



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

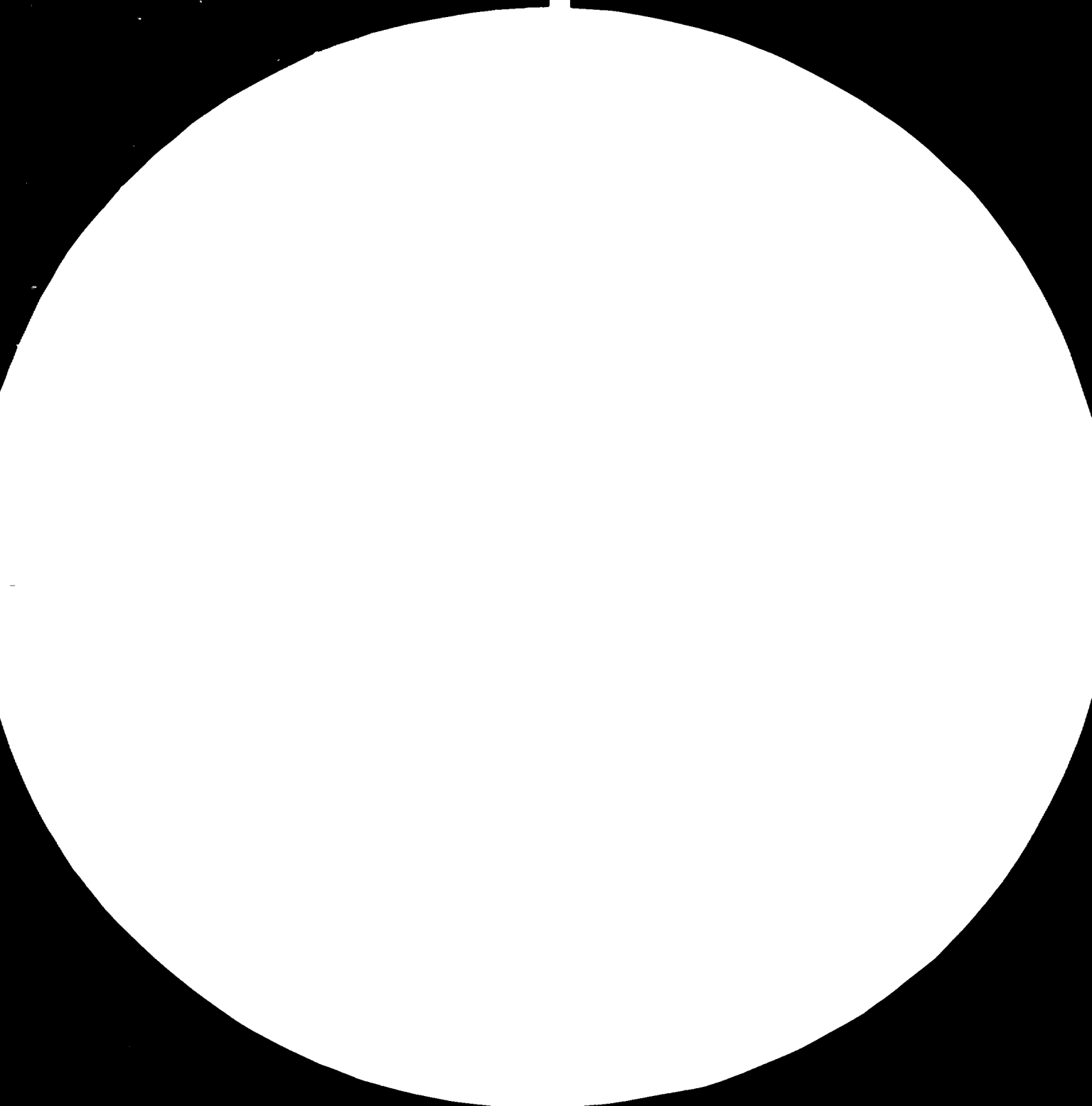
FAIR USE POLICY

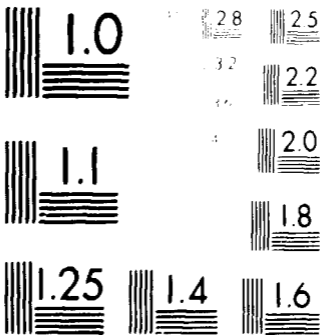
Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org





Microcopy Resolution Test Chart
 (ANSI #1) 100% Contrast

09646

RESTRICTED

DP/ID/SER.B/231
15 May 1980
English

POSSIBILITIES OF STARTING A PULP AND PAPER INDUSTRY
USING LOCALLY AVAILABLE FIBROUS RAW MATERIALS .

SI/SIL/79/802 .

SIERRA LEONE .

Terminal report*

Prepared for the Government of Sierra Leone
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Henryk Szoka, senior consulting engineer

United Nations Industrial Development Organization
Vienna

* This document has been reproduced without formal editing.

TABLE OF CONTENTS

| | <u>Page</u> |
|--|-------------|
| 1. Table of Contents | 2 |
| 2. Summary | 4 |
| 3. Introduction | 6 |
| 3.1. Project background | 6 |
| 3.2. Summary outline of official arrangements | 6 |
| 3.3. Objectives of the project | 6 |
| 3.4. Main activities of the project | 7 |
| 4. Findings | 8 |
| 4.1. Local demand for paper | 8 |
| 4.1.1. Per capita consumption of paper | 8 |
| 4.1.2. Paper consumption trends | 8 |
| 4.1.3. Major consumers of cultural papers | 8 |
| 4.1.4. Paperboard and Major consumers of packaging paper | 8 |
| 4.2. Fibrous raw materials | 11 |
| 4.2.1. Wood | 11 |
| 4.2.2. Mangrove | 13 |
| 4.2.3. Bagasse | 13 |
| 4.2.4. Waste paper | 13 |
| 4.2.5. Rice straw | 14 |
| 4.3. Other raw materials | 15 |
| 4.4. Utilities, manpower, land | 15 |
| 4.4.1. Power | 15 |
| 4.4.2. Water | 17 |
| 4.4.3. Fuel | 17 |
| 4.4.4. Manpower | 18 |
| 4.4.5. Construction and repair facilities | 18 |
| 4.4.6. Land | 18 |
| 4.5. Conclusions | 19 |
| 4.5.1. Market for paper | 19 |
| 4.5.2. Fibrous raw material | 19 |
| 4.5.3. Production capacity | 19 |

| | <u>Page</u> |
|---|-------------|
| 4.5.4. Production programme | 20 |
| 4.5.5. Preliminary lay-out of the plant | 20 |
| 4.5.6. Preliminary estimate of investment and production costs | 23 |
| 4.5.7. Site selection | 24 |
| 5. Recommendations | 25 |
| 6. Appendices | |
| 6.1. Job description | 27 |
| 6.2. Project counterpart, duration of assignment | 29 |
| 6.3. List of persons contacted | 30 |
| 6.4. Imports of paper, paperboard and paper products 1975 - 1978. Quantity. | 32 |
| 6.5. Imports of paper, paperboard and paper products 1975 - 1978. Value | 33 |
| 6.6. Imports of paper, paperboard and paper products 1973. Quantity and value. | 34 |
| 6.7. Number of students attending schools | 35 |
| 6.8. Population estimates | 35 |
| 6.9. Printing and publishing enterprises in Sierra Leone | 36 |
| 6.10. Major forest reserves | 37 |
| 6.11. Information on <i>Gmelina arborea</i> | 38 |
| 6.12. Major rice cultivation areas | 39 |
| 6.13. Annual production of rice 1975 - 1979 | 40 |
| 6.14. Production of rice by districts | 41 |
| 6.15. Map of Western Area (Freetown Peninsula). | 42 |
| 6.16. Estimate of manpower for the proposed pulp and paper mill | 43 |
| 6.17. Illustrative projection of financial operating results - CASE 1. | 44 |
| 6.18. Illustrative projection of financial operating results - CASE 2. | 45 |
| 7. Bibliography | 46 |
| 8. Explanatory notes | 48 |

2. SUMMARY

The present imports of paper amount to 2,000 - 2,300 tons per year and the total value of imported paper is approximately 4 million Leones per year (1 US \$ = 1.05 Le). The per capita consumption is 0.55 kg/year, but it is likely to grow rapidly if there is local production of paper. The production of paper will have positive impact in respect of the education plans and also on country's economy reducing imports and creating new jobs and new source of revenue.

The only available fibrous raw material is rice straw estimated at 900,000 to 1 million tons per year.

An integrated pulp and paper mill is suggested with a capacity of 20 tons per day (6,000 tons/year) of writing, printing and wrapping paper. The mill shall be equipped with a multi-purpose paper machine capable to change the paper grades produced in accordance with market requirements. The rice straw pulp will constitute 80 % of the furnish composition of these papers.

If growing market enables in future an expansion of the proposed mill, the first production line will continue with the production of writing and printing paper grades only and the new production line of approximately the same capacity shall manufacture wrapping paper and packaging board.

Total investment cost is roughly estimated at Le9 million, of which Le 6 million is the cost of machinery, Le 2.5 million - the cost of land and buildings, Le 0.5 million - working capital.

Illustrative projection of financial operating results shows net profit of Le834.500, i.e. 19.8% of sales or 9.24% of investment. The break-even point is at 10 tons/day production, however, even with this production capacity the mill can operate with profit, if the investment cost is lower, i.e. if reconditioned second-hand machines are purchased.

A follow-up feasibility study is recommended comprising evaluation of bids from machinery suppliers, preliminary design of the factory and detailed cost estimate.

Further UNIDO assistance will be required in procurement of consultancy services and in purchases of equipment.

3. INTRODUCTION

3.1. Project background

Free education at certain levels introduced by the Government of Sierra Leone can only be effective if there is a continuous supply of paper. Since there is no paper mill in the country all paper, paperboard and paper products have to be imported. These articles, however, are not always forthcoming, because of the current international economic crisis and the limitations of foreign exchange in Sierra Leone.

The above conditions led to the conclusion that a possibility of having a paper mill should be taken into consideration. As a result of this conclusion, during the UNIDO Industrial Board Meeting held in Vienna in March/April 1979, the Sierra Leone delegation had discussions with the members of the Industrial Operations Division of UNIDO concerning the feasibility of establishing a pulp and paper mill in Sierra Leone using rice straw as the major input.

Formal request from the Ministry of Development and Economic Planning for assistance to study the possibility of establishing a pulp and paper mill in Sierra Leone was channeled to UNIDO via the UNDP office in Freetown on 10 August 1979. At the request of the Permanent Representative of Sierra Leone to UNIDO, Mr. B.M. Conteh, an informal discussion took place in Vienna on 23 August 1979, between Mr. Sama S. Banya, Minister of Development and Economic Planning, Mr. B.M. Conteh, Permanent Representative and officials from the Industrial Operations Division, UNIDO. One of the projects discussed was an exploratory mission to assess the possibility of starting a pulp and paper industry. The Minister indicated that he attached great importance to the early implementation of this project.

3.2. Summary outline of official arrangements

The project document of 14 September 1979 was accepted by the Government on 6 November 1979. The nomination of the expert was accepted by the Government on 31 December 1979.

Total UNIDO contribution was US \$ 13,500 (3 m/m expert, etc.)

The duty station was the Ministry of Trade and Industry, Freetown, Sierra Leone. The Project started on 11 February 1980 and was completed on 10 May 1980.

3.3. Objectives of the Project.

Immediate objective of the project was to examine conditions under which a first pulp and paper mill could be operated in Sierra Leone. The long term objective was to study the feasibility of starting a pulp and paper industry in Sierra Leone and its importance to the development strategy of the country.

The production of writing and printing paper had a remarkable significance in respect of the education plans.

The production of packaging paper and board will boost the local industry enabling better packaging of manufactured products. As a whole the production of paper will have a positive impact on country's economy reducing imports and enabling export of paper to neighbouring countries, creating new jobs and a new source of revenue.

3. 4. Main activities of the project.

The writer was attached to the Ministry of Trade and Industry. In co-operation with his counter-part, Mr. Sama S. Banya, Assistant Small Industries Officer, he has summarised the data concerning the country's demand for paper and established the availability of raw materials and utilities. This has been the base for proposals in respect of the recommended mill's capacity and for selection of the site for the location of the mill. A brief, preliminary investment and production cost estimate is also included thus enabling to assess the break-even point and the economical viability of the project. Findings arising from these activities are detailed in section 4. Full list of persons contacted is given in the Appendix No.3 (ref.6.3.)

The writer would like to express his particular appreciation of the excellent co-operation with his counter-part, Mr. Sama S. Banya from the Ministry of Trade and Industry. He is also greatly indebted to the Office of the United Nations Resident Representative in Freetown, to Mr. Ivan F. Contreras, Senior Industrial Development Field Adviser UNDP/UNIDO and to Mr. S. Shafiqat Ali, Team Leader of the UNDP/UNIDO Project on Industrial Development Programming and Project Elaboration, for their ready collaboration and for much helpful assistance received, which facilitated the task of his mission.

4. FINDINGS.

4.1. Local demand for paper

4.1.1. Per capita consumption of paper

The imports of paper, paperboard and paper products are approximately 2,200 - 2,300 tons per year (ref. 6.4. and 6.6.) Total import figures are almost stable, showing even a slight decline in 1976 and 1977. The latter was, however, most likely due to the rising prices of paper. Therefore the total value of imported paper, paperboard and paper products is also rising and currently it can be estimated at 4 million Leones per year (ref. 6.5. and 6.6.).

Thus with no local production of paper and with imports hampered by the limitations of foreign exchange the present per capita consumption is very low: 0.55 kg/year.

The population in 1980 is actually estimated at about 4 million exceeding considerably the population estimates of the National Development plan (ref. 6.8., 7.1 and 7.2.)

4.1.2. Paper consumption trends.

Two major groups dominate the pattern of the paper consumption (ref. 6.4., 6.5. and 6.6.):

Approximately 50% of total imports of paper are packaging materials like corrugated board packing containers and wrapping papers.

25 to 30% are cultural papers: printing and writing papers, ruled or squared paper, exercise books, news print etc.

The rest are specialty papers imported in small quantities.

4.1.3. Major consumers of cultural papers.

4.1.3.1. Education.

Per capita paper consumption for educational purposes can be roughly estimated as 2.5 kg/year at primary school level and 6 kg/year at secondary and higher levels. Thus with reference to the estimated number of students (ref. 6.7.) the demand for exercise books and other kinds of paper for educational purposes in 1985 will be approximately 900 tons for primary schools and 500 tons for all other schools, totalling to 1,400 tons per year.

4.1.3.2. Government Printing Department.

This Department does all printing jobs for the government offices and also procurement and distribution of stationary. (ref.6.3.12.) The consumption is approximately 120 tons per year of printing papers, cover papers and board for printing purposes and 240 tons/year of Stationary.

Trimnings and other waste from the printing presses are being burnt or dumped and could be easily used for repulping in case a paper mill would be established. The amount of waste is estimated at 8%.

4.1.3.3. Newspapers.

The major newspaper in Sierra Leone is "We Yone" (ref. 6.3.14.) edited twice a week with a circulation of 15,000. Sunday edition has 16-20 pages, Wednesday edition 12 pages. The size of the paper used is 30" x 20" (762 x 508mm) and the consumption is 60 reams on Sundays and 45 reams on Wednesdays.

No trimnings are available. The circulation is limited by the capacity of the printing press.

The proprietors are now installing a rotary press and later this year will be editing a daily 16 pages newspaper with a circulation of 25,000. In 1981 they are also planning a weekly magazine and a monthly political review.

Thus the present consumption of newsprint of 48 tons/year will rise to approximately 120 tons/year.

There are also in Freetown some other newspapers: Daily Mail, Flash, The progress, Tablet and Sabanoh. The volume and the circulations of these newspapers have no significant impact on the consumption of newsprint.

4.1.3.4. Atlantic Printers Ltd.

This company does general printing jobs for the public. The consumption is approximately 20 tons/year of wood free bank paper, cover paper and cardboard.

The waste is estimated at 2-3% and could be collected for repulping in a paper mill.

Local price quotations are 950-1050 Le/ton of bank paper and 1e1050-1250 Le/ton of cardboard (ref 6.3.15.)

4.1.3.5. Commercial Printers Company Ltd.

The consumption is approx. 20-30 tons of printing paper per year. The waste is estimated at 5-6% and could be collected. The local price quotations are 590-800 Le/ton of paper.

The company is also manufacturing approximately 2 million exercise books per year consuming for this purpose 100 tons/year of writing paper. (ref. 6.3. 16.)

Full list of printing process in Sierra Leone is given in the Appendix No. 9 (ref. 6.3).

4.1.4. Major consumers of packaging paper and paperboard.

4.1.4.1. United Paper Company Sierra Leone Ltd. (UNIPAC) Freetown.

The factory is manufacturing corrugated boxes consuming 120 ton/year of imported corrugated board.

There are 7-10% of trimmings and other waste that can be collected for repulping in a paper mill.

The factory is also rewinding and cutting tissue paper. The capacity is 5,000 toilet paper rolls per day,

the consumption of tissue paper is varying from 120 to 180 tons/year waste approx. 5%. (ref. 6.3.18).

4.1.4.2. Sierra Fishing Company Ltd., Freetown.

One of the company's activities is the packaging of frozen or canned fish and shrimps. Inner packs are made of foodboard, outer packs of twin-wire board. Consumption of packing materials:

For shrimps

250,000 inner packs of 100g each = 25 tons/year,

25,000 outer packs of 750g each = 18.75 tons/year.

For cattle fish

7,500 packs of 850g each = 6.35 tons/year.

Total: approximately 50 tons/year.

Following the requirements of external market the packs have high quality finish with multicolour print and varnish. They are imported ready made (ref. 6.3.17.)

4.1.4.3. Other existing consumers of packaging paper and board include:

- Sierra Leone Brewery Ltd. (containers of paper board).
- National Confectionary Ltd. NATCO,
- Aureol Tobacco Company Limited,
- Sierra Leone Match Industries Limited,
- Sierra Leone Suitcase Works Limited
- Washex Soap Company,
- Seaboard West Africa Flour Mills Limited,
- Salt Manufacturing Company Limited.

4.1.4.4. Major future consumers of paper sacks:

- Mamunta Sugar Mill (ref. 4.2.2.)
will start operation early 1981.
- Cement factory: production targets and starting date are not known yet.

4.2. Fibrous raw materials

4.2.1. Wood

The forestry sector in Sierra Leone has little significance. The country has over 289,300 ha forest reserves, i.e. some 4% of its land surface. Most of these forest reserves are located in the eastern part of the country (see map - ref.6.10). The exploitable forest area is estimated at 192,000 ha. The forests are predominated by a large variety of lesser known species. There are no comprehensive forest inventories, the standing volume can only be assessed roughly as follows (ref.7.7.):

| | |
|---------------------|-----------------------------|
| Sawn timber species | 2.12 million m ³ |
| Veneer species | 1.43 million m ³ |
| | <hr/> |
| Total | 3.35 million m ³ |

Besides the above forest reserves protected forests of *Gmelina arborea* have been planted in narrow strips (50-200m wide) along the main roads. These plantations cover some 7,600 ha and are aged from 1 to 45 years. The standing volume is not known (ref. 6.3.9. and 6.11.)

Some small experimental plots of pine (*Pinus caribaea*) have been planted on Kambui Hills in the vicinity of Kenema. The growth rate of this pine is reported to be fairly high (ref. 6.3. 24.)

The majority of the forest reserves are committed to the existing and planned saw mills. The largest plant is that of Forest Industries Corporation in Kenema which consists of a sawmill furniture factory and joinery plant. Panguma Sawmill produces sawn timber only. The sawmills in operation have the following capacities (ref. 7.8.):

| | <u>Annual Capacity</u> | <u>Annual Production</u> | <u>\$</u> |
|-----------------------------------|------------------------|--------------------------|-----------|
| Forest Industries Corp. Kenema: | 14,000 m ³ | 8,400 m ³ *) | 60 |
| Panguma Sawmill | 7,000 m ³ | 1,200 m ³ | 60 |
| Forestry Division Sawmill Kenema: | 1,120 m ³ | 176 m ³ | 42 |
| Waikenda Sawmill: | 672 m ² | 56 m ³ | 8 |

*N.B. Part of the production facilities was destroyed by the fire in 1977 and a second fire in 1978. According to FIC Annual Report 1978 the production of sawn timber amounted to 2,366 m³ in 1977 and 4,052 m³ in 1978.

The capacity of the planned Sileti Sawmill will be approximately 20,000 m³ sawn timber p.a. (ref.7.7.).

The waste from sawmilling is used as fire wood. The management of Forest Industries Corporation is considering a development programme which would probably include also the utilisation of wood waste and sawdust for the production of fibreboard or its gasification.

The quantities of wood sawn in the existing and planned sawmills given above do not justify the establishment of a viable pulp mill based on waste from sawmilling. A wood pulp mill based on logs felled in forest cannot be recommended because of very high cost involved in felling and hauling operations which include also the cost of building access roads.

There are also some technological problems involved in the production of pulp from mixed tropical species. Theoretically it is possible to use all the species in the tropical forests, but in practice the heterogeneity of raw material causes variations in pulp quality unacceptable especially in small-capacity mills. An integrated 3,000 tons/year mill based on natural forests was operated as a pilot plant in Ivory Coast from 1950-54. Economically, the mill's capacity was too low to be profitable.

- 13 -

The above findings and considerations show that there are no prospects for a wood pulp mill in Sierra Leone unless an appropriate afforestation programme of planting selected species of tropical and sub-tropical softwoods (preferably pine) and fastgrowing hardwoods will be implemented. However, with 10-15 years growth cycle this cannot give immediate production effects.

4.2.2. Mangrove

There is an abundance of mangrove on coastal swamps in Sierra Leone. Mangroves have been always selectively exploited on a small scale for building poles, fuelwood, charcoal, etc. Most species regenerate readily under these conditions and do not require intervention from the forester. A chip harvesting operation, however, is not selective. Moreover, its scale may be such that the cleared areas are well beyond the biological capacity of the species for natural regeneration. Replanting would involve considerable financial and manpower resources.

The mangrove clearance would also effect such features as coastal erosion, the mobility of sand bars, tidal and current movements, fish breeding, etc.

The harvesting and transport operations in inaccessible swamp areas would result in high cost of raw material delivered to the factory site.

Thus the use of mangrove as raw material for the production of pulp and paper cannot be recommended.

4.2.3. Bagasse

A sugar cane plantation of 3,000 acres (1214 ha) has been established in the vicinity of Mamunta (see map - ref.6.12.) and a sugar mill is being constructed with the aid of the government of the People's Republic of China. The production capacity will be approximately 6,000 tons/year. The mill is scheduled to start operation early next year. The content of bagasse is expected to be 25%, however, all bagasse will be burnt as fuel in the steam boiler and there will be no surplus of bagasse for the production of pulp (ref.6.3.20 - 6.3.22).

4.2.4. Waste Paper

At present all waste from the printing presses and from United Paper Company is being dumped or burnt. The quantity of the waste paper that could be collected and repulped in a paper mill can be estimated as follows :

| | |
|---|------------------------|
| kraft corrugated board waste from UNIPAC: | 9-12 tons/year |
| tissue waste from UNIPAC: | 6-9 tons/year |
| printing waste: Government Printing Dept: | 9.6 tons/year |
| Atlantic Printers: | 0.4-0.6 tons/year |
| Commercial Printers: | 1-1.8 tons/year |
| Other sources: | <u>14-17 tons/year</u> |
| Total: | <u>40-50 tons/year</u> |

4.2.5. Rice Straw

Rice is by far the most important single crop as it is cultivated on approximately 1 million acres (405,000 hectares) by about 80% of farmers in all parts of the country. In 1979 the production was 251,500 tons of cleaned rice. As a result of the intensified rice development programme which the Government has embarked on, additional 400,000 acres (162,000 hectares) are to be cultivated and the production of rice in 1985 is estimated at 430,000 tons (ref.6.13).

The distribution of the rice cultivation by districts and provinces is presented in the Appendix No.14 (ref. 6.14). The highest is the production of rice in the Northern Province, especially in the Port Loko District. Notably the intensified rice development programme is expected to cover areas in Mapotolon, Kassiri, Port Loko, Makeni and Magburaka in the Northern Province, as well as Gbundapi, Moyamba and Bo in the Southern Province (see map - ref. 6.12).

The common practice is to harvest rice once a year: in November - December on upland plantations, up to January on swamp plantations. The Government is encouraging the cultivation of swamp rice because of higher yield.

The rice straw is being left on the fields. According to the information available the average quantity of straw is 6 tons per acre (14.8 tons per hectare) for all the rice ecologies (ref. 6.13). This figure seems to be exaggerated. Rather it can be assumed that the yield of rice straw reaches approximately the same figure as e.g. in Egypt: 2.4 tons/ha p.a. or 3.7 tons

of straw per ton of rice. Thus the corresponding quantity of rice straw available in Sierra Leone would be 900,000 to 1,000,000 tons p.a. This figure is comparable to that in Egypt where the annual production

of white rice stands at some 270,000 tons p.a. and the corresponding quantity of rice straw reaches 1 million tons p.a.

The consumption of rice straw for pulping in Egypt is at present 100,000 to 110,000 tons p.a. (ref. 7.13.)

In Sierra Leone for an initial production of 6,000 tons of paper per year the consumption of rice straw would be 10,000 to 12,000 tons per year.

4.3. Other raw materials

The chemicals used in the pulp mill depend upon the technological process. For the pulping of rice straw probably a simple chemo-mechanical pulping process will be most suitable, with cooking under atmospheric pressure done in hydropulpers and followed by hot stock refining. In this case lime and caustic soda will be necessary. Sodium sulphite and sodium bicarbonate are used in mono-sulphite batch cooking, caustic soda and chlorine - in the continuous Celdecor-Pomilio process.

Chlorine, sodium hypochlorite and caustic soda are necessary for bleaching the pulp.

The stock additives used in the paper mill are: aluminium sulphate, rosin, starch, soda ash and miscellaneous chemicals used in smaller quantities, like dyes, optical bleaching agents, etc.

All chemicals have to be imported. No local price quotations for the chemicals were available.

4.4. Utilities, manpower, land.

4.4.1 Power

Sierra Leone Electricity Corporation's (SLEC) power stations are located in: Freetown, Lungi, Port Loko, Rokupr, Kambia, Makeni, Magburaka, Kabala, Koidu, Kailahun, Kenema, Pujehun, Bo, Bonthe and Moyamba.

Agency stations: N'jala, Jimmy Gagbo, Koyeima, Daru .

The capacity of generating facilities (ref. 7.1.):

| <u>Location</u> | <u>Installed Capacity MW</u> | <u>Firm Capacity MW</u> |
|------------------------------------|----------------------------------|-----------------------------|
| SLEC Western Area | 26.505 | 15.970 |
| SLEC Provinces and agency stations | 13.991 | 3.090 |
| Private plants, Freetown | 0.781 | n.a. |
| - " - , Provinces | 1.505 | 0.256 |
| Mining Companies | 38.195 | 21.770 |
| Water treatment plants | 5.401 | 1.700 |

Bumbuna Hydro-Electric Scheme with a capacity of 46 MW of its first phase is in the early planning stage.

For a pulp and paper plant of approximately 1 MW of installed power the only reliable source seems to be the King Tom power station in Freetown with a capacity of ca. 20 MW. Outside Western Area in relatively good condition are the power stations in Bo, Kenema and Koidu, however, due to the limited capacity of the stations the location of a plant with such power demand would create serious problems (e.g. the capacity of the Port Loko power station is 1 MW).

According to SLEC rules the plants with high power demand should have their own generating facilities as stand-by. The supply will be with a high tension line (11 KV). If the substation is provided by the customer the tariff is Le 5.00 per kWh of demand per month plus consumption rate 8.5 cents per kWh. Minimum charge is Le 5.00 per month. If the substation is provided by SLEC the consumption rate is 10.5 cents per kWh and the minimum charge is Le 100.00 per month (ref.6.3.22.)

4.4.2 Water

The average annual rainfall ranges from about 1,750 mm near the Guinea frontier in the North-East to about 4,600 mm on the coast near Liberian border. The annual rainfall average for the whole country is 2,780 mm. The precipitation, however, is concentrated in the rainy season between the months of May and November. There are the problems of flooding during the rainy season and, conversely, the difficulties in obtaining sufficient water supply during the dry season (ref. 7.1. and 7.2) The best water supply scheme is operating in Western Area. The Guma Valley Water Company operates water treatment plant with a capacity of 18 million gallons per day ($81,720 \text{ m}^3/\text{day}$) and provides water to Freetown and other settlements in Western Area from Sussex to Allen Town. The Guma Dam reservoir (see map - ref. 6.15.) has a capacity of 4,600 million gallons (21.8 million m^3) and can easily provide estimated 4,000-5,000 m^3/day of water for a pulp and paper mill (ref. 6.3.30.)

The tariff for treated drinking water is 0.40 Le/ m^3 (1.80 Le/1000 gall.)

The water supply scheme in the provinces cannot provide sufficient quantities of water for industrial purposes due to limited capacities (e.g. Io $360 \text{ m}^3/\text{h}$, Kenema $400 \text{ m}^3/\text{h}$, Port Loko $150 \text{ m}^3/\text{h}$).

The flow rates of some bigger rivers, like Rokel, Sewa etc. have not been made available.

4.4.3 Fuel.

A refinery is operated at Freetown (Kissy) by the Sierra Leone Petroleum Refining Company Ltd. This company is owned jointly by the Government and four oil companies: British Petroleum, Shell, Texaco Africa and Mobil Oil. The marketing of petroleum products is being done by the oil companies. Fuel oil is readily available in Freetown and Western Area. The oil companies, however, decline deliveries of fuel oil outside Western Area due to the shortage of transport facilities (tankers).

The price of fuel oil supplied in large quantities in Western Area would be:

0.81 Le per gallon duty-free,

1.23 Le per gallon duty-paid.

(Ref. 6.3.26.)

4.4.4 Manpower

There is a surplus of unskilled manpower and shortage of skilled workers. A draft training programme should constitute an important part of the preliminary design of the factory and detailed pre-investment study.

A review of the average monthly wages and salaries and a detailed estimate of the required manpower for the proposed pulp and paper mill are given in the appendix No. 16 (ref 6.16)

4.4.5 Construction and repair facilities

A large size workshop established by the defunct Sierra Leone Railway for the maintenance of its locomotives and carriages has been transformed into National Workshop. The built up area covers 20,000m³. The facilities include:- - repair and maintenance shop equipped with lathes of various turning diameters and length, turret lathes, side-head boring mills, drilling machines, milling machines, planers, grinding machines, etc.

- wood saw mill, joinery and upholstery shop
- cast iron foundry and aluminium casting shop,
- blacksmithing and copper smithing shop,
- sheet and plate fabrication shop,
- tool room.

The employment is approx. 400; 50% of it are skilled workers (ref.6.5.23.) The National Workshop has a considerable potential in the repair and maintenance of plant equipments and in the fabrication of engineering goods against orders. Thus the repair workshop of the future paper mill can be reduced to the necessary minimum of maintenance facilities.

4.4.6 Land

A plot of approximately 20 hectares (50 acres) will be necessary for the construction of the mill including the storage yard for baled rice straw. Government land can be easily obtained in the provinces.

There is also a possibility to obtain government land in Western area in the vicinity of Waterloo or Icke and No. 2. settlements (see map - ref. 6.15).

4.5. Conclusions

4.5.1. Market for paper

The present per capita consumption of paper in Sierra Leone is considerably lower than the 5.9 kg per year average for the 42 African countries for which statistics are available (ref.7.15.).

Thus as an intermediate objective for a country with a population of more than 4 million a production target of 16,000 to 20,000 tons of paper per year could be set up. However, with the present import figure reaching only 3,000 - 4,000 tons/year an immediate consumption jump cannot be expected. Therefore a more moderate production capacity of 6,000 - 9,000 tons/year for the first phase of the pulp and paper mill seems to be more reasonable. Any surplus of paper can be easily sold to neighbouring countries. Although no up-to-date market surveys in those countries are available, some earlier reports (ref. 7.12.) indicate that e.g. in Guinea there is a potential market for paper. Local production will add to the growth of the paper consumption and after some time an extension of the pulp and paper mill will be required.

4.5.2. Fibrous raw materials

Rice straw is available in quantities that are sufficient not only for the proposed production capacity, but also for any future expansion of this industry in Sierra Leone. The writer suggests that some of the existing rice buying stations, established up-country by Sierra Leone Produce Marketing Board, can be easily equipped with mobile small baling machines and serve also as rice straw buying centres on a contract basis. The straw bales of 20-30 kgs weight would be transported by lorries to the paper mill. A price of 10 Le/ton of straw baled and delivered to the mill site is suggested. It seems to have a reasonable profit margin for the buying organization and also leaves the necessary margin for the profitable operation of the pulp and paper mill.

4.5.3. Production capacity

Comparative preliminary investment and production cost estimates have been made (Appendix No.13 - ref.5.13) for capacities of 10, 20 and 30 tons/day (3,000, 6,000 and 9,000 tons/year). The analysis of these estimates shows that the production of 10 tons/day lays slightly below the break-even point.

Of course even at this capacity the factory can be operated at profit if the investment cost will be lower. This can be achieved by purchasing second-hand machines instead of the new ones.

The writer suggests, however, to start with a production of 20 tons/day (5,000 tons/year). The machines and equipment shall be rated for a production of 30 tons/day, thus enabling the mill, after the initial period of operation with lower production capacity, to raise gradually the output to the demand of the market with no additional investment cost. Provision should be made for the future erection of a similar pulp and paper production line.

4.5.4. Production programme

The easiest and most profitable (ref 6.17 and 6.18) programme would be the production of wrapping paper and packaging board from unbleached pulp and this is suggested for start-up and initial period of operation. From the social point of view, however, this industry should also cater for cultural needs of the population, especially for educational needs. Therefore the writer suggests that the pulp mill shall be equipped with bleaching department right from the beginning and the paper machine shall be a multi-purpose Fourdrinier capable of producing at intervals unbleached paper grades, like the above mentioned wrapping paper and packaging board, as well as bleached paper grades for writing and printing purposes. This will involve approximately 10% higher initial investment cost but will also substantially broaden the variety of paper grades produced. If growing market will in future enable an expansion of the proposed mill the above first production line would continue with the production of writing and printing paper grades only and the new production line shall produce exclusively unbleached pulp. The second paper machine would be an MG machine, possibly twin-wire, so that it would manufacture also machine glazed wrapping paper, and line board. In this case a paper converting plant manufacturing corrugated board could be added to the paper mill or could be established as an independent manufacturing unit.

4.5.5. Preliminary lay-out of the plant

PULP MILL: 20 - 25 tons/day.

An inexpensive and simple chemo-mechanical process is suggested for the pulp mill. In this case the following basic equipment will be required:

- scales for straw bales, capacity 50-100 kg,
- Straw conveyor,
- straw cutter,
- blower,
- cyclone separator,
- screw mixer-feeder,
- hydropulper,
- hot stock chest with agitator,
- hot stock pump,

- hot stock refiner,
- dilution box
- vibrating screen
- riffler
- washer cum thickener
- washed pulp chest with agitator
- washed pulp chest pump
- screw press
- opening machine
- chlorination tower
- acid wash filter
- alkaline tower
- alkaline wash filter
- screen
- cleaners
- decker
- bleaching tower
- final wash filter
- storage chest.

Other production processes for the pulp mill, like e.g. cooking in batch digesters or a continuous Caldecor-Pomilio process can be also considered, subject to competitive prices for the machinery or convenient credit facilities.

PAPER MILL: 25-30 tons/day

(The straw pulp drains very slowly. To a certain extent it improves the sheet formation, however, it seriously limits paper machine speed. Therefore for a given production rate the rated capacity of the paper machine should be higher.)

Basic equipment:

- Hydrapulper for repulping of imported wood pulp and waste paper
- Hydrapulper extraction pump
- 5 - 6 beaters or refiners
- 2 deflakers

- 3 - 4 mixing chests with agitators, the capacity and number of the chests to be in accordance with the design of the stock preparation section
- machine chest
- Fourdrinier paper machine with a capacity 30-40 tons/day, required to cover a wide range of grades and of basic weights (from 60 to 300-400 g m²).
- overhead crane
- rewinder - slitter
- sheet cutter
- guillotine cutter
- 2 lift fork trucks

AUXILIARY AND SERVICE DEPARTMENTS:

- Pumps for the pumphouse
- Elevated water storage tank
- Effluents settling basin or lagoon
- steam boiler
- Back pressure steam turbine + generator
(Since Sierra Leone Electricity Corporation requires that an emergency power generating unit (ref.6.3.29) be installed, the writer suggests to install a steam turbine instead of a diesel generator set and to generate power continuously, thus reducing the cost of purchased electricity. In this case the steam boiler should be constructed for higher steam pressure.)
- Electrical substation with a 11/0.5 kV transformer
- Maintenance workshop equipment (limited to minor maintenance jobs only - ref. 4.4.5.)
- Laboratory equipment for quality tests
- Fire fighting equipment
- Vehicles (motor-car, minibus, delivery van, 2 lorries
2 light tractors with trailers).

NOTA

It is recommended to consider as an alternative the purchase of reconditioned second - hand machines. This would reduce considerably the investment cost and increase the profitability of the mill.

4.5.6. Preliminary estimate of investment and production costs

The investment cost estimate for the pulp and paper mill outlined in sub-section 4.5.5. above as well as production cost estimate related to the production capacity and programme discussed in sub-sections 4.5.3. and 4.5.4. are preliminary, based on reports from other mills and personal experience. No price quotations from potential suppliers of machinery and of raw materials were available.

Following assumptions have been made:

- a) The furnish compositions for unbleached and bleached paper grades will consist of 80% unbleached or bleached straw pulp and of 20% unbleached or bleached imported wood pulp accordingly.
- b) Two cases have been studied, each case at three different production levels; case 1 - production of bleached and unbleached grades. Case 2 - production of unbleached grades only.

Case 1 - Production of:

| | | | |
|----------------------|--------------|--------------|--------------|
| printing paper (tpa) | 1,000 | 2,000 | 3,000 |
| writing paper (tpa) | 500 | 1,000 | 1,500 |
| wrapping paper (tpa) | <u>1,500</u> | <u>3,000</u> | <u>4,500</u> |
| Total (tpa) | 3,000 | 6,000 | 9,000 |

Case 2 - Production of wrapping paper only: 3,000, 6,000 and 9,000 tons per annum.

- c) Yield of pulp from rice straw is assumed at:
 - 35% for bleached pulp
 - 55% for unbleached pulp.
- d) Price of straw is estimated at 10 Le/ton, of unbleached wood pulp at 350 Le/ton and of bleached wood pulp at 400 Le/ton.
- e) Prices of end product:
 - Printing and writing paper 800 Le/ton
 - wrapping paper 600 Le/ton
- f) Cost of building:
 - 5,000 m² at 400 Le/m² = 2,000,000 Le

- g) Interest:
10% on 1/2 investment cost.
- h) Income tax:
30% on gross profit
- i) Depreciation:
8% on machinery
5% on buildings.

Illustrative projection of financial operating results is given in Appendix No. 17 (ref.6.17) for case 1 and in Appendix No.18 (ref. 6.18) for case 2.

4.5.7. Site selection

To select a site suitable for the construction of the factory, various sometimes discrepant, premises are to be taken into consideration. Prevailing is the opinion that the pulp and paper mill has to be located in Western Area, with an option either near to Waterloo (location 2) or in the vicinity of Toke and No.2 settlements (location 1 - see maps - ref. 6.12 and 6.15). These locations have following advantages:

- Short distance from Freetown where major customers of the mill are located. (ref. 4.1.4. and 6.9).
- Availability of port facilities at a short distance: machinery and equipment as well as some of raw materials (wood pulp and chemicals) will be delivered by sea. Exported paper will also be shipped by sea.
- Housing for the mill personnel is easier available in Freetown than in the provinces where the cost of building a housing estate would add to higher investment cost. In case of location in Western Area only few houses for the emergency personnel are to be built at close distance from the factory.
- Availability of utilities. Power can be supplied from the King Tom power station (ref. 4.4.1) and water can be tapped from Guma Valley reservoir (ref. 4.4.2).
- Repair facilities of the National Workshop in Freetown at short distance (ref. 4.4.5).
- Fuel oil can be supplied only to sites located in Western Area (ref. 4.4.3).

Disadvantageous are: longer distance from sources of straw supply, more troublesome acquisition of government land and the fact that these locations will not contribute to the development of rural areas in the provinces.

In case, however, that the development strategy of the Government would require to locate the pulp and paper mill in the provinces an alternative site (location 3 - see map , ref. 6.12) is suggested in Port Loko District, near to the bridge crossing the Rokel river, on the road from Ma Siaka to Port Loko and Lunsar. This site is close to sources of straw supply and not very far from Freetown with a fairly good road connection. The writer has had the opportunity to see that even in mid dry season the Rokel river still carries a considerable amount of water, however, no firm decision in respect of this location can be made until the reports on the flow rates of the river are studied and the possibilities of supply of power and of fuel oil are thoroughly examined.

5. RECOMMENDATIONS

5.1. It is proposed that a consulting organisation specialized in the field of pulp and paper industry be hired to carry out a detailed feasibility study comprising:

- evaluation of bids from potential machinery suppliers and selection of equipment best fitting to production targets outlined in sub-sections 4.5.3 and 4.5.4 above.
- preliminary design of the pulp and paper mill in accordance with technical specifications of the selected equipment,
- final selection of the factory site, land survey maps
- detailed requirements of utility industry in respect of the project,
- detailed investment and production cost estimate based on price quotations from the suppliers of machinery and of raw materials
- training programme for supervisory and technical staff.

- 5.2. It is proposed that UNIDO be requested to provide further technical assistance, in particular to find a consulting organization and to carry out the detailed feasibility study.
- 5.3. UNIDO to be asked to provide assistance in procurement of equipment for the mill. The possibility of purchase of reconditioned second-hand machines should be explored.
- 5.4. It is proposed to carry out the survey of external market for paper in neighbouring countries.
- 5.5. The Ministry of Trade and Industry may adopt measures necessary for the realisation of the project:
- prepare the project budget and negotiate with development banks and donors of capital aid the possibilities of financing,
 - take final decision on implementation of the project
 - decide which institutions or corporations are to be made responsible for further planning and preparatory work.
 - provide the land for the construction of the mill.
 - draw up provision on Government policy in respect of investment incentives, tariff protection of this new industry, etc.

6.1. JOB DESCRIPTION
SI/SIL/79/802/A/11-01/32.1.E

| | |
|--------------------|---|
| Post title | Expert in Pulp and Paper Production |
| Duration | 3 m/m |
| Date required | As early as possible |
| Duty station | Freetown with travel within the country |
| Purpose of project | To study the possibilities of starting a pulp and paper industry in Sierra Leone using locally available fibrous raw materials. |
| Duties | <p>The expert is expected to:</p> <ol style="list-style-type: none">1. Carry out a market survey to determine the local demand for the different types of papers and board.2. Make a study on the quantities of raw materials available in the country like straw, bagasse, cotton waste, waste paper etc.3. Analyze whether under the given conditions the small-scale production of paper or board is to be recommended.4. Make a first preliminary lay-out and cost estimate for such a small pulp and paper plant. The expert will also be expected to prepare a final report of his mission setting out the findings of his mission and his recommendations to the Government on further action which might be taken. |

QUALIFICATION: University degree or equivalent knowledge in pulp and paper technology using non-woody fibers and waste paper.

LANGUAGE: English

BACKGROUND
INFORMATION:

1. Background and Justification

With local demand for all types of paper rising, the Ministry of Trade and Industry is studying the possibility of establishing a pulp and paper industry in the country. Sierra Leone is virtually a non-producing country as far as pulp and paper are concerned; about 5,000 tons of paper and board were imported in 1977.

Assistance is needed to study the possibility of establishing a pulp and paper mill using mainly locally available rice straw and other agricultural waste materials.

5.2

PROJECT COUNTERPART, DURATION OF ASSIGNMENT.

Name and function of project counterpart:

Mr. Sama S. Banya, Assistant Small Industries Officer,
Ministry of Trade and Industry, Freetown.

Starting date of assignment: 11 February, 1980.

Concluding date of assignment: 10 May, 1980.

| 6. 3. | | LIST OF PERSONS CONTACTED | |
|-----------|-----------------------|---------------------------|--|
| 6. 3. 1. | Mr. M.S. Konteh | - | Deputy Secretary, Ministry of Trade and Industry. |
| 6. 3. 2. | Mr. J.A.M. King | - | Principal Industrial Development Officer, Ministry of Trade & Industry. |
| 6. 3. 3. | Mr. E. Tuboku-Metzger | - | Director, Central Planning Unit, Ministry of Development & Economic Planning. |
| 6. 3. 4. | Mr. I.F. Contreras | - | Senior Industrial Development Field Adviser, UNDP/UNIDO. |
| 6. 3. 5. | Mr. C.D. Williams | - | Permanent Secretary, Ministry of Education. |
| 6. 3. 6. | Mr. Sheikh H. Sesay | - | Principal Educational Officer-Primary Schools, Ministry of Education. |
| 6. 3. 7. | Mr. W.B. Munn | - | Permanent Secretary, Ministry of Agriculture and Forestry. |
| 6. 3. 8. | Mr. A.R. Seffar | - | Chief Agriculturist, Ministry of Agriculture and Forestry. |
| 6. 3. 9 | Mr. A.P. Koroma | - | Assistant Chief Forest Industries Officer, Ministry of Agriculture and Forestry. |
| 6. 3. 10 | Mrs C.H. Lansana | - | Senior Statistician, Central Statistic Office. |
| 6. 3. 11. | Mr. F.E. Harleston | - | Controller, Customs and Excise Department |
| 6. 3. 12. | Mr. S. Shafqat Ali | - | Team Leader, UNDP/UNIDO Project: Industrial Development Programming and Project Elaboration. |
| 6. 3. 13. | Mr. S.H. Langley | - | Deputy Government Printer, Government Printing Department. |
| 6. 3. 14. | Mr. Sam J.E. Metzger | - | Managing Editor, The Yone Press Freetown |
| 6. 3. 15. | Mr. L.C. Forster | - | General Manager, Atlantic Printers Ltd., Freetown. |
| 6. 3. 16 | Mr. James C. Tutt | - | Commercial Printers Company Ltd. F/tow |
| 6. 3. 17 | Mr. Sanusi Deen | - | General Manager, Sierra Fishing Company Ltd., Freetown |

- 6. 3. 18. Mr. Orlando Price - Manager, United Paper Company S.L. Ltd., (UNIPAC), Freetown.
- 6. 3. 19. Mr. Guo Shude - Attache, Embassy of the People's Republic of China in the Republic of Sierra Leone.
- 6. 3. 20. Mr. Hung - Coordinator, Sugar Complex, Mamunta.
- 6. 3. 21. Mr. Ho - Team Leader, Sugar Cane Plantation, Mamunta.
- 6. 3. 22. Mr. Lin - Factory Manager, Sugar Mill, Mamunta.
- 6. 3. 23. Mr. Jozsef Kucsera - Metallurgical Engineer, National Workshop, Freetown.
- 6. 3. 24. Mr. J.T.D. Lewally - General Manager, Forest Industries Corporation, Kenema.
- 6. 3. 25. Mr. J.J. Stoll - General Manager, Panguma Sawmill, Panguma.
- 6. 3. 26. Mr. M. Jarber - Assistant Sales Manager, Shell of Sierra Leone, Head Office, Freetown.
- 6. 3. 27. Mr. M.M. Sesay - Department Manager, Kingsway Chemist - a Division of the United Africa Company of Sierra Leone Ltd. Freetown.
- 6. 3. 28. Ms M. Jabber - Manager, S.L. Suitcase Works Ltd., Kissy Dockyard.
- 6. 3. 29. Mr. S.B. Jones - General Manager, Sierra Leone Electricity Corporation.
- 6. 3. 30. Mr. S.A.H. Williams - Chief Engineer, Guma Valley Water Company, Freetown.
- 6. 3. 31. Mr. S.C. Lansana - Assistant Director, Lands Surveys Department, Ministry of Lands.

6.4 IMPORTS OF PAPER, PAPERBOARD AND PAPER PRODUCTS : 1975-1978
QUANTITY (TONS)

| Item No. | Commodity | 1975 | 1976 | 1977 | January - June, 1978 |
|--------------|---|------------------|------------------|------------------|----------------------|
| 641-100 | Newsprint | 79.482 | 117.445 | 163.844 | 62.661 |
| 641-810 | Uncoated printing and Writing papers in rolls or sheets | 158.508 | 100.827 | 118.055 | 74.807 |
| 641-820 | Other paper and paper board simply finished | 104.740 | 158.457 | 161.658 | 33.440 |
| 641-830 | Impregnated, coated and decorated papers etc. | 181.173 | 118.157 | 55.902 | 35.117 |
| 641-920 | Composite paper and paperboard in rolls and sheets | 15.958 | 3.252 | 0.559 | 9.707 |
| 641-930 | Corrugated paper or paperboard in rolls and sheets | 69.928 | 143.770 | 99.404 | 40.859 |
| 641-940 | Ruled or squared paper in rolls or sheets | 318.692 | 20.176 | 89.443 | 42.790 |
| 641-970 | Wall paper and linocrusta | 2.032 | 1.525 | 1.016 | 4.015 |
| 642-110 | Packing containers of paper or paperboard | 523.344 | 636.724 | 642.670 | 501.390 |
| 642-200 | Correspondence papers and envelopes etc. | 103.673 | 61.645 | 55.800 | 57.884 |
| 642-300 | Exercise books, registers etc. of paper of paperboard. | 298.364 | 145.142 | 123.137 | 95.999 |
| 642-930 | Paper cut to size not elsewhere specified | 277.528 | 128.524 | 197.029 | 100.827 |
| 642-960 | Articles of paper pulp, paper or paperboard | 163.031 | 170.501 | 158.660 | 43.756 |
| Total | | 2,296.453 | 1,806.145 | 1,867.177 | 1,103.252 |

Source: Central Statistics Office, Tower Hill, Freetown (ref. 6.3.10.)

(For the purpose of this report statistical figures have been computed into metric
tons: 1 cwt. = 0.05082 t).

6.5 IMPORTS OF PAPER, PAPERBOARD AND PAPER PRODUCTS: 1975 - 1978

VALUE (LEONES)
1 USS = 1.05 Le.

| Item No. | Commodity | 1975 | 1976 | 1977 | January - June 1978 |
|----------|---|-----------|-----------|-----------|---------------------|
| 641-100 | Newsprint | 36.370 | 124.605 | 217.526 | 37.836 |
| 641-810 | Uncoated printing and writing papers in rolls or sheets | 200.007 | 133.500 | 189.457 | 116.822 |
| 641-820 | Other paper and paperboard simply finished | 115.435 | 181.021 | 269.603 | 46.776 |
| 641-830 | Impregnated, coated and decorated papers etc. | 180.768 | 133.621 | 99.092 | 103.782 |
| 641-920 | Composite paper and paperboard in rolls or sheets | 16.701 | 4.764 | 2.421 | 10.143 |
| 641-930 | Corrugated paper or paperboard in rolls or sheets | 65.924 | 156.457 | 89.742 | 31.516 |
| 641-940 | Ruled or squared paper in rolls or sheets | 315.918 | 23.170 | 124.574 | 41.623 |
| 641-970 | Wall paper and linocrusta | 1,955 | 3,803 | 162 | 5,837 |
| 642-110 | Packing containers of paper or paperboard | 538,280 | 798,821 | 1,002,713 | 819,523 |
| 642-200 | Correspondence papers and envelopes etc. | 186,911 | 124,356 | 208,920 | 167,484 |
| 642-300 | Exercise books, registers etc. of paper or paperboard | 555,962 | 275,575 | 357,615 | 164,476 |
| 642-930 | Paper cut to size not elsewhere specified | 408.556 | 212,844 | 416,872 | 141,601 |
| 642-960 | Articles of paper pulp paper or paperboard | 272,902 | 355,477 | 345,306 | 135,075 |
| | Total | 2,895,689 | 2,528,014 | 3,324,003 | 1,922,494 |

Source: Central Statistics Office, Tower Hill, Freetown (ref. 6.3.10)

6.6. IMPORTS OF PAPER, PAPERBOARD AND PAPER PRODUCTS: 1973

Quantity (tons) and Value (Leones). (1 US\$ = 1.05 Le)

| Item No. | Commodity | Quantity (tons) | Value (Leons) |
|----------|--|-----------------|---------------|
| 641-100 | Newsprint | 128.625 | 27,243 |
| 641-810 | Uncoated printing and writing papers in rolls and sheets | 251.559 | 145,700 |
| 641-820 | Other paper and paperboard simply finished | 50.261 | 46,409 |
| 641-830 | Impregnated, coated and decorated papers etc. | 11.394 | 10,306 |
| 641-920 | Composite paper and paperboard in rolls and sheets | | |
| 641-930 | Corrugated paper or paperboard in rolls and sheets | 35.218 | 15,159 |
| 641-940 | Ruled or squared paper in rolls or sheets | 18.448 | 10,298 |
| 641-970 | Wall paper and linerusta | 6.454 | 5,865 |
| 642-110 | Packing containers of paper or paperboard | 626.611 | 360,737 |
| 642-200 | Correspondence papers and envelopes etc. | 263.857 | 194,708 |
| 642-300 | Exercise books, registers etc. of paper or paperboard | 228.487 | 275,224 |
| 642-930 | Paper cut to size not elsewhere specified | 269.956 | 187,986 |
| 642-960 | Articles of paper pulp, paper or paperboard | 381.962 | 346,377 |
| | Total | 2,281.005 | 1,633,858 |

Source: The Sierra Leone Quarterly Trade Statistics Vol. LKVIII. Oct.-Dec., 1973, No. 47 (ref.7.4.).

(For the purpose of this report statistical figures have been computed into metric tons: 1 cwt = 0.05082 t)

6.7. 6.7. NUMBER OF STUDENTS ATTENDING SCHOOLS

| YEAR | PRIMARY SCHOOLS | SECONDARY SCHOOLS | VOCATIONAL AND TECHNICAL TRAINING | TEACHER TRAINING COLLEGES | UNIVERSITY COLLEGES |
|------|-----------------|-------------------|-----------------------------------|---------------------------|---------------------|
| 1975 | 204,409 | 46,835 | 840 | 1,519 | 1,642 |
| 1976 | 218,376 | 51,564 | 571 | 1,656 | 1,574 |
| 1977 | 227,815 | 53,897 | 581 | 1,743 | 1,594 |
| 1978 | 241,484 | 57,414 | 895 | 1,868 | 1,705 |
| 1979 | 225,973 | 59,421 | 904 | 1,999 | 1,722 |
| 1980 | 271,331 | 62,392 | 913 | 2,139 | 1,739 |
| 1981 | 287,611 | 65,512 | 922 | 2,289 | 1,756 |
| 1982 | 304,868 | 68,788 | 931 | 2,449 | 1,773 |
| 1983 | 323,160 | 72,227 | 940 | 2,620 | 1,791 |
| 1984 | 342,550 | 75,838 | 949 | 2,803 | 1,809 |
| 1985 | 363,103 | 79,630 | 958 | 2,999 | 1,827 |

Source: Ministry of Education, Freetown (ref. 6.3.6.)

6.8. POPULATION ESTIMATES (medium variant)
(thousands)

| 1960 | 1965 | 1970 | 1975 | 1980 | 1985 |
|-------|-------|-------|-------|-------|-------|
| 2,136 | 2,367 | 2,644 | 2,982 | 3,389 | 3,977 |

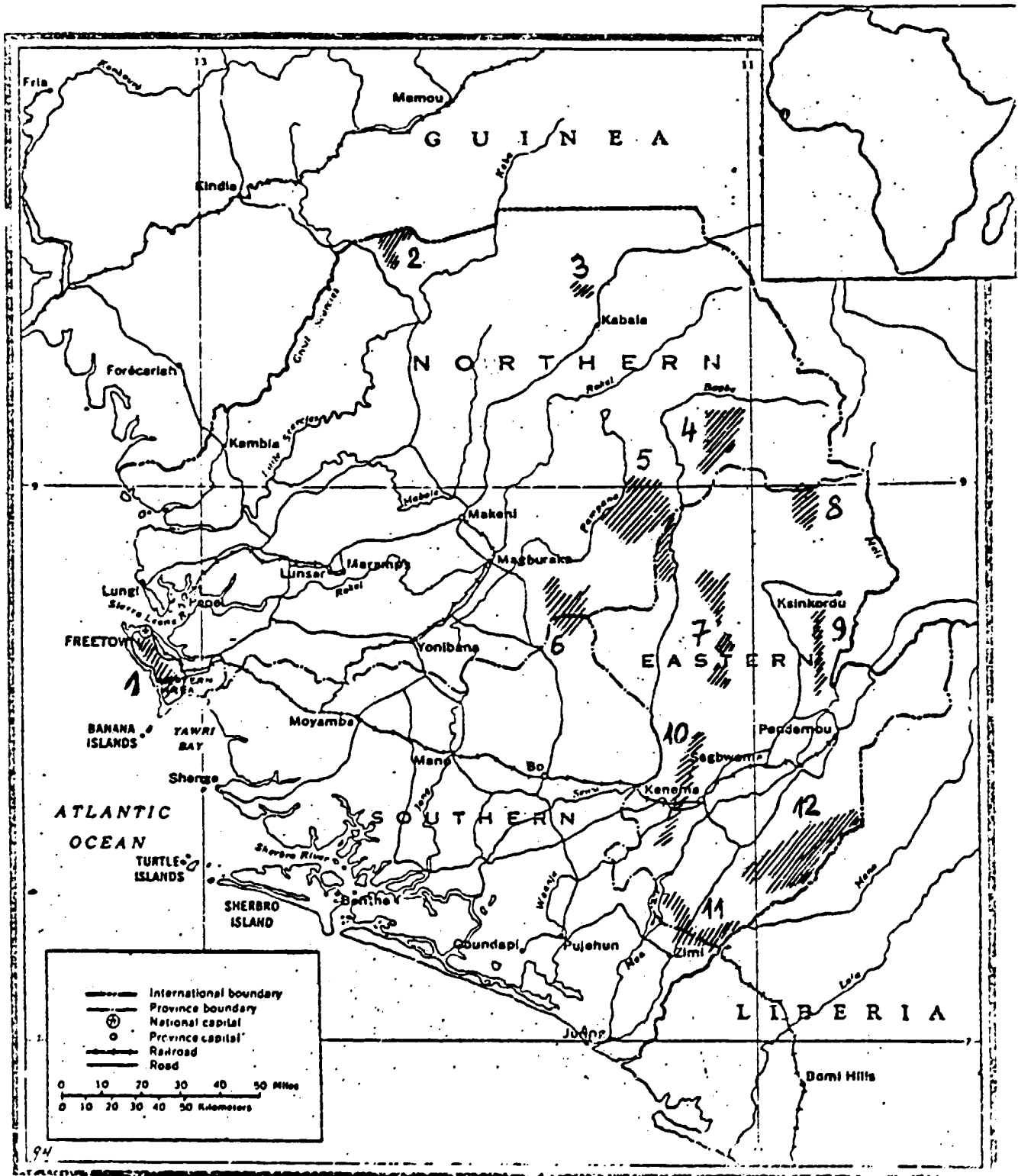
Source: National Development Plan 1974/75 - 1978/79 - 1978/79
(ref. 7.1.).

APPENDIX No. 9

- 6.9. PRINTING AND PUBLISHING ENTERPRISES IN SIERRA LEONE
- 6.9.1. S.L. Government Printing Department, Freetown.
- 6.9.2. Provincial Government Printing Press, Bo.
- 6.9.3. Provincial Government Printing Press, Kenema
- 6.9.4. Provincial Government Printing Press, Makeni
- 6.9.5. We Ebne Press, Freetown.
- 6.9.6. Daily Mail Press, Freetown.
- 6.9.7. Commercial Printers Company Ltd., Freetown.
- 6.9.8. Atlantic Printers Ltd. Freetown.
- 6.9.9. Associated Printing Press Ltd., Freetown.
- 6.9.10. M.E. Macauley Commercial Printers, Kissy
- 6.9.11. New Era Printing Press, Freetown.
- 6.9.12. Fourah Bay College Printing Press, Freetown.
- 6.9.13. Oduntor Printing Press, Freetown.
- 6.9.14. Michael Maurice Printing Works, Freetown.
- 6.9.15. Joshua Printers, Freetown.
- 6.9.16. Bunumbu Printing Press, Bo.

(Ref. 7. 14.)

6.10. MAJOR FOREST RESERVES.



Forest Reserves:

- | | | |
|--------------------|---------------------|------------------|
| 1. Colony | 5. Tonkoli and Tama | 9. Gori Hills |
| 2. Kuru Hills | 6. Kangari Hills | 10. Kambui Hills |
| 3. Wara Wara Hills | 7. Nimini | 11. Gola West |
| 4. Loma Mountains | 8. Sankan Biriwa | 12. Gola North |

APPENDIX NO. 11

6.11.

INFORMATION ON GHELIINA ARBOREA
IN SIERRA LEONE

Acreage - about 18,750 acres (7588 La)
Age - from 1 year to 45 years.
Location of Plantations - Plantations have been established all over the country mostly innarrow strips along major roads.

TOTAL YIELD PRODUCTION PER ACRE

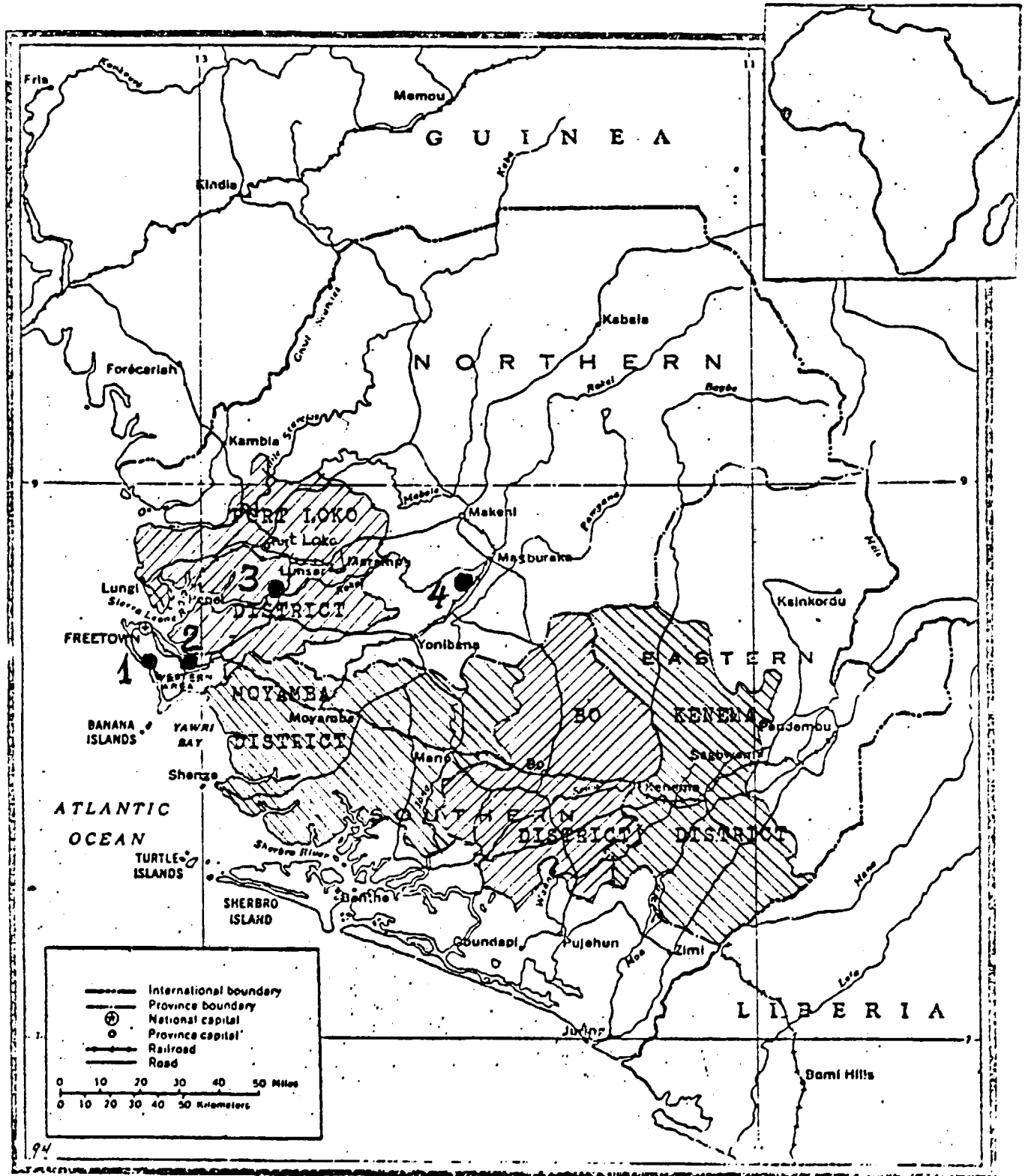
| | | | |
|---------|---|-------------|---------------------------|
| 5 Years | - | 25.8 cu.ft. | (1.80 m ³ /ha) |
| 7 " | - | 138 " | (9.65 ") |
| 9 " | - | 432 " | (30.21 ") |
| 11 " | - | 665 " | (46.50 ") |
| 17 " | - | 877 " | (61.33 ") |

The above production figures are applicable only to the Eastern Province and on quality class 1 sites.

Yields in the Northern Province are comparatively lower. These for the Southern Province are intermediate.

Source: Ministry of Agriculture and Forestry (ref. 6.3.8.)

6.12. MAJOR RICE CULTIVATION AREAS.



- 1, 2, - Proposed sites for the paper mill in Western Area.
- 3 - Alternative site for the paper mill in Port Loko District.
- 4. - Mamunta Sugar Complex.

APPENDIX NO. 13

6.13 ANNUAL PRODUCTION OF RICE - 1975 - 1979

| <u>Year</u> | <u>Area under Cultivation (Acres)</u> | <u>Annual Crop of Rice (metric tons)</u> |
|-------------|---------------------------------------|--|
| 1975 | 866,000 | 259,800 |
| 1976 | 933,000 | 279,900 |
| 1977 | 1,053,000 | 315,900 |
| 1978 | 872,600 | 219,650 |
| <u>1979</u> | 1,006,000 | 251,500 |
| 1980 | 1,076,000 | 322,800 |
| 1981 | 1,124,062 | 355,218 |
| 1982 | 1,242,651 | 372,795 |
| 1983 | 1,305,482 | 391,644 |
| 1984 | 1,370,600 | 411,430 |
| 1985 | 1,439,200 | 431,760 |

Cleaned rice = 50% milling of husk rice.

Average yield of husk rice under different ecologies, i.e. upland, swamp, boliland, grassland: 0.6 tons per acre.

Average quantity of straw for all the rice ecologies: 6 tons per acre.

Source: Ministry of Agriculture and Forestry (ref. 6.3.8)

6.14

APPENDIX NO. 14

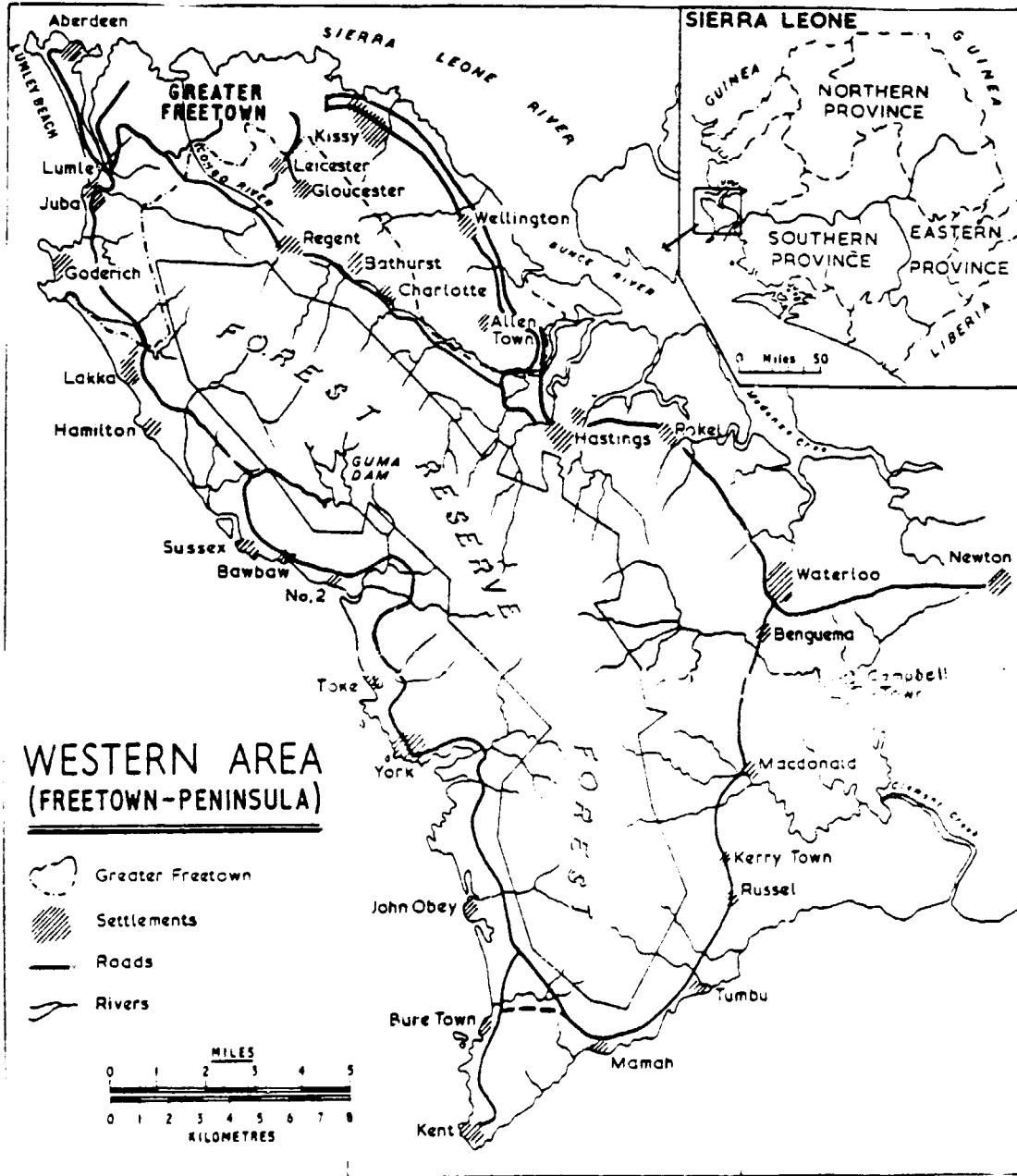
PRODUCTION OF RICE BY DISTRICTS

| Districts | Area under rice Cultivation(hectares) | % Area | Production (Tons) |
|-------------------------|--|-----------|----------------------|
| Bo | 43,514 | 13.2 | 61,745.82 |
| Bonthe | 5,626 | 1.7 | 6,654.01 |
| Moyamba | 45,110 | 13.8 | 59,557.67 |
| Pujehun | 15,206 | 4.7 | 19,178.01 |
| Total Southern Province | 109,316 | 33.4 | 147,115.51 |
| Kailahun | 21,413 | 6.6 | 29,461.40 |
| Kenema | 39,055 | 11.9 | 60,520.33 |
| Kono | 16,948 | 5.2 | 26,727.61 |
| Total Eastern Province | 77,416 | 23.7 | 116,769.39 |
| Bombali | 21,782 | 6.6 | 25,308.37 |
| Kambia | 25,459 | 7.8 | 33,840.51 |
| Koinadugu | 18,912 | 5.8 | 23,327.03 |
| Port Loko | 43,459 | 13.3 | 67,422.34 |
| Tonkolili | 29,608 | 9.1 | 21,671.85 |
| Total Northern Province | 130,220 | 42.6 | 177,670.10 |
| Western Area | 852 | 0.3 | 1,323.79 |
| Total Sierra Leone | 326,304 | 100.0 | 442,878.79 |

Source: Agricultural Statistical Survey of Sierra Leone 1970/71. (ref. 7.3)

(For the purpose of this report area under rice cultivation
has been computed into hectares: 1 acre = 0.40469 ha.).

6.15. Map of the Western Area. (Freetown Peninsula)



6.16 Estimate of manpower for the proposed pulp and paper mill.

| | Number of shifts | Total number of employees | | | | |
|---|---------------------|------------------------------|--------|--------|----|---|
| | | M | Q | T | S | U |
| 1. Management | 1 | 4 | | | | |
| 2. Office staff | 1 | | 2+6+4 | | | |
| 3. Factory shift supervision | 3 | 3 | | | | |
| PULP MILL | | | | | | |
| 4. Supervisors | 3 | 3 | | | | |
| 5. Straw cutting | 3 | | | 3 + 9 | | |
| 6. Cooking, refining, screening, thickening | 3 | | | 6 + 24 | | |
| 7. Bleaching | 3 | | | 3 + 9 | | |
| PAPER MILL | | | | | | |
| 8. Supervisors | 3 | 3 | | | | |
| 9. Stock preparation | 3 | | | 3 + 12 | | |
| 10. Paper machine | 3 | | | 3 + 12 | | |
| 11. Rewinder-slitter | 3 | | | 3 + 3 | | |
| 12. Sheet cutter | 3 | | | 3 + 6 | | |
| 13. Guillotine cutter | 3 | | | 3 + 3 | | |
| 14. Sheet sorting | 2 | | | | 20 | |
| 15. Packaging | 2 | | | 3 + 6 | | |
| AUXILIARY SERVICES | | | | | | |
| 16. Pump house | 3 | | | 3 | | |
| 17. Boiler house | 3 | | | 3 + 3 | | |
| 18. Power generator | 3 | | | 3 + 3 | | |
| 19. Maintenance workshop (mechanical and electrical) | 3 | | 3 + 15 | | | |
| 20. Drivers | 1 | | | 4 | | |
| 21. Storekeepers | 2 | | | 4 + 4 | | |
| 22. Materials handling (offloading and storage of raw materials, loading of products) | 1 | | | | 8 | |
| 23. Internal transport | 3 | | | | 12 | |
| 24. General workers | 3 | | | | 9 | |
| 25. Watchmen | 3 | | | | 9 | |
| 26. Laboratory | 3 | | | | | |

$$4+5+18+65+152 = 244$$

M- Leading managerial staff: L\$1,000 per month (expatriates: L\$3,000)

Q - Qualified independent working skilled worker (supervisor): L\$500-600 per month.

T - Qualified skilled worker (technician): L\$100-120 per month.

S - Semi-skilled worker: L\$50-80 per month.

U - Unskilled worker: L\$ 40-50 per month.

1 US\$ = L\$ 1.05

APP INDEX NO. 17

6.17 ILLUSTRATIVE PROJECTION OF FINANCIAL OPERATING RESULTS (L x 1000).
CASE 1: PRODUCTION OF WRITING, PRINTING AND WRAPPING PAPER.

| | Total 3,000 | Production 6,000 | (tons/year) 9,000 |
|-------------------------------|----------------|---------------------|----------------------|
| Sales: | 2,1000 | 4,2000 | 6,300 |
| Costs: | | | |
| Straw | 55 | 110 | 165 |
| Imported pulp | 225 | 450 | 675 |
| Chemicals | <u>250</u> | <u>400</u> | <u>600</u> |
| Total raw materials | 510 | 1,020 | 1,530 |
| Labour and supervision | 250 | 250 | 250 |
| Depreciation | 605 | 605 | 605 |
| Power (electric, fuel) | 160 | 310 | 470 |
| Other overheads | <u>150</u> | <u>200</u> | <u>350</u> |
| Total costs | 1,635 | 2,395 | 3,215 |
| Gross profit: | 415 | 1,805 | 3,085 |
| Interest: | 437.5 | 450 | 462.5 |
| Income tax: | <u>121.5</u> | <u>241.5</u> | <u>325.5</u> |
| Net profit: | 562 | 991.5 | 1,330 |
| Investment: | | | |
| Machinery | 6,000 | 6,000 | 6,000 |
| Land and buildings | 2,500 | 2,500 | 2,500 |
| Working capital | <u>250</u> | <u>500</u> | <u>750</u> |
| Total investment | 8,750 | 9,000 | 9,250 |
| Net profit as % of sales | - | 19.30 | 26.34 |
| Net profit as % of investment | - | 6.24 | 10.55 |

APPENDIX NO. 18

6.18

ILLUSTRATIVE PROJECTION OF FINANCIAL OPERATING RESULTS (Ls x 1000).
CASE 2: PRODUCTION OF WRAPPING PAPER ONLY.

| | Total 3,000 | Production 6,000 | (tons/year) 9,000 |
|-------------------------------|----------------|---------------------|----------------------|
| Sales: | 1,800 | 3,600 | 5,400 |
| Costs: | | | |
| Straw | 45 | 90 | 135 |
| Imported pulp | 210 | 420 | 630 |
| Chemicals | <u>90</u> | <u>180</u> | <u>280</u> |
| Total raw materials | 345 | 700 | 1,045 |
| Labour and supervision | 260 | 260 | 260 |
| Depreciation | 525 | 525 | 525 |
| Power (electricity, fuel) | 140 | 280 | 420 |
| Other overheads | <u>120</u> | <u>180</u> | <u>300</u> |
| Total costs | 1,390 | 1,945 | 2,550 |
| Gross profit: | 410 | 1,655 | 2,850 |
| Interest: | 383.5 | 392.5 | 401 |
| Income tax: | <u>123</u> | <u>496.5</u> | <u>855</u> |
| | 506.5 | 389.0 | 1,256 |
| Net profit | - 96.5 | 766 | 1,594 |
| Investment: | | | |
| Machinery | 5,000 | 5,000 | 5,000 |
| Land and buildings | 2,500 | 2,500 | 2,500 |
| Working capital | <u>170</u> | <u>350</u> | <u>520</u> |
| Total investment | 7,670 | 7,850 | 8,020 |
| Net profit as % of sales | - | 21.28 | 29.52 |
| Net profit as % of investment | - | 9.76 | 19.86 |

7. BIBLIOGRAPHY

7. 1. Sierra Leone Government, Ministry of Development and Economic Planning. Central Planning Unit: National Development Plan 1974/75 - 1978/79 Freetown, August 1974.
7. 2. Sierra Leone Government, Ministry of Development and Economic Planning. Central Planning Unit: National Development Plan 1974/75 - 1978/79 (Condensed Version). Freetown, December 1975.
7. 3. Sierra Leone Government. Central Statistic Office: Agricultural Statistical Survey at Sierra Leone 1970/71.
7. 4. The Sierra Leone Quarterly Trade Statistics Vol. LXVIII. Oct.-Dec., 1973 No.470
7. 5. T. A. White: Forest inventory of the Gola Forest Reserves. FAO, No.TA 3155, Rome, 1972.
7. 6. E. Doffine, G.S. Welsh: Possibilities for the manufacture of Wood Based Panels. FAO, No.TA 2742, Rome 1970.
7. 7. Feasibility Study on the TIMBER INDUSTRY COMPLEX KENEMA for the German Agency for Technical Cooperation prepared by ATLANTA Industrie - and Unternehmensberatung GmbH, Hamburg, May 1978.
7. 8. FORETIM - Rumanian State Enterprise for Foreign Trade: Feasibility report and Market Survey. Logging and Woodworking Industries. Republic of Sierra Leone. Vol. 1: General Data and Market Survey. Prepared by Research and Design Institute of Wood Industry, Bucharest, Rumania, August 1975.
7. 9. S.L. Keswani: Chemo - Mechanical Pulping Process for Pulping Agricultural Residues for Small Paper Mills - A case Study. Paper for 2th World Forestry Congress Jakarta, October, 1973.

7. 10. Small Scale Production of Cultural Papers. FAO Working Paper 15, Po : DP/ITI/74/026, October 1976.
7. 11. Otto Goehre: Bellmer-Anlagen fuer Strohhalfzellstoff. Neues Verfahren zur wirtschaftlichen Produktion von Faserstoff fuer hochwertige Wellpappen - Rohpapiere und Vollpappen. Bellmer-Post Mitteilung No.9, September 1978.
7. 12. Henryk Szoka: Etude de possibilité de créer une industrie de la pâte et du papier en Guinée. Rapport Final préparé pour Le Gouvernement de la République de Guinée. UNIDO/TS/GUI/74/001/11-01/04/, February, 1975.
7. 13. Appropriate industrial technology for paper products and small pulp mills. UNIDO Monograph on Appropriate Industrial Technology No. 3. United Nations, New York, 1979.
7. 14. Industrial Review of Sierra Leone
Part 1 - Existing Industry, its Perspectives, Problems and Prospects. UNDP/UNIDO Report DP/SIL/78/002, Freetown, September 1979.

8. Explanatory notes

8.1. Abbreviations used:

UNIDO = United Nations Industrial Development Organization

UNDP = United Nations Development Programme

SLEC = Sierra Leone Electricity Corporation

8.2. Weights and measures:

1 cwt (hundredweight) = 0.05082 t (tons)

1 acre = 0.40468 hectares

1 cubic feet per acre (cu.ft/acre) = 0.07 m³/ha

1 gallon = 4.54 litres

8.3. Production output and fibrous raw materials (straw and pulp/input are calculated on bone dry basis.

8.4. Yearly production figure results from 300 operational days per year of continuous 24 hours per (3 shifts) operation with a capacity of 20 - 30 tons per day.

8.5. Exchange rate of local currency:

1 US\$ = 1.05 Leone



