia (Liberia) in 1965. Buyers of fuelwood were interviewed at market places, relevant data were recorded and the average size of fuelwood bundles was measured by applying Archimedes Law. Data on annual average consumption of fuelwood per caput and by households were assessed, the average annual per caput expenditure on fuelwood estimated and, by applying the Monrovia data to the whole of Liberia, an attempt was made to arrive at a total figure for fuelwood consumption in the whole country.

1. INTRODUCTION

According to the latest information,[1] the world's fuelwood removals accounted for about 45 per cent of the total wood removals in 1963. In North America, fuelwood removals amounted to less than 10 per cent of the total, whereas in Africa the corresponding figure was 90. The rest of the world lies between these extremes (Yearbook ... pp. 2—3).

The recording of the removals of industrial wood has always been more accurate than that of fuelwood and, therefore, the fuelwood percentages may still be on the low side. However, the above figures are significant enought to show the kind of role fuelwood plays in Africa today.

The following annual per caput figures for fuelwood consumption exist for the different African regions:

	cu.m. (1959/61 average)
Western	0.81
Eastern	1.01
Northern	0.08
Southern	0.14
Total	0.68

(African ... p. 79; for the regional division, please see the map of the study referred to.)

The data below show annual (1959/61 average) fuelwood consumption in selected West African countries:

	Per caput, cu.m.	*Total, mill. cu.m.*
Liberia	1.20	1.55
Sierra Leone	1.17	2.55
Ghana	1.12	7.60
Ivory Coast	1.00	3.23
Nigeria	0.81	28.50
Upper Volta	0.69	2.50
Guinea	0.59	1.80

(African ... p. 100.)

Consequently, fuelwood problems are important in West African forestry. In a regional comparison, per caput consumption of fuelwood is on the high side in Liberia. Although fuelwood questions in Liberia are not as important — or, better to say, the same — as in many European countries where fuelwood competes with small-sized industrial wood, they are worth considering as problems of family budget, forest legislation and so on.

2. PURPOSE OF PAPER

The purpose of this paper is to assess, in Monrovia, in 1965:

(1) Annual per caput consumption of fuelwood (in cu.m.)
(2) Annual consumption of fuelwood by households (of different sizes)
(3) Annual per caput and household (family) expenditures for fuelwood.

The above data make possible an attempt to assess annual fuelwood consumption in the whole of Liberia. Therefore, this too was included in the paper.

Information was also collected on logging and transport of fuelwood as well as on the elasticity of demand. No special emphasis could be put on this part of the work. Where relevant data were obtained, they were included in the paper.

[1] When this was written.

3. METHOD

The most reliable fuelwood consumption data can be obtained by careful measuring at places where wood is used. This method could not, for several reasons, be used in this study; instead, buyers of fuelwood were interviewed at different market places in Monrovia; these places are found all over the city, and fuelwood is sold there in bundles. A record was made of the number of bundles bought by individual buyers; if, after questioning, buyers made it clear that the fuelwood was intended for domestic purposes only (i.e. not for re-sale, food-shops, etc.); the following additional questions were asked: (1) How long (in days) would the purchase last? (2) How many persons belong to the household concerned?

Since it could be assumed that the average size of a fuelwood bundle varied between market places, all data were recorded by market place. Recording was also kept separate by interviewers; changing interviewers from one market place to another made it possible to check the reliability of the interviewers' work, as well as to find out whether the results differed from place to place (owing to the size of the average bundle, species, quality of wood, etc.). For checking purposes, Dr. Nebo's (see Acknowledgements) preliminary results were compared with those obtained from the students' material.

The size of an average fuelwood bundle was assessed by its volume.[1] Owing to the small size of bundles, their solid volume with bark could be measured by applying Archimedes Law. For that purpose, a well-preserved oil drum was acquired, and its dimensions measured. It was so filled with water that bundles could be completely submerged without the water level rising above the top of the drum. The water level in the drum was re-measured before submerging a new bundle.

Bundles were taken at random from two different market places (Appendix I), where the bundles seemed to be of the same size, and the average size was calculated.

The price of fuelwood bundles, which was constant throughout, was converted to a price per cu.m. on the basis of the average size of the fuelwood bundle.

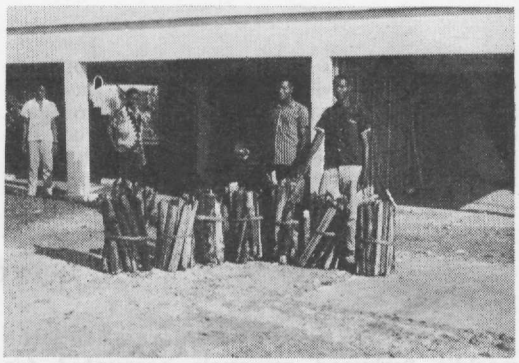

Fig. 2. Typical Monrovian fuelwood bundles.

Kuva 2. Tyypillisiä Monrovian polttopuunippuja.

Fig. 1. Fuelwood is often stored in heaps as shown in the photo and therefore measurement is virtually impossible and even estimating difficult. Photo from Bouaké in the Ivory Coast.

Kuva 1. Polttopuu varastoidaan usein kuvan esittämissä röykkiöissä, jonka vuoksi määrien mittaus — jopa arviointi — on vaikeaa. Valokuva Bouakésta Norsunluurannikolta.

Fig. 3. Measuring devices.

Kuva 3. Mittausvälineet.

[1] Bundles could also have easily been weighed; weight, however, varies by species and season (dry or wet).

4. RESULTS

Table 1. Annual per caput and per household consumption of, and expenditures on, fuelwood in Monrovia in 1965.

Taulukko 1. Vuotuinen henkeä ja talousyksikköä kohti laskettu polttopuun kulutus sekä polttopuumenot Monroviassa v. 1965.

Size of household, no. of persons *Talousyksikön koko, henkilöiden luku*	Annual consumption, cu.m.[1] *Vuotuiskulutus, k-m³* [1]		Annual expenditures, $ *Vuotuismenot, dollaria*	
	Per caput *Henkeä kohti*	Per household *Talousyksikköä kohti*	Per caput *Henkeä kohti*	Per household *Talousyksikköä kohti*
I	1	2	3	4
1[2]	7.4	7.4	55.9	55.9
2	2.8	5.6	21.1	42.3
3	1.9	5.7	14.3	43.0
4	1.5	6.0	11.3	45.3
5[3]	1.3	6.5	9.8	49.1
6	1.1	6.6	8.3	49.8
7	1.0	7.0	7.6	52.9
8	0.95	7.6	7.2	57.4
9	0.85	7.7	6.4	58.1
10 +	0.80	8.0	6.0	60.4

[1] Partly with bark.
[1] *Osaksi kuorineen.*
[2] Data unreliable.
[2] *Tieto epäluotettava.*
[3] Approx. average.
[3] *Likimääräinen keskiarvo.*

41. Fuelwood consumption in Monrovia

Table 1 shows fuelwood consumption per caput and household in Monrovia in 1965. Consumption is expressed as a function of the size of household. Annual expenditures for fuelwood are also shown. For Table 1, data on three similar market places were combined (Benson Street, Clay Street and Sinkor). These data, indicating, for example, the number of observations in each household class, are shown in Appendix II.

The curve in Figure 4 shows annual per caput consumption of fuelwood as a function of the size of household. The figures in Column 1 of Table 1 correspond to this curve and not to the calculated figures in Appendix II (Column 4). It was assumed that the variation (in the calculated averages from the observations by the size of household) was due to errors of various types, not to real reasons. The variation of individual observations (by the size of household) is — in some cases, rather wide, but the averages seem to fit well with the curve drawn by free hand.[1,2,3]

Average annual per caput consumption of fuelwood in Monrovia was found to be 1.3 cu.m. in 1965.[4] This figure refers to a house-

[1] To reduce the subjectiveness in drawing up the curve, two persons made it separately; the results agreed well with each other.

[2] Original field sheets (with individual observations) are filed at the College of Forestry in Monrovia.

[3] The (calculated) figures in Appendix II reveal that the per caput consumption is noticeably higher in the following household classes when compared to the curve drawn: 6, 9, 13, 17 and 20. This may well be due to errors, although there seems to be some pattern in it. The above household size classes are divisable — or nearly — by three. Therefore, one might assume that the size of cooking facilities has an optimum which does not fit with household sizes divisable by three. Since observations concerning large households are few and since this type of interview is not expected to produce more than approximate results, this question is not further considered here.

[4] This 1.3 (1.28) cu.m. per caput is obtained if the sample of 323 observations (corresponding to a total of 1661 people) is used as weights. If the sample of 226 observations (1118 people) is used, 1.2 (1.23) cu.m. results. Since, qualitatively, both samples are equally good as regards the distribution of buyers by household size and since the former is larger, 1.3 cu.m. should be considered as more correct than 1.2.

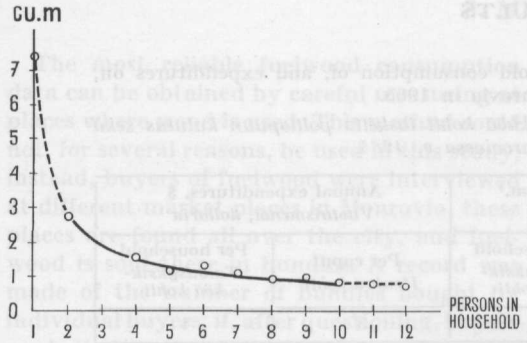

Fig. 4. Annual per caput consumption of fuelwood in Monrovia in 1965 according to the size of household.

Kuva 4. Vuotuinen henkeä kohti laskettu polttopuun kulutus Monroviassa v. 1965 talousyksikön koon mukaan.

hold of 5 persons. It is believed that fuelwood buyers consisted of those persons in whose households wood was always or usually used for cooking. In Monrovia, many possibilities exist for replacing wood by coal or kerosine; electricity is also available but all the facilities required for it may be more expensive than those for coal or kerosine. Some families use both fuelwood and kerosine for cooking. The consumption of fuelwood for business (food shops and the like) was excluded. Therefore, the 1.3 cu.m. is to be considered as a minimum per caput estimate for the families which used fuelwood for domestic purposes (mainly for cooking) in Monrovia in 1965. It is not known how much of the total population in Monrovia used fuelwood (regularly) in 1965.

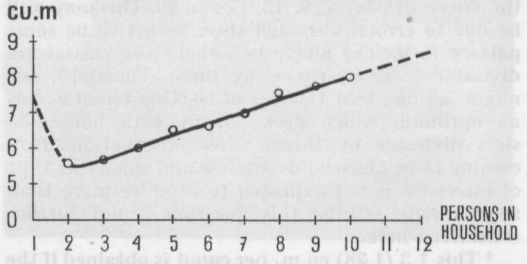

Fig. 5. Annual fuelwood consumption per household in Monrovia in 1965 according to the size of household.

Kuva 5. Vuotuinen talousyksikköä kohti laskettu polttopuun kulutus Monroviassa v. 1965 talousyksikön koon mukaan.

In the FAO statistics, fuelwood appears in solid volume without bark. This makes fuelwood quantities comparable with other roundwood, although bark is also used in the case of fuelwood. Cubic metres here include bark. This does not, however, make much difference between barkless volumes. First, the bark of many tropical woods is thin; second, in splitting, making tight bundles and in other treatment of wood, bark is partly excluded when fuelwood is on sale. Therefore, these figures may well be compared with the barkless ones.

The per caput figure of 1.3 cu.m. corresponds to about 6.5 cu.m. per household per annum.[1]

Not too much emphasis should be put on the consumption figure of a one-person household. It is based only on three observations and it seems to be on the high side. It is difficult to understand why one person alone should use as much fuelwood as households of 7—8 persons. One explanation may be that in a one-person household more meals are cooked daily on an average than in a 7—8 person household; a more lavish use may also occur. Otherwise the figures seem to match, although the consumption by household may become more accurate if taken from the curve (Figure 5) than from the calculated values of Table 1. (See for instance the difference between the household sizes of 8 and 9.)[2]

The price of a bundle on the Monrovia fuelwood market was constant throughout the city (including suburbs), i.e. 25 cents. This makes $ 7.6 per solid cu.m. The average annual per caput expenditure for fuelwood in Monrovia was about $ 9.7 in 1965; the corresponding figure per household was slightly less than $ 50.[3] It is not known what the average family income (and, from it, per caput income) was at this time. The typical wage of the heads of households living in those Monrovia districts where fuelwood use was common was somewhere around $ 50 per month in 1965. If the annual income, calcu-

[1] The rounded figure of 6.5 cu.m. per household (6.58) is from the sample of 323 observations.

[2] For households of 10 or more persons, the annual per caput figure of 0.80 cu.m. was used although the curve (Fig. 4) seems to continue to produce lower values, for instance, in households of 11 and 12 persons. However, observations concerning large households are rather meagre and there are indications that per caput consumption may increase when households are over-sized, i.e. when cooking etc. facilities consist rather of those of two households than of one (Appendix II).

[3] Based on the sample of 323 observations.

Table 2. Distribution of the Liberian population by size of household in 1962 according to the Bureau of Statistics and the same as regards the study sample of fuelwood buyers in Monrovia in 1965.

Taulukko 2. Liberian asukasluvun jakaantuminen talousyksikön koon mukaan (Tilastotoimisto) sekä niiden henkilöiden vastaava jakautuminen, jotka ostivat polttopuuta Monroviassa v. 1965.

Size of household, no. of persons *Talousyksikön koko, henkilöiden luku*	Bureau of Statistics *Tilastotoimisto*		Monrovia fuelwood buyers' sample *Monrovian polttopuun ostajat (näyte)*		
	Persons, 1000 *1000 henkilöä*	Per cent *Prosenttia*	Persons *Henkilöitä*		Per cent *Prosenttia*
			Interviewed *Haastatellut*	Corresponding total *Vastaava kokonaisluku*	
I	1	2	3	4	5
1	30	3	9	9	1
2	84	9	28	56	3
3	161	16	60	180	11
4	98	10	55	220	13
5	134	14	49	245	15
6	113	12	46	276	16
7	91	9	25	175	11
8	72	7	19	152	9
9	54	5	11	99	6
10 +	145	15	21	249	15
Total *Yhteensä*	982	100	323	1 661	100

lated on this basis, is divided by 5, it brings per caput income to somewhere around $ 120.[1] If this is correct, about 8 per cent of the annual income was spent on fuelwood. This is — on a world-wide scale — a high figure, especially when one remembers that no heating is needed in Monrovia.

42. Attempt to assess fuelwood consumption in Liberia (the minimum national estimate)

Table 2 also shows the population of Liberia according to the latest [2] information from the Liberian Bureau of Statistics. It totalled 982 thousand in 1962. According to the US Army Handbook for Liberia, the population at the same time was slightly bigger, i.e. 999 thousand persons. These figures agree well with each other and are far below the estimates published in various official and semi-official papers, according to which the population of Liberia was 2—3 million. In this paper, a figure of 982 thousand inhabitants in 1962 is used.

Distribution by the size of household (from the Liberian Bureau of Statistics) does not appear very logical since it is hard to find an explanation for the two-peak distribution (see Figure 6). The study sample of 323 observations (1661 persons), consisting of those fuelwood buyers in Monrovia whose answers were accepted as material for the study, gives a more logical distribution with one peak coinciding with the household of 6 persons. The other difference between the distribution curves is that the study sample gives a higher figure for the average household size than the distribution of the total population. This, however, may be quite correct, the result of an apparent influx of people from the interior into Monrovia where more job and schooling opportunities exist. Household does not correspond to the definition of family. It should not be assumed, of course, that fuelwood buyers in Monrovia are representative of the distribution by size of household in the country as a whole. Fuelwood buyers from bigger households may appear more often at market places than those from smaller ones, but even this may not be correct, since the former usually buy more at a time than the latter.

To attempt to assess the annual minimum total fuelwood consumption estimate for the whole of Liberia in 1965, one may assume

[1] As to the early 1960 conditions, the following quotation may be made: »Probably not more than 10 per cent of the population earned regular wages or salaries; of these some three-quarters were unskilled, illiterate workers whose average annual income was about $ 150 . . .» (US Army . . . p. 98—99).

[2] When this was written.

Table 3. Assumed[1] population using fuelwood, and its distribution by size of household, in Liberia and the (minimum) estimate for the total consumption of fuelwood in 1965.

Taulukko 3. Liberian oletettu[1] polttopuuta käyttävä väestö ja sen jakautuminen talousyksikön koon mukaan sekä (vähimmäis)arvio polttopuun kokonaiskäytöstä 1965.

Size of household, no. of persons *Talousyksikön koko, henkilöiden luku*	Persons, 1000 *1000 henkilöä*	Annual consumption *Vuotuiskulutus*	
		Per caput, cu.m. *Henkeä kohti, k-m³*	Total, 1000 cu.m. *Yhteensä, 1000 k-m³*
I	1	2	3
1	32	7.4	237
2	89	2.8	249
3	171	1.9	325
4	104	1.5	156
5	142	1.3	185
6	120	1.1	132
7	96	1.0	96
8	76	0.95	72
9	57	0.85	48
10 +	154	0.80	123
Total or average *Yhteensä tai keskiarvo*	1 041	1.56	1 623

[1] Assumed that total population in 1965 was 6 % larger than in 1962. In this assumption, an allowance has been made to that part of population (mainly in Monrovia) which uses fuels other than wood. Distribution by household was assumed to be the same in 1962 and 1965.

[1] *Oletettu, että koko asukasluku v. 1965 oli 6 % suurempi kuin v. 1962. Näin tehtäessä on otettu huomioon se väestönosa (etupäässä Monroviassa), joka käytti muuta polttoainetta kuin puuta. Jakautuminen talousyksikköihin oletettu samaksi vv. 1962 ja 1965.*

that the average annual per caput fuelwood consumption, as a function of the size of household, follows the pattern of the fuelwood users in Monrovia. The population increase from 1962 to 1965 minus that part of the total population not using fuelwood had to be estimated. In principle, the inclusion of the business use of fuelwood should also be taken into account. These latter factors were covered by increasing the 1962 Liberian population by 6 per cent until 1965, and by keeping the total population distribution by household classes for 1965 the same as in 1962. These assumptions may leave room for criticism but in the absence of relevant information they may also be defended.

Table 3 shows that, according to the above assumptions, total annual consumption of fuelwood was 1.62 mill. cu.m.[1] in Liberia in 1965. It gives an annual per caput figure of some 1.6 cu.m.[2]

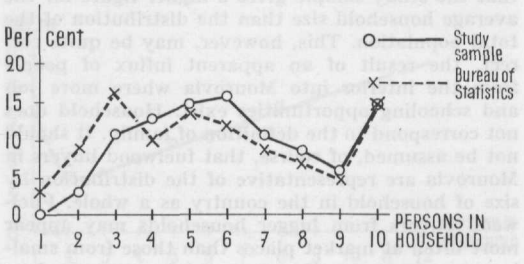

Fig. 6. Distribution of the Liberian population by household size in 1962 (Bureau of Statistics) and that of persons corresponding the sample of fuelwood buyers in Monrovia in 1965.

Kuva 6. Liberian asukasluvun jakaantuminen talousyksikön koon mukaan (Tilastotoimisto) sekä niiden henkilöiden vastaava jakautuminen, jotka ostivat polttopuuta Monroviassa v. 1965.

[1] Partly with bark.

[2] The difference between this 1.6 (1.56) cu.m. and that obtained from the (Monrovian) sample, i.e. 1.3 (1.28) cu.m. is entirely due to different population distribution. Since the total distribution gives a smaller average for the household size, it also produces a higher per caput consumption figure.

The latest FAO fuelwood removal figure for Liberia, an unofficial one, refers to 1962 and shows a total of 1.57 mill. cu.m. without bark. If the 1.6 mill. cu.m. obtained here is reduced (mainly because of the difference in population) by 6 per cent, the result is about 1.53 mill. cu.m. These figures (1.62 mill. cu.m. partly with bark and 1.57 mill. and 1.53 mill. cu.m. without bark) match each other well.

However, it cannot be assumed — to get a realistic estimate for the country — that the per caput consumption of fuelwood in the whole country follows the pattern of fuelwood users in the capital. More is definitely used outside the capital. There are several reasons for this:

(1) Fuelwood in Monrovia is relatively expensive whereas it is free, except for the effort, in many other parts of the country. Trees grow everywhere and there are immemorial usage rights for fuelwood.
(2) Availabilities of substitutes for fuelwood are less outside Monrovia; the price for them is higher (imported through Monrovia) and the rural population is more bound to follow traditional habits than the citizens of Monrovia.
(3) The climate, especially at night, is colder in inland regions than in the coastal zone, and wood may therefore be needed outside Monrovia for heating, especially at high altitudes.

All these differences lead to a higher per caput consumption of wood as fuel; they may also lead to a lavish use. It is unfortunate that no investigations could be made on the rural use of wood for fuel in the context of this study. The estimates, indicating an excess in per caput use over the Monrovia average, vary from 100 to 300 per cent.[1] The corresponding totals would then exceed the FAO total fuelwood removal estimate by 100—300 per cent. It is impossible — without studies — to say where the most realistic total should lie, closer to, say, 3.2 mill. or to 6.5 mill. cu.m. The only thing about which one can be sure (on the basis of the above attempt) is that the national FAO estimate can only be considered a minimum one; the same is true for the latest estimates on per caput use of fuelwood in Liberia, published in the African Timber Trends and Prospects Study.

[1] Dean Benson: 300 per cent. Mr. Witherow, USAID Forestry Adviser to the Bureau of Forest and Wildlife Conservation: 200—300 per cent. Mr. Ghaus, FAO Forestry Expert and an Associate Professor of Forest Management at the College of Forestry: 100 per cent.

43. Related Aspects

Some fuelwood buyers were asked how much more or less fuelwood they would buy if the price was decreased or increased from the constant figure of 25 cents per bundle. Most answers indicated that the amounts purchased would have remained unchanged. This means that (1) nearly or all the amounts needed were bought; (2) substitution did not play any important role among fuelwood users, which supports the assumption made earlier, i.e. (3) that the people being questioned were more or less exclusive fuelwood users. Among those interviewed, fuelwood was a necessity, demand for which is very inelastic. In exceptional cases, it was said, a decrease in fuelwood price could have allowed one to cook two meals per day instead of one.

Interviews with fuelwood sellers as well as observations showed that most fuelwood consisted of *Hevea brasiliensis* made into fuelwood on the Firestone Rubber Plantation, about 30 to 40 miles from Monrovia. The Firestone Company allows one to take the cut stems. Only one condition for obtaining the wood is made: that new plants are not damaged. The input or cost items for fuelwood to be sold at the Monrovia market consist, then, of cross-cutting, splitting, making bundles and transporting them to Monrovia. It was not investigated, in this context, how the whole chain of this process functions and whether the fuelwood makers on the spot are associated with the sellers at the Monrovia markets.[1] What does become more or less clear, however, is that the high fuelwood price in Monrovia results from the substantial profit to the seller and from inefficient logging methods and overall organization.

[1] According to information received from Mr. Nebo (January 1966), there are three common practices:

(1) The Firestone workers cross-cut the stems, split the wood, bundle it and hire transport to Monrovia where they sell it at 25 cents per bundle.
(2) They sell the bundles at the road side for 15 cents per bundle.
(3) They also transport the bundles themselves to Monrovia.

The difference between the Monrovia market price and that alongside the road on the Firestone Plantation is, consequently, 10 cents per bundle. An estimate based on whole truck transports gives a transport fee of some 7.5—10.0 cents per bundle.

The Firestone Company, which cannot use more than a small proportion of the stems cut annually, is — in a way — excluded from fuelwood business because the Liberian laws do not allow expatriates to run commercial transport business. It is understandable that Firestone is not interested in promoting any organized fuelwood marketing under these conditions. This is a pity since by rationalization fuelwood prices could be greatly lowered in Monrovia.

It has been suggested [2] that fuelwood plantations could be established near densily populated areas on the coastal savannah. This would not help the situation since there are enough fuelwood-quality stands already there and new plantations would only introduce a new cost item, i.e. production costs of growing fuelwood. Under the present system the latter are nil; it is assumed that the difference in the distance to the market would not compensate the new cost item. In addition, it is questionable whether fuelwood plantations should be established close to any capitals where more and more people are turning to the use of modern fuels.

[2] van Dillewijn (1963 p. 46).

5. CONCLUSIONS

(1) The annual average per caput consumption of fuelwood (among the users of wood for fuel) was about 1.3 solid cu.m. (with partial bark) in Monrovia in 1965. It was 2.8 cu.m. in a household of two persons and 0.80 cu.m. in a household of 10 persons or more. (Table 1.)

(2) The average annual consumption of fuelwood by households amounted to 6.5 — 6.6 cu.m. (the same place and time as above) and varied from 5.6 cu.m. (2 persons in household) to 8.0 cu.m. (10 or more persons).

(3) The average annual per caput expenditure on fuelwood in 1965 in Monrovia was $ 9.7; this corresponds to a household of about 5 persons and means a household (family) expenditure of slightly less than $ 50 per annum.

By applying the Monrovia data to the whole of Liberia and by making some assumptions on the population increase and other relevant factors, an annual figure of 1.62 mill. cu.m. was obtained in 1965. This fits well with the latest [1] FAO data but cannot be considered as anything but a minimum estimate. The real total may be more than 100 per cent higher and suggests the need for further studies.

It is also likely that the high fuelwood price in Monrovia results from high profits and inefficiency in fuelwood logging and in overall organization. Since fuelwood seems to be a necessity (with inelastic demand) for those using wood for cooking in Monrovia, it would be desirable — at least from a social point of view — to take some measures to control the situation.

[1] When this was written.

Acknowledgments: This paper is an outcome of the students' training program in Forest Economics at the College of Forestry of the University of Liberia during 1965; from August 1964 until November 1965, the writer of this report was responsible for the teaching of, and research in, Forest Economics in this College.

This paper serves as a contribution to the established research program of the said College under the FAO/UNSF Forestry Project in Liberia (General Plan of Work, 4.2: ix — xii).

Work for this paper started as a counterpart training program under which Dr. Godfrey W. Nebo made preliminary interviews at market places. The work continued under the students' training program and the Senior Class 1965 performed the main interviewing.

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I wish to thank Dr. Nebo, the 1965 Senior students in Forestry, and — last but not

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SAMENVATTING:
VERBRUIK VAN BRANDHOUT IN DE STAD MONROVIA, (LIBERIA) IN 1965.

Voor deze studie, die gemaakt werd in het kader van de training van counterpart en studenten (werkcolleges in Boshuishoudkunde) werd een interviewmethode toegepast.

De resultaten kunnen in het kort als volgt worden samengevat:

(1) Het gemiddelde jaarlijkse verbruik aan brandhout per hoofd van de bevolking (onder de verbruikers van hout als brandstof) was ongeveer 1,3 m³ (gedeeltelijk met schors) te Monrovia in 1965. Het gebruik per hoofd varieert aanzienlijk met de grootte van het huishouden. (Tabel 1, Figuur 4.)

(2) Het gemiddelde jaarlijkse verbruik van brandhout per huishouden was 6,5 tot 6,6 m³ (plaats in tijd als boven).

(3) De gemiddelde uitgaven per hoofd per jaar voor brandhout te Monrovia in 1965 bedroegen ongeveer f. 35, en per huishouden iets minder dan f. 180. Vergeleken met de (onbetrouwbare) gegevens met betrekking tot inkomen wordt relatief veel uitgegeven aan hout voor brandstof.

Als de cijfers voor het verbruik per hoofd van de bevolking voor Monrovia toegepast worden voor het gehele land, wordt een getal van 1,62 miljoen m³ verkregen. Dit komt goed overeen met de laatste schatting van FAO, maar kan als niets anders worden beschouwd dan als een minimum schatting, aangezien — om verschillende redenen — het verbruik van brandhout per hoofd buiten Monrovia bepaaldelijk veel groter is.

LYHENNELMÄ:
POLTTOPUUN KULUTUS MONROVIASSA (LIBERIA) VUONNA 1965.

Tutkimus suoritettiin UNSF/FAO:n metsäprojektin puitteissa, jolloin yhtenä tarkoituksena oli sekä 'counterpart training' että ylioppilaiden seminaarityöt metsätaloustieteessä. Menetelmä oli polttopuun ostajien haastattelu markkinapaikoilla:

Tulokset olivat seuraavat:

(1) Keskimääräinen vuotuinen henkeä kohti laskettu polttopuun kulutus (niissä talouksissa, jotka käyttivät polttopuuta yksinomaisena tai lähes yksinomaisena polttoaineena) oli noin 1.3 k-m³ (osittain kuorellisena). Polttopuun henkeä kohti laskettu kulutus vaihteli suuresti talousyksikön koosta riippuen (taulukko 1, kuva 4).

(2) Talousyksikköä kohti laskettu vuotuinen polttopuun käyttö oli 6.5—6.6 k-m³ (aika ja paikka kuten yllä).

(3) Henkeä kohti laskettu vuotuismeno oli noin 31 mk[1] ja talousyksikköä kohti noin 125 mk.[1] Epäluotettavien tietojen perusteella polttopuumenot tekivät noin 8 % vuotuismenoista.

Soveltamalla Monrovian näytteen perusteella saatuja lukuja Liberiaan saatiin kokonaiskulutukseksi 1.62 milj. k-m³ vuodessa (1965). Tämä arvio käy hyvin yhteen viimeisimmän FAO:n arvion kanssa, mutta sitä voidaan pitää ainoastaan minimiarviona, koska — monista syistä — polttopuun kulutus Monrovian ulkopuolella on paljon suurempi. Liberialaisten tai kauan maassa olleiden asiantuntijoiden mukaan kulutus henkeä kohti voi olla maaseudulla 100 — 300 % suurempi kuin Monroviassa.

[1] *Laskettu ennen markan devalvointia (1967) edeltäneen vaihtokurssin mukaisesti.*

APPENDICES

Appendix I. Determining the average solid volume of fuelwood bundles, cu.m. without bark.

Liite I. Polttopuunippujen keskisisällön (k-m³, ilman kuorta) määrittäminen.

The water level (original 60 cm.) in a drum 57 cm. in diameter was the following when the bundles were placed in water:

Sample group 1, Sinkor market

Bundle	No.	cm.
	1	73.0
	2	75.5
	3	73.3
	4	73.0
	x̄	73.7

Sample group 2, Clay Street market

Bundle	No.	cm.
	1	76.5
	2	65.5
	3	74.5
	x̄	72.2

Sample group 1

$$3.14 \times \left(\frac{57}{2}\right)^2 \times 13.7 \times 10^{-6}\text{m}^3 = 0.034541 \text{ m}^3$$

Sample group 2

$$3.14 \times \left(\frac{57}{2}\right)^2 \times 12.2 \times 10^{-6}\text{m}^3 = 0.031115 \text{ m}^3$$

Applied weighted average: 0.033 cu.m.

Appendix II. The combined material[1] from the fuelwood market places on Clay Street, Benson Street and at Sinkor.

Liite II. Yhdistetty aineisto[1] Clay- ja Benson-katujen sekä Sinkorin polttopuun markkinointipaikoista.

Size of household, no. of persons *Talousyksikön koko, henkilöiden luku*	Number of observations (persons) *Havaintojen luku (henkilöitä)*	Consumption of fuelwood — *Polttopuun kulutus*			
		Daily total, bundles *Yhteensä päivässä, nippuja*	Daily average per caput, bundles *Keskimäärin päivässä henkeä kohti, nippuja*	Annual average, per caput, cu.m. *Keskimäärin vuodessa henkeä kohti, k-m³*	Levelled values (Column 4) according to Fig 4. *Tasoitetut arvot (sarake 4) kuvan 4 mukaan*
I	1	2	3	4	5
1	3	1.8333	0.6111	7.38	7.4
2	20	4.5585	0.2279	2.75	2.8
3	42	6.3057	0.1501	1.81	1.9
4	45	5.8463	0.1299	1.57	1.5
5	37	3.7304	0.1008	1.22	1.3
6	27	2.9761	0.1102	1.33	1.1
7	17	1.6041	0.0944	1.14	1.0
8	10	0.7938	0.0794	0.96	0.95
9	8	0.7024	0.0878	1.06	0.85
10	6	0.4142	0.0690	0.83	0.80
11	3	0.2121	0.0707	0.85	.
12	4	0.2560	0.0640	0.77	.
13	1	0.0769	0.0769	0.93	.
14	1	0.0476	0.0476	0.58	.
...	...	...	...	...	.
17	1	0.1176	0.1176	1.42	.
...	...	...	...	...	.
20	1	0.0750	0.0750	0.91	.

[1] Used for converting the consumption in bundles to that in cubic metres.

[1] *Käytetty muuntamiseen kulutuksesta nippuina kulutukseen kuutiometreinä.*

Appendix III. The distribution of the sample population of table 2 by household size in classes 10 and more persons.

Liite III. Taulukon 2 (näyte) aineiston jakautuminen talousyksikköihin luokissa, joissa on 10 henkilöä tai enemmän.

Size of household, no. of persons *Talousyksikön koko, henkilöiden luku*	Number of observations (persons) *Havaintojen luku (henkilöitä)*
I	1
10	6
11	7
12	4
13	1
14	1
...	...
17	1
...	...
20	1

Appendix I. Determining the average solid volume of fuelwood bundles, cu.m. without bark.

Liite I. Polttopuunippujen keskisuuruuden (kiintokuutiometriä ilman kuorta) määrittäminen.

The water level (original 60 cm.) in a drum 57 cm. in diameter was the following when the bundles were placed in water:

Sample group 1, Sinkor market

Bundle No.	cm.
1	73.9
2	75.5
3	73.3
4	73.0
$\bar{x}$	73.7

Sample group 2, Clay Street market

Bundle No.	cm.
1	76.5
2	65.5
3	74.2
$\bar{x}$	72.2

Sample group 1

$$3.14 \times \left(\frac{57}{2}\right)^2 \times 13.7 \times 10^{-6} m^3 = 0.034941\ m^3$$

Sample group 2

$$3.14 \times \left(\frac{57}{2}\right)^2 \times 12.2 \times 10^{-6} m^3 = 0.031116\ m^3$$

Applied weighted average, 0.033 cu.m.

Appendix II. The combined material[1] from the fuelwood market places on Clay Street, Benson Street and at Sinkor.

Liite II. Yhdistetty aineisto[1] Clay- ja Benson-katujen sekä Sinkorin polttopuun markkinointipaikoista.

Size of household, no. of persons *Taloudyksikön koko, henkilöiden luku*	Number of observations (persons) *Havaintojen luku (henkilöitä)*	Consumption of fuelwood — *Polttopuun kulutus*: Daily total, bundles *Yhteensä päivässä, nippuja*	Daily average per capita, bundles *Keskimäärin päivässä henkeä kohti, nippuja*	Annual average, per capita, cu.m. *Keskimäärin vuodessa henkeä kohti, k-m³*	Levelled values (Column 4) according to Fig 1. *Tasoitetut arvot (sarake 4) kuvan 1 mukaan*
1	1	2	3	4	5
1	3	1.8333	0.6111	7.38	7.4
2	20	4.5585	0.2279	2.75	2.8
3	42	6.3057	0.1501	1.81	1.9
4	45	5.8463	0.1299	1.57	1.5
5	37	3.7304	0.1008	1.22	1.3
6	27	2.9761	0.1102	1.33	1.1
7	17	1.6047	0.0944	1.14	1.0
8	10	0.7939	0.0794	0.96	0.95
9	8	0.7024	0.0878	1.06	0.85
10	6	0.4142	0.0690	0.83	0.80
11	3	0.2121	0.0707	0.85	
12	4	0.2560	0.0640	0.77	
13	1	0.0769	0.0769	0.93	
14	1	0.0476	0.0476	0.58	
...	...	...	...	...	
17	1	0.1176	0.1176	1.42	
...	...	...	...	...	
20	1	0.0750	0.0750	0.91	

[1] Used for converting the consumption in bundles to that in cubic metres.

[1] *Käytetty nuntamiseen kulutuksesta nippuina kulutukseen kuutiometreinä.*

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