REPUBLIC OF LIBERIA

MINISTRY OF PUBLIC WORKS

FEASIBILITY REPORT

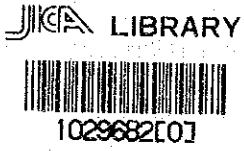
FOR

GBARNGA-KOLAHUN-MENDIKOMA HIGHWAY PROJECT

MAIN RERORT

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY



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PREFACE

In response to the request of the Government of the Republic of Liberia, the Government of Japan has decided to carry out a feasibility study on the Project for Gbarnga-Kolahun-Mendikoma Highway linking the north-eastern region with the east central region of Liberia, and the Japan International Cooperation Agency (JICA) conducted the study.

Recognizing the importance of the Gbarnga-Kolahun-Mendikoma Highway Project for the economic development in the region, the JICA dispatched to Liberia in February 1979 a preliminary survey team for the preparation of the study. Thereafter, JICA organized an Advisory Committee chaired by Mr. Masaya Tokumaru, Assistant Director, Kinki Regional Construction Bureau, Ministry of Construction for the successful execution of the study. JICA sent from June to September 1979 a survey team headed by Mr. T. Kawakami, a senior highway engineer of the Nippon Koei Co., Ltd., to Liberia.

A field survey was carried out as scheduled over a period of about two and a half months with close cooperation of the Liberian authorities. After its return to Japan, the team made further detailed studies and analyses, and compiled this report.

I sincerely hope that this study would be found useful for the socio-economic development of the region and serve for the promotion of the friendly relations now existing between our two countries.

I wish to express my deep appreciation to the competent Authorities and officials concerned in Liberia for their valuable assistance offered to the teams throughout the survey period.

March, 1980

Keisuke Arita
President
Japan International
Cooperation Agency

SUMMARY AND RECOMMENDATION

SUMMARY AND RECOMMENDATION

1. The Republic of Liberia, with about 1.7 million of population and an area of 111,400 square kilometers, is now following a policy to expand the base for the development of the national economy under the Five Year Development Plan (1976-1980). For attaining this national object, special emphasis is placed on the improvement of transport facilities, particularly, on the improvement of the road network for which US$141 million or almost 40% of the total investment was allocated.

2. Road network of the country consists of 1,202 miles (1,934Km) of primary roads, 3,387 miles (5,450Km) of secondary and feeder roads and 1,486 miles (2,391Km) of private roads The road density per square kilometer in the country is low of 0.106Km/Km^2. Beside the quantitative shortage, the roads in the country are still in shortage in quality. Even for the primary roads only 20% is paved and the remainders are laterite roads.

3. The proposed Gbarnga-Mendikoma Highway Project is a part of the government program and is included in the Fourth Highway Project. The Project aims to accelerate the regional economic development through the improvement of the trunk line in the northeastern part of the country and integrating all the feeder roads in the region, and, at the same time, to facilitate international communication and transactions with Sierra Leone and Guinea.

4. The Project area (or influence area) covers parts of Bong County and Lofa County with the total population of around 170 thousand. Agriculture is the most important economic sector in which more than 70% of the total population is involved. Major crops in the project area are rice, coffee, cocoa and oil palm, the production of which are now being

promoted under Upper Lofa County Agricultural Development Project (LCADP) and Upper Bong County Agricultural Development Project (BCADP). Beside the agricultural crop production, the area includes the potential development of forestry production and mining production including the Wologisi iron ore.

5. Present traffic on the Project road was estimated mainly on the basis of the traffic survey. Projection of the future traffic up to the year 2004 was made for normal, diverted and generated traffic by analyzing the present traffic, population growth and regional economic development including the production estimate of the agricultural crops, forestry, rubber, iron ore, etc. Projected total traffic including normal traffic and generated traffic is around 1,100 - 3,300 in the year of 2004.

6. Engineering studies were conducted on the basis of the preliminary results of the field investigation. In the study, study on route alternatives was discarded in due consideration of relatively good horizontal alignment of the existing road and economic development situation in the Project area. Characteristics of the soils and construction materials were studied by analyzing the results of the laboratory tests and the road surface tests. The results confirmed the reliability of the laterite soil to be applied for the pavement materials of the proposed Project road.

7. Based on the traffic forecast and the result of the engineering analysis, preliminary design was made basically in accordance with the AASHTO standard referring to MPW's design standard. In the preliminary design, comparative study was conducted for alternative design speeds and alternative pavement structures. Through this comparison, the design speed was determined at 80Km/h except one mountaineous section and the optimum pavement structure

is hotmix asphalt for all sections using gravelly laterite for base course and sub-base course. Main features of the proposed plan are presented in the attached list herein

8. Construction plan and its implementation schedule were formulated fully taking into account the locality such as climate and available construction materials and equipment, future traffic and financial requirement. The proposed construction period for the improvement is about 7 years in total. Construction work quantities were calculated from the preliminary design and construction plan, on the basis of which construction cost was estimated. The estimated Project cost is US$75.2 million at the price level of late 1979, which includes US$59.6 million of foreign currency portion and US$15.6 million of local currency portion.

9. Major quantifiable benefits accrued from the Project are savings of road users' costs and savings of the road maintenance cost. Beside these benefits, benefit of the dust stopping was estimated, but, which was excluded in the basic economic evaluation and included in the sensitivity analysis.

10. On the basis of the economic benefits and the economic Project cost which was estimated by applying shadow rate to the financial cost, economic internal rate of return (EIRR) of the Project road was calculated at 18.9%, which indicates that the Project is economically viable. Sensitivity tests were also made to check the economic viability under various assemptions. The sensitivity analysis indicates that the Project is still vaiable with 14.7% of EIRR under the worst case (15% cost increase plus 15% benefit reduction).

11. Besides, socio-economic impacts of the Project were assessed including acceleration effect of the regional economic development, improvement of the education and health in the region and contribution to the national and international integration as well as negative impacts such as inflation and labor shortage problem. Through the evaluation, the Project is identified to have considerable favorable impacts both tangibly and intangibly.

12. As the Project is technically sound, economically viable and socially desirable, it is worthy of taking necessary actions toward early implementation. It is recommended that arrangement for financing the Project including detailed design works be made at the earliest moment.

Main Features of the Project Road

I. Road Structures

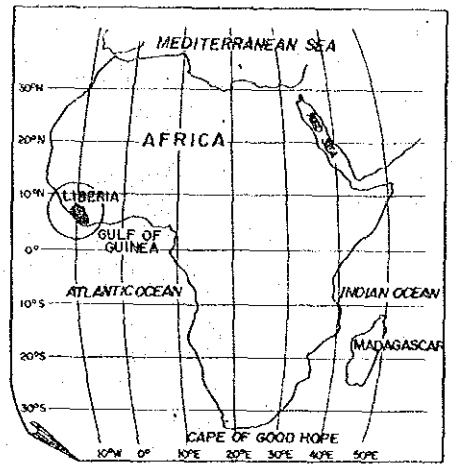
Road Length:	270.9 km
Road width and structures:	
Formation width	
Gbarnga - Lofa river	10.0 m
Shello - Mendikoma	10.0 m
Lofa river - Shello	11.0 m
Pavement width	
Konia - Lofa river	6.5 m
Other sections	7.0 m
Surface and base course	
Hotmix asphalt concrete	3.0 cm
Road mix asphalt treatment overlay, after 10 years	3.0 cm
Cement Stabilized base course	12 cm - 15 cm
Main Construction Works	
Earth work	5,229,000 m3
Pavement	1,877,000 m2
Drainage	
Corrugated pipe	2,700 m
Box culvert	380 m

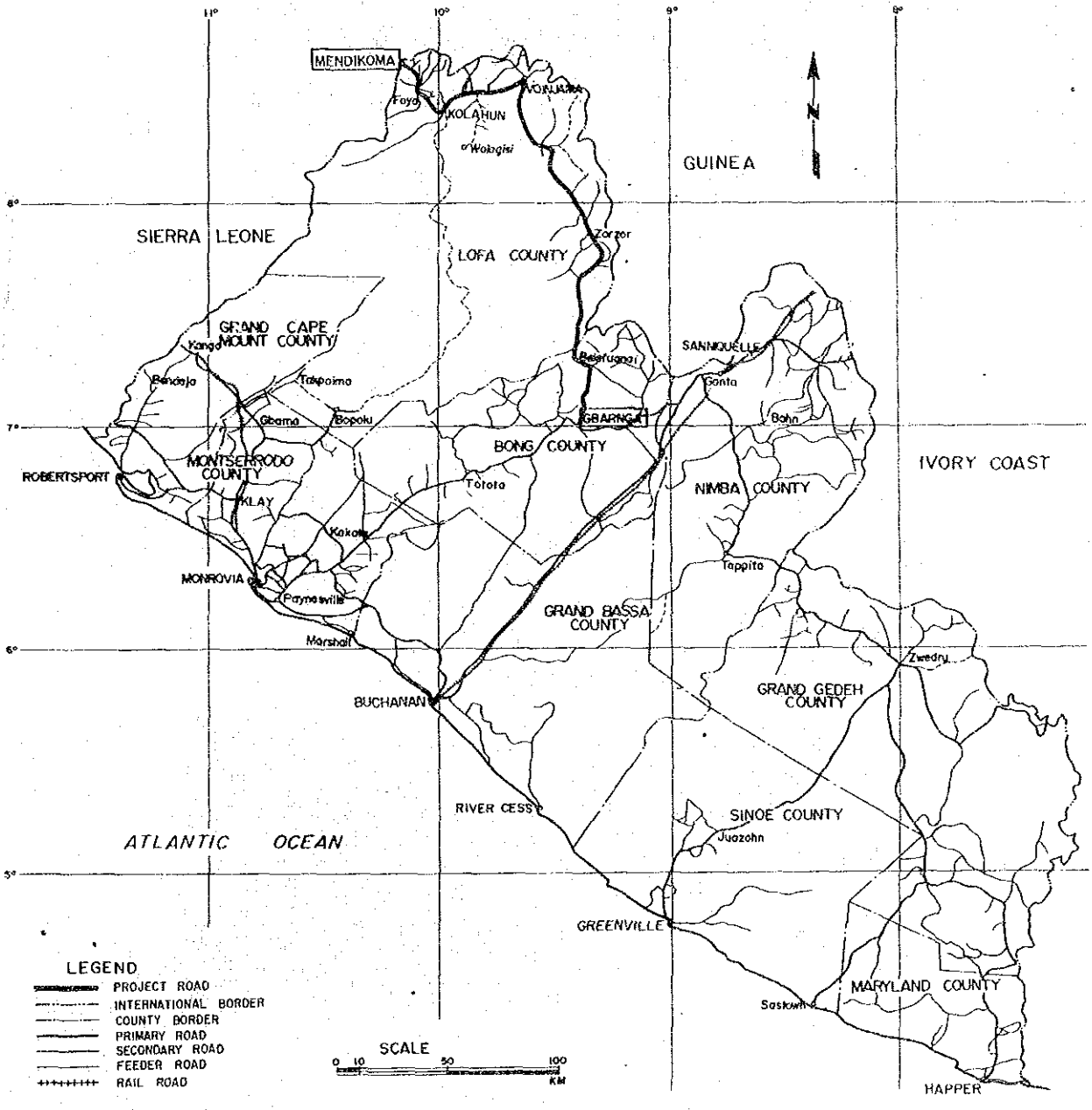
II. Construction Cost

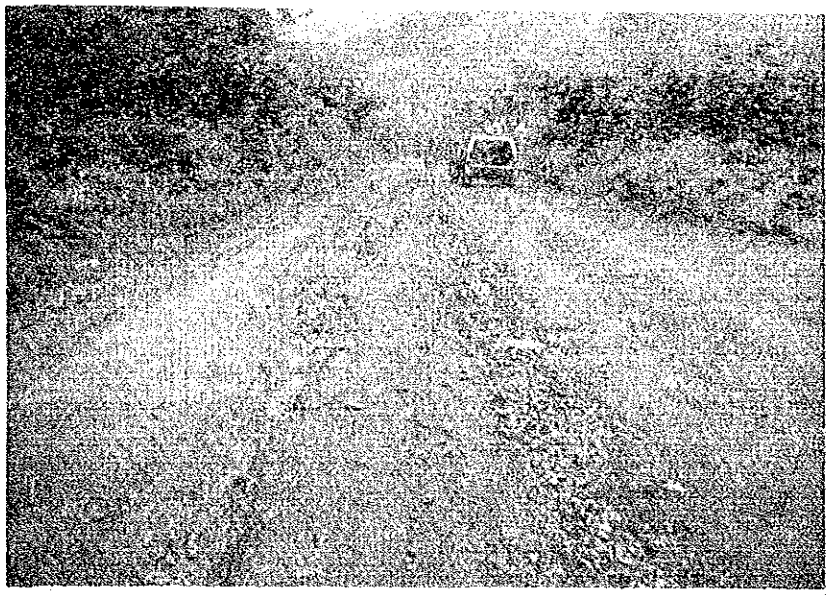
(10^3 US$)

	Local	Foreign	Total
(1) Package I			
Direct Construction Cost	4,052	16,001	20,053
Right of Way	226	0	226
Engineering and Administration	514	1,920	2,434
Physical Contingency	428	1,600	2,028
Sub-total	5,220	19,521	24,741
(2) Package II			
Direct Construction Cost	5,152	20,898	26,050
Right of Way	233	0	
Engineering and Administration	643	2,509	3,152
Physical Contingency	538	2,089	2,627
Sub-total	6,566	25,496	32,062
(3) Package III			
Direct Construction Cost	2,986	11,966	14,952
Right of Way	176	0	176
Engineering and Administration	380	1,438	1,818
Physical Contingency	316	1,197	1,513
Sub-total	3,858	14,601	18,459
Grand Total	15,644	59,618	75,262

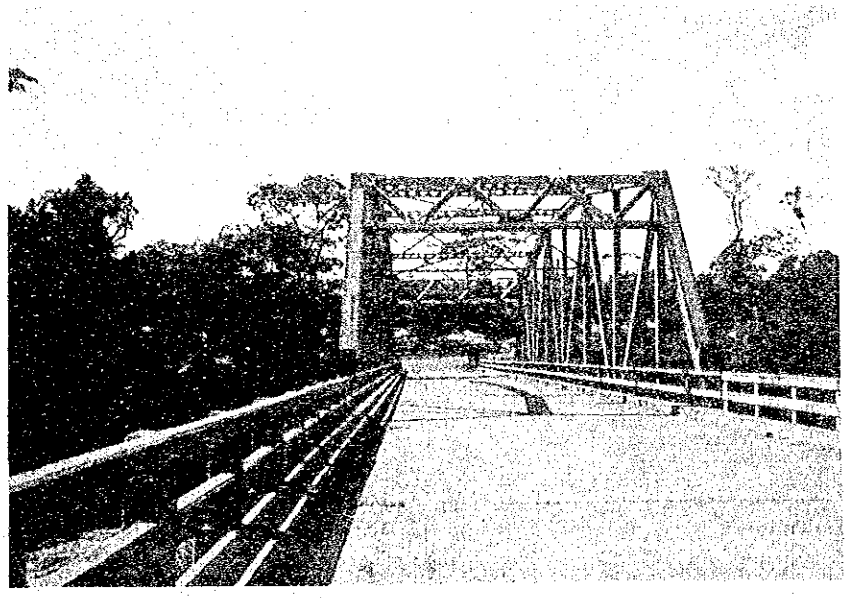
LOCATION MAP



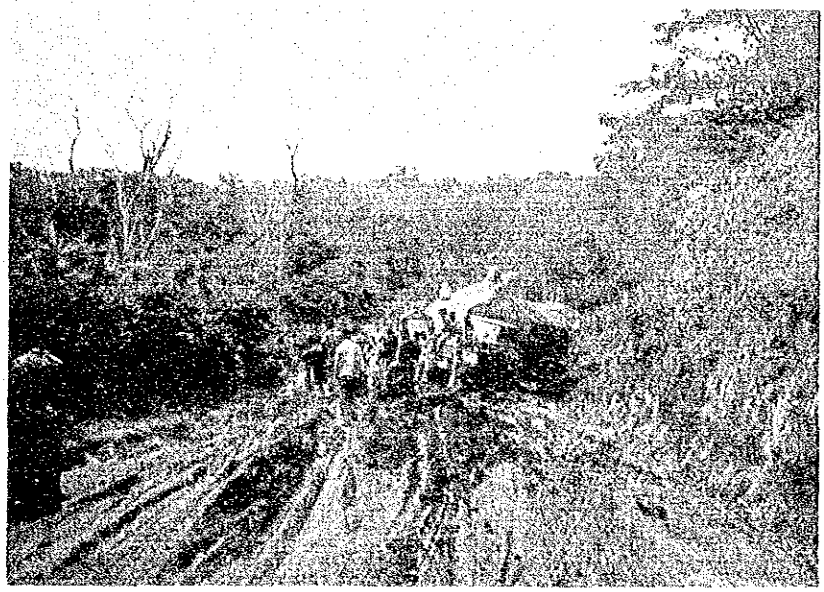




Bumpy Road Surface

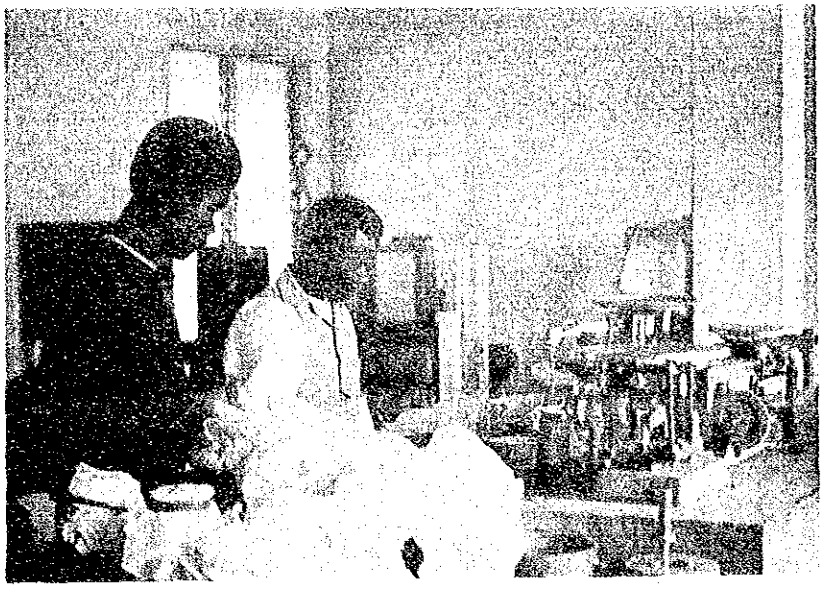


St. Paul River Bridge



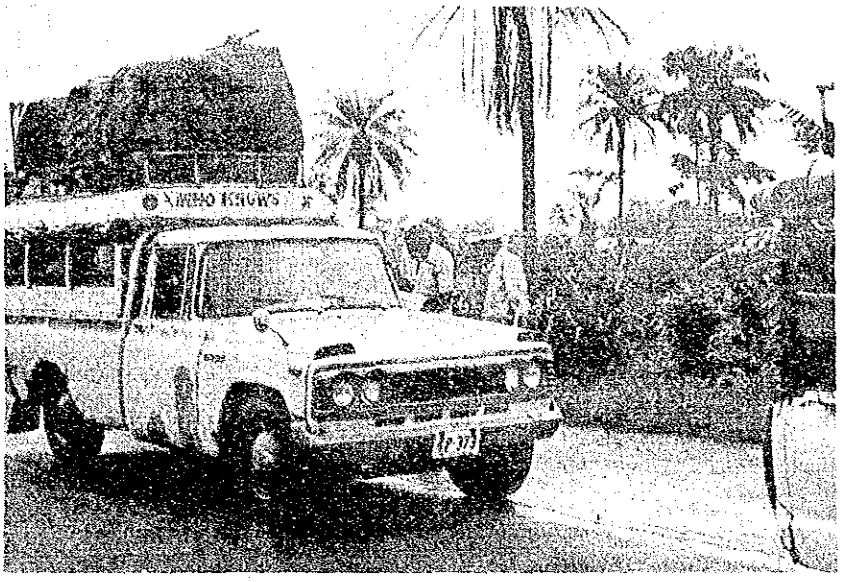
Slippery Road Surface

Rutty Road Surface



Laboratory Test (M.P.W)

Field CBR Test



O-D Survey at Voinjama

O-D Survey at Kolahun

TABLE OF CONTENTS

TABLES

FIGURES

ANNEX

[I]

INTRODUCTION

I. INTRODUCTION

1.1 Project Background

The Government of Liberia is following a policy to expand the base for the country's economic development, now dependent largely on the mining sector, to agriculture. Under this strategy, it is placing special emphasis on the improvement of transport facilities. During the Five Year Development Plan period (1976-1980) US$141 million or almost 40% of the total investment was allocated for improvement of the road network. The objectives of the Plan for the road sector are 1) to improve road maintenance, 2) to upgrade key primary roads and extend the secondary road system to agricultural development areas, and 3) to provide most urgent feeder roads to support rural development.

Included in the plan are Totota - Ganta Road, Ganta - Saniquellie and Ganta - Tapita Roads, Paynesville - Robertsfield Road and Tubman Bridge - Bomi Hills Road for the primary road, and Monrovia By-Pass, and New Mesurado Bridge (Gabriel J. Tucker Bridge) and U. N. Drive for urban roads improvement, most of which are under construction or under preparation./1

Improvement of rural roads or feeder roads has been much more facilitated for promoting regional economic development particularly agricultural development. Most significant performance is Lofa County Feeder Roads and Upper Bong County Feeder Roads now partly under construction both of which constitute an integral part of the regional agricultural development projects.

/1 : Names of the cities, towns, clans and counties indicated in this report are derived from Road Network Map in Liberia.

The Gbarnga - Mendikoma Road is a primary road connecting the capital of Bong County with Mendikoma, a border town between Liberia and Sierra Leone. The road passes through the highest agricultural potential area, Upper Bong and Upper Lofa, in the country and acts not only as a national trunk line in the north-east but also as a main agricultural transport road integrating all the feeder roads in the region.

In view of the importance of the road for the regional development, the project was identified earlier and the feasibility study was originally included in the Fourth Highway Project financed by the World Bank in 1978. From June 1978, pre-feasibility study was commenced by the Ministry of Public Works. During the study, traffic survey including traffic counts and O-D survey, and economic survey was conducted.

In parallel with the pre-feasibility study, a preliminary engineering study on the project road (excluding Kpakutua - Mendikoma section) was made by JICA in 1978 as a part of the "Infrastructure study for the development of the Wologisi Mine" under the technical assistance of the Japanese Government. In the study, preliminary cost estimate for the road improvement was conducted as well as economic impacts study. The results of the preliminary study indicated that the improvement on the road is marginally feasible. After this survey, the Liberian Government decided to request further technical assistance on the road improvement extending from Gbarnga to Kolahun to the Japanese Government.

In response to the request, the Japanese Government accepted to conduct a feasibility study of the said project and despatched a preliminary survey mission in February 1979 for working out details of the study. A draft scope of work together with tentative work schedule was formulated in the

bilateral discussion which recommended that the road to be studied be extended to Mendikoma.

On the basis of the results of the discussion, JICA organized an Advisory Committee and nominated Mr. M. Tokumaru, Assistant Director, Kinki Regional Construction Bureau, Ministry of Construction as the chairman. JICA despatched the survey team headed by Mr. T. Kawakami, a senior highway engineer of Nippom Koei Co., Ltd. to Liberia in June, 1979. The survey team continued the field investigation and preliminary study up to early September 1979. Detailed study and analysis on the project road were conducted after the field survey the results of which were compiled into a Draft Final Report. From early February, discussion was held between the JICA mission and MPW staff on the Draft Report in Monrovia. All the comments raised during the discussion were studied and incprporated into this Final Report.

1.2 Scope of the Study

The objective of the study is to formulate the most economical road improvement plan connecting Gbarnga with Mendikoma through the engineering and economic analysis, and to make recommendation for the optimum implementation plan. This feasibility study has been conducted in three stages, namely, Inception stage, Field Investigation and Study stage and Detailed Study and Analysis stage.

The Inception stage, half a month in Japan, included review of available data and reports collected by the preliminary mission and preparation of the Inception Report.

The Field Investigation and Study stage covered field reconnaissance and inventory survey, economic and traffic surveys, projection of traffic generating sources, preliminary traffic forecast, formulation of alternative plans and their preliminary study, and preparation of Progress Report. Profile and cross-section survey and laboratory tests on the soils and construction materials were also conducted in this stage.

The Detailed Study and Analysis stage was commenced immediately after the previous stage. All the findings, results of the study and analysis were compiled into a Final Report together with the recommendation. The Final Report consists of the following two volumes :

- Main Report
- Appendix and Drawings

Main Report explains the procedures of the investigation and study, and the results of the engineering analysis and economic evaluation.

Appendix and Drawings contains technical details relating to the road inventory, results of the soil and materials tests and hydrological study, plan and profile of the proposed road, and the typical cross-section.

1.3 Study Approach

On the basis of the engineering survey and socio-economic survey and study, conceivable alternatives are to be formulated for selecting the most optimum improvement plan of the Project road. However, route alternatives were discarded in view of the present good condition of the road and potential development in the influence area, and only structural alternatives were considered. Detailed engineering study and the analysis have, therefore, been conducted under this framework in this report.

Socio-economic study was conducted to identify the present condition and to project the future development potential in the influence area, which includes population projection and major economic development forecast such as agriculture, forestry and mining. The traffic projection was made both for passenger traffic and cargo traffic on the basis of these forecasts and estimated present traffic

on the Project road. The passenger traffic was projected in due consideration of the population growth and growth in per-capita income, while the cargo traffic from the expected production growth as well as the regional economic growth in the influence area.

In parallel with the traffic study, basic vehicle operating cost was studied by reviewing past studies carried out in Liberia and by updating the cost components based on the results of the newly collected data. The adjustment factors for the basic vehicle operating cost were also reviewed for surface condition, gradients and curvature.

Detailed engineering study was conducted by analyzing the results of the field investigation including the soil and materials tests fully taking into account the projected future traffic. Design standard was reviewed, according to which preliminary design was carried out. In the preliminary design, alternative plans were compared both for design speed and pavement design. Construction work quantities were calculated for the selected plan. By multiplying unit costs, which were determined through the analysis of the recent contracts of the similar type of construction, to the estimated work quantities, construction cost of the Project were estimated.

Estimate of the principal benefits was made, which include savings of road user's cost and savings of road maintenance cost. The economic evaluation of the Project road was conducted by the comparison of the benefits and the economic cost value at economic price. Internal rate of return and benefit cost ratio were calculated for the Project assuming that the project life is 20 years after the improvement. Sensitivity analysis was also made with respect to increase of the construction cost, reduced benefits and for the case that the dust stopping benefit is included.

Based on the results of the economic evaluation and other socio economic impacts analysis, recommendations for the project implementation were made in this Report.

(II)

GENERAL BACKGROUND

II. GENERAL BACKGROUND

2.1 Geography and Economy

Liberia consists of a narrow coastal plain with extensive swamps, tidal lagoons and creeks, a central plateau and a mountainous area along the country border with Guinea. Total area is about 111,400 km^2. The population of the country is estimated at 1.71 million in 1978 with an average annual growth rate of 3.3%. The average population density is estimated at 15 persons per km^2. The population is unevenl distributed; over 60% occupy about 30% of the land area in the central and southwest regions. Nearly 30% of the population live in urban areas which registered high annual growth rate of 7.9%. The population shift from rural areas to urban areas is evident.

Gross Domestic Product (GDP) /1 in real terms (1971 constant price) is estimated at US$431 million in 1977. From 1964 to 1974, the economy grew at an annual average rate of 5.7%, but stagnated thereafter with an average annual growth rate of 0.5%. The average growth rate of the economy for the whole period of 1964 - 1977 is estimated at around 4.2% per annum. Per capita GDP increased in real terms at 2.4% per year over the period of 1964 - 1974 and stagnated after 1974, which is estimated at about US$300 (at 1971 constant price) in 1977.

The economy of Liberia is a dualistic one where production and consumption patterns differ considerably between the monetary and traditional sectors. The monetary economy generates almost 80% of GDP, while 60% of the total population still live in the traditional economy producing residual 20% of GDP. The economy is dominated by the mining sector in which iron ore mining is by far the largest activity with the total production

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/1 : Definite data regarding GDP in 1978 are not available.

value of US$105 million in 1978. The sector's contribution to GDP and export value were around 30% and 56%, respectively, in 1978. Iron ore mining is operated by three foreign mining companies.

Agriculture is the second largest sector in the economy contributing 25% of GDP and 40% of export earnings. Total production value from the agriculture sector was US$114 million in 1978. Commercial operations of modern agriculture are dominated by foreign-owned rubber plantation and logging companies. Rubber is the largest single commodity, which produces about 40% of all agricultural exports and employs a third of the country's labor force. Forestry products are the second important activity in the agriculture sector contributing 10% of the national export value in 1978.

The production of other sectors than mining and agriculture is quite limited; manufacturing and energy sector produced US$59 million and construction sector raised US$50 million in 1978 contributing less than 10% of GDP in total.

Total export value was US$486 million in 1978. Export of goods increased at a relatively high growth rate of 14% per annum during 1970 - 1974 period, while it slowed down thereafter with around 5% of the annual growth rate. The export of the country depends on production of the primary goods, in which particularly iron ore and rubber are the most important contributing about 70% of the total export. Total import value in 1978 was US$480 million. During the past eight years (1970 - 1978), import of goods increased continuously with higher rate of 16% per year. Raw materials including crude oil accounts for more than 50% of the total import, while investment goods for about 23%, and consumption goods including food about 27%. Rice, an important staple food in the country, is still insufficient and about 60,000 tons were imported in 1977. The country's external account

on trade balance showed a relatively large surplus until 1976, but it turned to deficit or marginal surplus since then due to the stagnated export growth against continuous high growth of imports.

2.2 Present Transport System

Transportation demands in Liberia are met by a combination of road network, coastal shipping, air transport, and on a limited scale, inland waterways. In addition, railway transportation is available in the country, which is run by the mining companies mainly for iron ore transport.

2.2.1 Road Network and Road Transport

1) Road Network

Liberia's road network totals 6,075 miles (9,775 km), which includes 1,202 miles (1,934 km) of primary roads, 3,387 miles (5,450 km) of secondary roads and 1,486 miles (2,391 km) of private roads. The highway network in Liberia is shown in Table 2.1.

Table 2.1 The Highway Network in Liberia
(Miles)

Type of Road	1971	1974	1977	1978
I. Public Roads				
1. Primary Roads				
Paved	203	208	230	253
Laterite (all weather)	941	968	946	949
(Total)	(1,144)	(1,176)	(1,176)	(1,202)
2. Secondary & Feeder Roads				
Laterite (all weather)	487	707	823	973
Earth (Dry weather)	1,270	1,265	1,432	2,414
(Total)	(1,757)	(1,972)	(2,255)	(3,387)
Sub-total I	2,901	3,148	3,431	4,589
II. Private Roads				
Paved	86	86	90	98
Laterite & Earth	1,184	1,308	1,359	1,382
Sub-total II	1,270	1,394	1,444	1,486
Total	4,171	4,542	4,875	6,075

Source: Ministry of Public Works, Planning & Programming Div.

There are three main trunks of primary roads starting from Monrovia within the national road network. The first trunk line runs northeast direction through relatively populated areas of Montserrado and Bong countries up to Yekepa, Nimba Country, a border town with Guinea, with junctions at Gbarnga and Ganta. Total length of the road is 211 miles (338 km). The Gbarnga junction continues in a northern direction to Voinjama and, then turns to west up to Mendikoma, while the Ganta junction continues in southeast direction, passes through Tapeta and Zwedru and arrives at Harper, Maryland County, a major population and economic center near the Ivory Coast border. These trunk lines are mostly unpaved except Monrovia - Gbarnga (Gbarnga - Ganta section is now being paved).

The second trunk line runs in the northwest direction through Bomi Hills up to the Mano River on the Sierra Leone border, with a junction at Klay. Total length of this road is 87 miles (139 km), and 37 miles is now being paved from Monrovia to Bomi Hills. The road runs alongside the joint LMC-NIOC ore concession railway line. From Klay, the road takes west direction and reaches Bo, a border town with Sierra Leone, where a road and bridge are under construction to link both countries. From the Medina junction on the Klay-Bo road, a new road runs through the coastal area and reaches Robertsport, promising port with a potential resort near Lake Piso. The third trunk line is a 94 miles (150 km) paved road that runs through Robertsfield and Harbel to Buchanan, Capital city of Grand Bassa County.

In spite of the impressive increase in road mileage since late 1960's, Liberia still has one of the lowest road density in West Africa. The road density per km^2 in the country is only 0.106 km/km^2, which is relatively low compared with that of 0.27 km/km^2 in Sierra Leone. The road density per 1,000 population is only 4.2 km considerably lower than

that of 33 km in Sierra Leone and 38 km in Cameroon.

Beside the quantitative shortage, the roads in Liberia are still in shortage in quality. Even for the primary roads only about 20% is paved and the remainings are laterite roads. Although the laterite roads are classified into all weather road, passage on most of them is difficult during the wet season. A particular deficiency exists with regard to the secondary and feeder roads including private roads. Most of the feeder roads were built by forestry and rubber concessionaires as short term low-standard haul roads and many are merely earth trucks without sufficient drainage.

To improve the above situation, the Liberian Government is emphasizing their improvement through strengthened regular maintenance work and new investments not only for the primary roads but also for the secondary and feeder roads. One of these investments is a new road construction plan connecting Belle-Yella with Kolahun. Detailed design of the road is being carried out, which is planned to be constructed by 1984. Beside this, planning of a new road, which links Kpakuta with Bopolu (up to Monrovia) is now under study for the development of the Wologisi iron ore.

Typical feeder road improvement projects now being implemented are the feeder roads in upper Lofa County and upper Bong County both for facilitating rural development through agricultural production expansion.

2) Road Maintenance System

The Operation Bureau of the Ministry of Public Works is responsible for the maintenance of all public roads. Recently, the Ministry was reorganized and its maintenance capacity was expanded to cope with the primary and secondary road network. The maintenance of the feeder roads is also under the responsibility of the Ministry.

The road maintenance work of Gbarnga-Mendikoma highway have been conducted by the regional maintenance offices in Bong and Lofa counties. The Bong regional office is responsible for the first 44.5 km stretch from Gbarnga to St. Paul river, while the remaining 230.3 km long section is under Lofa regional office. The Lofa section is further divided into three stretches, namely, 85 km of St. Paul river - Konia, 65 km of Konia - Kolahun and 78.3 km of Kolahun - Mendikoma. Each stretch is being patrolled to check and repair promptly in case of failures.

The maintenance system on the Project road is satisfactory at present in terms of both quality and quantity of machinery and manpower. However, re-organization for the maintenance system including establishment of plant and machinery system such as asphalt mixing plant, asphalt producing plant and crushing plant might be required in future, if the laterite road is improved by bituminous pavement.

3) Road Transport

The growth and composition of the vehicle fleet can be traced by the available data on vehicle registration as summarized in Table 2.2.

Table 2.2 Number of Vehicles Registration in Liberia

Year	Passenger Cars	Taxis	Trucks /1	Buses	Total
1970	9,377	4,735	5,234	3,864	23,210
71	8,996	4,103	5,454	2,521	21,074
72	10.607	3,384	4,730	2,575	21,295
73	10,769	3,507	5,384	3,135	22,795
74	9,875	4,576	5,841	1,800	22,092
75	10,375	2,421	5,466	2,497	20,759
76	11,800	1,967	4,770	2,600	21,134
77	11,234	2,981	5,621	N/A	19,836
78	10,695	3,046	6,427	1,049	21,181

/1 : Including Pick-ups

Source: Ministry of Finance, and Ministry of Commerce, Industry and Transportation.

During a decade upto 1970, vehicle registration had been increased at an annual rate of 11%, but vehicles going out of use were not automatically deregistered. Since 1970, vehicles no longer use have been removed from the register.

Another available data indicating the trend of road transport is fuel consumption. The data shows only a slow growth in traffic. Fuel consumption is shown in Table 2.3.

Table 2.3 Consumption of Petroleum Products
(1,000 US Gallons)

Year	Gasoline	Kerosene	Gas-Oil
1969	15,519	3,171	23,139
70	N/A	N/A	N/A
71	19,987	3,695	51,181
72	16,098	3,144	48,688
73	21,374	3,823	58,046
74	18,891	3,616	61,614
75	21,078	3,139	54,676
76	23,708	3,251	48,140
77	-	-	-
78	-	-	-

N/A : Not available

Source : Ministry of Finance

2.2.2 Other Transport Mode

1) Railways

The railways are another important transport mode in Liberia, which, owned and operated by mining concessions, are used mainly for iron ore transportation. Around 20 million tons of iron ore were carried by the railways in 1978. Beside the iron ore, general cargo and passenger were transported by the railways; the Liberian American Mining Company (LAMCO) line carries some 100,000 tons of general cargo annually including about 10,000 tons of rubber and 6,000 tons of logs and sawn timber, and about 150 passengers daily.

2) Ports

There exist four seaports in Liberia, which include two deep-water ports at Monrovia and Buchanan and shallow-water ports at Greenville and Harper. About 85% of foreign trade goods or about 20 million tons are handled annually by Monrovia and Buchanan, while about 300,000 tons of goods are handled by Greenville and Harper. All ports are managed fairly efficiently by the National Port Authority (NPA) except Buchanan Port which is managed by LAMCO.

Capacity is adequate at all ports, but expansion of facilities and a new port will be required for the planned mining and forestry development. The studies are now being carried out including a new port construction at Robertsport. Traffic by ports is shown in the Table below.

Traffic by Ports
(1,000 Tons)

Port	1979	1976	1977	1978
Monrovia	11,082	11,713	8,795	8,936
Greenville	153	254	216	244
Harper	35	57	45	60
Buchanan	8,957	9,526	8,542	20,012
Total	20,227	21,550	17,598	20,252

Source: Economic Survey of Liberia, 1978

3) Air Transport

There is one international airport at Robertsfield in Liberia, which is now served by Air Liberia and there are twelve international flights. Both international passenger traffic and air cargo increased about 8% per year during the past 5 years upto 1976. Besides the international airport, 14 airfields are served by scheduled flights for domestic passenger and cargo. Domestic air transport still acts important role in the local transportation, particularly, for access to remote parts of the country. Domestic air traffic increased

rapidly with an average annual growth rate of 28% during 1976 - 1978. Domestic air traffic in Liberia is shown in the table below.

Domestic Air Traffic

Item	1976	1977	1978
Number of passenger disembarking	14,372	15,774	23,660
Embarking	14,399	15,839	23,759

Source: Ministry of Commerce, Industry & Transportation

〔III〕

THE INFLUENCE AREA

III. THE INFLUENCE AREA

3.1 Project Location and Influence Area

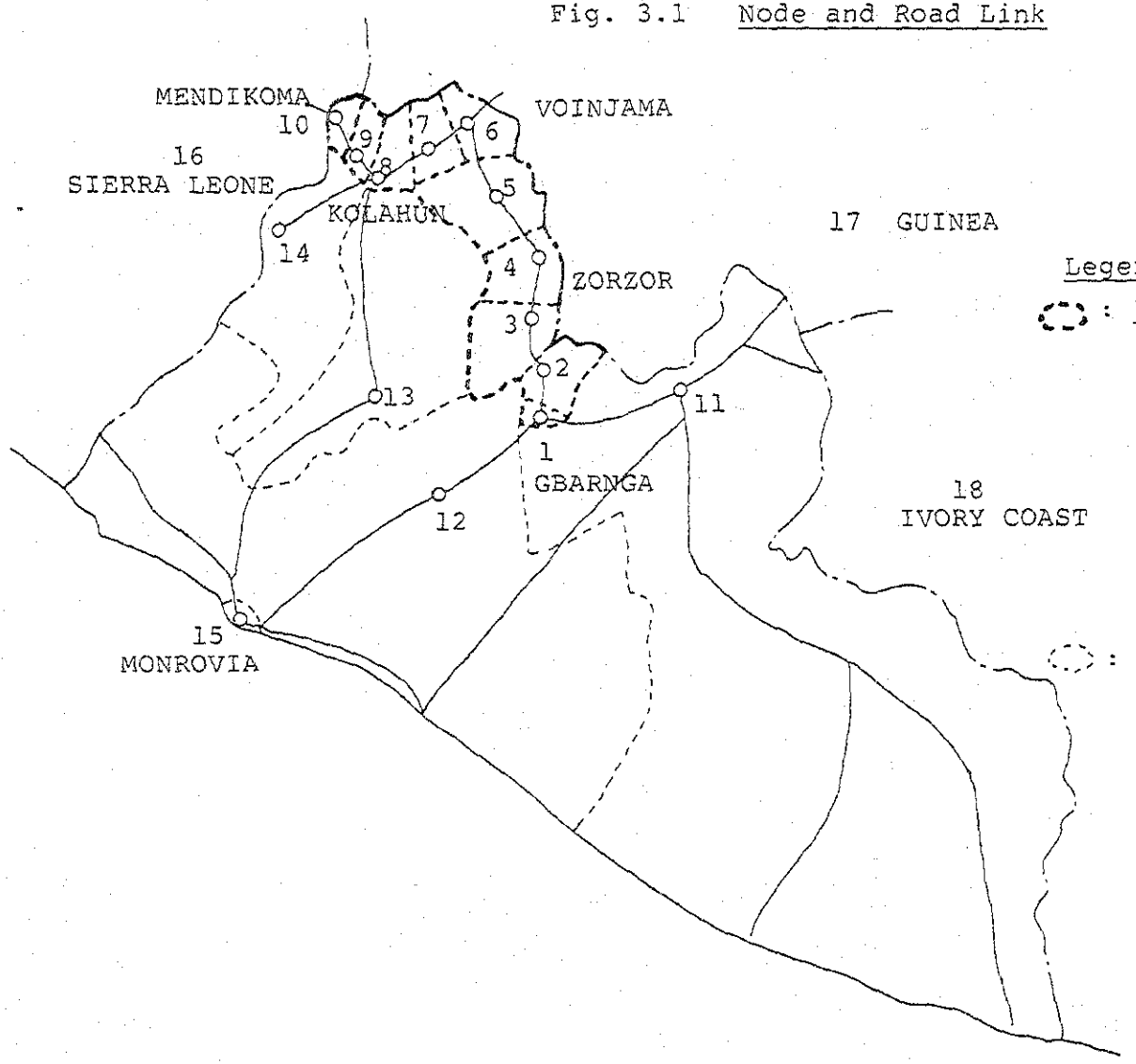
The Gbarnga-Mendikoma road is located in the northwestern part of the country and runs through Upper Bong County and Upper Lofa County. The road constitutes a part of the national primary road that links Monrovia with the northwestern areas of the nation up to the border country, Sierra Leone.

In view of the existing feeder road networks connecting with the Project road, the administrative organization and the regional development program related to the area, the influence area of the Project road is divided into internal influence area and external influence area. The internal influence area, through which the Project road passes and to which direct influence of the Project will be extended, is divided into 10 small zones on the basis of the administrative units of clans. The external influence area, outside the internal influence area, is divided into relatively larger 8 zones based on the administrative units of the country. The zonal system established for the study is summarized in Fig. 3.1 and Table 3.1 together with the link and node system. Important cities and towns are selected as the nodes for the zones. (It is noted that the word "the influence area" to be used hereafter means only the internal influence area).

3.2 Climate

Liberia is topographically divided into 5 different zones such as ever humid, humid, moist monsoon, hot equatorial-tropical and frostless highlands. The study area falls in a hot equatorial-tropical zone. The climate is tropical with clearly divided rainy season from May to November and dry season from December to April. Annual

Fig. 3.1 Node and Road Link



Legend

: Internal Influence Area

1 : Gbarnga
2 : Belefuanai
3 : Golu
4 : Zorzor
5 : Baziwen
6 : Voinjama
7 : Kpakuta
8 : Kolahun
9 : Foya
10 : Mendikoma

: External Influence Area

11 : Ganta
12 : Totota
13 : Belle Yella
14 : Vahun
15 : Monrovia
16 : Sierra Leone
17 : Guinea
18 : Ivory Coast

Table 3.1 Zonal Division

Zone	Clan	District	County
Internal Influence Area			
1.	Jorquellie	Gbarnga	Bong
2.	Jorpool	"	"
	Kporyorquellie	"	"
	Zota	"	"
	Kpaquellie	"	"
	Wruhan	"	"
3.	Gbalin	Zorzor	Lofa
4.	Palama	"	"
	Gizima	"	"
	Vavala	"	"
5.	Ziama	"	"
	Bondi	Voinjama	"
	Wy-Wome Gomai	"	"
6.	Upper Worker	"	"
	Wy-Wome Gomai	"	"
7.	Lower Worker	"	"
	LISCO Camp	"	"
8.	Wulukoha	Kolahun	"
	Tohamba	"	"
9.	Rankolle	"	"
	Wuom	"	"
10.	Tangai	"	"
External Influence Area			
11.	Bellequellie	Gbarnga	Bong
	Gbarnshy	"	"
	Shean-Sue	"	"
	Panta	"	"
11.	Waytua	Gbarnga	Bong
	Wolota	"	"
	-	Kokoya	"
	-	-	Nimba
	-	-	Grand Gedeh
	-	-	Sinoe
	-	-	Maryland
12.	Kpatawee	Gbarnga	Bong
	Suakoko	"	"
	Zeansue	"	"
	Garyea	"	"
	Yaidawon	"	"
	-	Sanoyea	"
	-	Salala	"
	-	-	Grand Cape Mount
	-	-	Montserrado
13.	Lucasu	Kolahun	Lofa
	Yarweyahun	"	"
	Buluyema	Zorzor	"
	-	Belle	"
	-	Gbokomu	"
	-	Bopolu	"
14.	Hassala	Kolahun	"
	Tangai	"	
	-	Guma	"
	-	Gbama	"
15.	-	-	Monrovia
16.	-	-	Sierra Leone
17.	-	-	Guinea
18.	-	-	Ivory Coast

mean rainfall varies from 4,000 to 5,000 mm in the coastal plain to 2,000 mm in the highlands. The study area 2,000 mm to 2,800 mm of rainfall annually on an average. Annual mean temperature is around 21°C-27°C with little seasonal variations

3.3 Geology

In western Liberia, such rocks are commonly found as, unfoliated granite, granitic gneiss, granulite, metasedimentary rocks, amphibolite, sedimentary rocks etc. Diabase dikes are most common in various mafic intrusive rocks.

In the Project area which is located in northwestern part of Liberia, massive granitic rocks and metamorphic rocks with granulite (also including some amphibolites) are found. Most of the soil is ferrallitic soil defined as lateritic soil. The Project area is composed of granite, leucocratic rock and granitic gneiss covered with lateritic surface soil.

3.4 Population

Two national population censuses are available, which are broken down to the size and distribution of the population in Liberia. The first census, conducted in 1962, is summarized separately by three territorial divisions, while the second and the latest census in 1974 is arranged by newly established 14 political sub-divisions of the country.

The total population of the internal influence area, according to the said censuses, is recorded at 104,551 in 1962 and increased up to 154,573 in 1974, with an average

growth rate of 3.3% per annum. The population in the external influence area excluding Great Monrovia increased at a rate of 2.7% per year during 1962 - 1974. Monrovia City showed very high rate of growth in the population, which was estimated at 8.0% per year. Zone-wise population estimated by both censuses is summarized in the following table.

Table 3.2 Zone-wise Population

Zone No.	1962	1974
(1) Internal Influence Area		
1	5,039	10,670
2	15 486	27,148
3	2,248	5,148
4	18,969	27,717
5	12,535	21,569
6	12,303	19,235
7	4,388	6,100
8	12,263	14,213
9	18,599	20,045
10	2,721	2,728
Sub-total	104,551	154,573
(2) External Influence Area		
11	379,276	531,801
12	397,111	548,802
13	34,149	37,574
14	20,123	26,408
15	81,233	204,210
Sub-total	911,892	1,348,795
Total	1,016,443	1,503,368

Because of the inconsistency in the basis of the two censuses, as mentioned hereinabove, it is not appropriate to estimate the past population growth trend for each traffic zone by using these two censuses data. The average annual growth rates of the population both in the internal influence area and external influence area during the period of the two censuses can only be considered as an indicative figure of the past population increase.

Another indicative figures to trace the past trend of the population is the growth trend of some representative indicators on the national level. Those indicators were selected, of which past growth rates were estimated on the basis of the available two censuses as follows:

Population Growth in Urban area	6.8% p.a.
Population Growth in Rural area	2.4% p.a.
Population Growth in Monrovia	8.0% p.a.

Population projection is made for each traffic zone both in the internal influence area and external influence area. In the preparation of the forecast all available information and data were studied which include present and future land use plan, future investment plan for agriculture, forestry, mining, etc. Particularly, agricultural development in the influence area is carefully studied in due consideration of its impact. Experience and results in other developing countries were also checked for this. Based on this the following assumptions are made for the population projection.

1) Present high growth rate both in the internal influence area and external influence area will be kept upto around 1980 but will decline thereafter in accordance with the expansion of family planning and socio-economic change.

2) Because of the implementing agricultural development projects, the areas covered by LCADP /1 and BCADP /2 will sustain relatively higher population growth rates compared with non-covered areas, which are expected to slow down near the end of the century.

3) Present high growth rate in Great Monrovia will go down in proportion to the development and increased employment opportunity in other areas or towns, and will reach 5.0-5.5% at the end of the century.

4) Population growth in Zone-7 depends heavily on the development of the Wologisi mine, which is estimated at 5.5% during 1980 to 1990 and become 2.9% in around 2000.

Respective growth rate for each time period is summarized into the following table.

	Total /1		Rural		Urban		Great Monrovia
	Internal Inf.Area	External Inf.Area	LCADP/ BCADP	Others	LCADP/ BLADP	Others	
1974-76	3.3	2.7	(2.4)	2.4	(6.8)	6.8	8.0
1976-80	3.3	2.7	2.4	2.0	6.5	6.0	7.5
1880-85	3.3	2.5	2.4	2.0	6.0	5.5	6.0
1985-90	2.9	2.3	2.2	1.8	5.5	5.0	5.5
1990-95	2.7	2.2	2.0	1.6	5.0	4.5	5.5
1995-00	2.6	2.0	1.8	1.4	4.5	4.0	5.0
2000-05	2.5	2.0	1.6	1.4	4.5	4.0	4.5

/1: Excluding Great Monrovia

/1: Lofa County Agricultural Development Project

/2: Bong County Agricultural Development Project

Based on the assumed growth rates and the estimated population destribution by zone, population both in the internal influence area and the external influence area is calculated upto 2005, which is presented in Table 3.3.

Table 3.3 Zone-wise Projected Population

(10^3)

Zone	1974	1976	1980	1985	1990	1995	2000	2005	Average 1974-2005
Internal Influence Area									
1	10.7	11.4	12.9	15.0	17.4	20.0	22.6	25.5	2.8%
2	27.2	29.0	33.0	38.5	44.6	51.1	58.0	65.7	2.9
3	5.2	5.5	6.2	7.0	7.9	8.9	9.9	11.0	2.4
4	27.7	29.6	33.7	39.3	45.4	52.1	59.1	66.9	2.9
5	21.6	23.1	26.3	30.7	35.5	40.7	46.2	52.3	2.9
6	19.2	20.5	23.4	27.3	31.5	36.2	41.1	46.6	2.9
7	6.1	6.5	7.4	10.7	12.6	14.5	16.8	19.4	3.8
8	14.2	15.2	17.4	20.3	23.5	26.9	30.5	34.6	2.9
9	20.0	21.3	24.3	28.4	32.8	37.7	42.8	48.5	2.9
10	2.7	2.9	3.3	3.8	4.3	4.9	5.5	6.2	2.7
Sub-total	154.6	165.0	187.9	221.0	255.5	293.0	332.5	376.7	2.9
External Influence Area									
11	531.8	560.9	621.5	700.5	782.8	866.8	950.5	1,044.8	2.2
12	548.8	578.8	646.3	735.8	830.7	929.2	1,029.1	1,143.3	2.4
13	37.6	39.7	43.9	49.4	55.2	61.1	67.0	73.6	2.2
14	26.4	27.8	30.8	34.7	38.8	43.0	47.2	51.8	2.2
Sub-total	1,144.6	1,207.2	1,342.5	1,520.4	1,707.5	1,900.1	2,093.8	2,313.5	2.3
Monrovia									
15	204.2	238.2	318.1	425.7	556.0	726.7	927.5	1,155.8	5.8
Total	1,503.4	1,610.4	1,848.5	2,167.1	2,519.0	2,919.8	3,353.8	3,846.0	3.1

3.5 Land Use

The influence area covers most of the Upper Lofa County and part of the Upper Bong County with a total area of 790,000 ha (or 7,900 km2). The land use is classified by natural forest area, secondary forest/1 and food crops area, tree crop and rubber plantation area and other area/2.

The natural forest is mainly located in Upper Lofa County along the road from Salaye up to the Lofa River. Most of the other areas than the natural forest are used for shifting cultivation of food crops with the interval of 5-10 years. Rubber is planted mostly in upper Bong and southern part of Upper Lofa. The intensity of the land use in the influence area is relatively high compared with other parts of the counties and other regions. Particularly, in such highly populated areas as Zorzor, Voinjama, Kolahun and Foya, agricultural production is conducted with intensive land use. Indicative land use figures are presented below.

Land Use in the Influence Area

Item	Area (ha)	%
Natural Forest /1	241,000	30.5
Secondary Forest and Food Crops	494,200	60.6
Tree Crops and Rubber	15,300	1.9
Others	39,500	5.0
Total	790,000	100.0

/1 : Includes concession area and unprotected forestry.

/1: Used mainly for shifting cultivation.

/2: Other areas include roads, rivers and residential areas and assumed to be 5% of the total area.

3.6 Agriculture

3.6.1 General

Agriculture is the most important economic sector in the influence area in which about 74%/1 of the total population is involved. The agricultural activity is characterized by the following three different types of farming system:

a) Concession farms and plantation
b) Liberian commercial farms and plantation
c) Traditional farms

The concession farms are large, mainly foreign owned enterprises and are operated on land leased from the Government. In the influence area only logging companies are operating under this system. Liberian commercial farms are primarily engaged in rubber production, but also include significant acreage of cocoa, coffee, oil palm and vegetables, and some poultry and livestock breeding. The size of the farms ranges from 2 ha to 500 ha. Traditional farms are, in general, small less than 5 ha and are cultivated by thousands of small-holders. Most of the food crops such as rice, cassava and a part of those cash crops like coffee, cocoa and oil palm in the influence area are produced by these farms.

Lofa County and Bong County, where the Project road is located, are well endowed with agricultural products in Liberia, producing about 40-60% of rice, coffee, cocoa and palm kernels in the nation. There are still enough agricultural potential lands available in these counties, which are now under shifting cultivation or forestry. For the exploitation of these agricultural potential, the Government has embarked on integrated rural development projects both in Upper Lofa County and Upper Bong County since 1976. Both projects aim to increase the agricultural production and

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/1 : Derived from the Feasibility Reports on LCADP and BCADP.

welfare of small Liberian farmers through providing new agricultural technology together with supplying physical and institutional infrastructures including feeder roads development, cooperative and credit, and health program. By these projects significant impacts are expected to be given not only to the agricultural and regional development in the area, but also to the regional traffic.

1) Upper Lofa Country Agricultural Development Project (LCADP)

The LCADP is located in Upper Lofa County with the total area of 3,300 km^2, all of which is included in the influence area of the Gbarnga-Mendikoma Road. About 14,000 farm families (or 71,000 of farming people) live in the LCADP area. The LCADP agricultural service package consists of improved cultivation methods, farm inputs, farm credit, agricultural cooperatives, marketing, banking and health monitoring. To support the agricultural development, the LCADP also includes road improvement, which consists of:

a) upgrading and maintenance of the primary road, linking Foya to Zorzor and 500 km of existing feeder roads; and

b) construction of 100 km of new feeder roads.

This project was commenced in 1976 and part of these road improvement works are now underway by the Ministry of Public Works. The LCADP aims to increase agricultural products through improving the existing cultivation and development of the new cultivating area, and focuses its development on upland rice, swamp rice, coffee and cocoa.

The expected annual incremental agricultural productions in the LCADP area are 10,900 tons of rice, 2,500 tons of coffee and 1,800 tons of cocoa. All the products

of the coffee and cocoa are purchased by LPMC/1 through respective cooperatives established in the districts, and brought to Monrovia for exports. Although a part of rice is consumed by the farmers, the residuals are purchased by LPMC through the cooperatives and be brought to local markets and other regions including Monrovia.

2) Upper Bong County Agricultural Development Project (BCADP)

Following the successful commencement of the LCADP, BCADP started in 1978, jointly financed by IDA/USAID. The BCADP has a total area of 6,500 km^2 with a population of about 19,000 farm families (or 98,000 farming population). A part of the BCADP area, about a quarter of the total area, is included in the influence area of the Project road, which consists of Gbarnga and Panta Districts. Agricultural package to be provided by the BCADP is almost same as that of the LCADP which includes both farming technics and institutional ones. The feeder roads improvement is also included in the BCADP, which are:

a) new construction of 170 km farm to market roads;

b) improvement in the existing 130 km of farm to market roads; and

c) maintenance of about 540 km of the feeder roads.

The Bong County Agricultural Development Project also emphasizes the development of food crops and tree crops such as rice, coffee and cocoa. Annual incremental agricultural productions to be expected in the wholw BCADP area will be 8,740 tons of rice, 3,000 tons of cocoa and 1,500 tons of coffee at the full development stage. All the products of cocoa and coffee are purchased by LPMC

/1 : Liberian Produce Marketing Company

mainly through local traders since cooperatives are not well established and not functioning as a buying agent, and brought to Monrovia. Rice is mostly consumed locally, but residuals are brought to local market and other regions through local traders.

3) Present Production

As mentioned above, the influence area of the Gbarnga-Mendikoma road includes all the LCADP area and a part of the BCADP area. Therefore, present production of major crops in the influence area included in the two project area is firstly estimated on the basis of their current production estimate referring to LPMC purchased volume of the products. Then, those products in the influence area outside the two projects are estimated in due consideration of the farming population, their average holdings and cropping pattern. The estimated products in the influence area/1 are 32,500 tons of rice, 1,800 tons of coffee, 1,500 tons of cocoa and 3,500 tons of oil palm (fresh fruits bunch). Details of the current production estimate are presented in Annex III-1.

4) Surplus Production

Surplus production of the major crops, at present, in the influence area is estimated on the basis of the following assumptions:

a) Per-capita consumption of rice is 100 kg in the influence area.

b) All the products of coffee and cocoa are sold to the market.

c) Per-capita consumption of red oil is 13 kg and all palm kernels are sold to the market.

/1: Beside these products, such minor crops as corn, cassave, banana, sugar cane, etc. are being cultivated, which are produced mainly for self-consumption.

d) Other food crops such as cassava, corn,and sugar cane are mostly consumed by farmers themselves and the marketed volume is negligible.

Marketable Surplus of Crops in 1978/1979

(tons)

Crops	Marketable Surplus
Clean Rice	650
(Paddy)	(1,080)
Coffee	1,800
Cocoa	1,500
Palm Kernel	900
Total	4,850

Around 4,850 tons/1 of agricultural products are the surplus production which can be exported to outside area.

5) Future Production Estimate

Future production of the major crops in the influence area is estimated mainly on the basis of the projected yield increase and expansion of newly cultivated land on LCADP and BCADP and their current progress. Estimated future productions are 51,850 tons of rice (31,100 tons of clean rice), 4,220 tons of coffee, 3,920 tons of cocoa and 17,200 tons/2 of oil palm, which will be attained at the full development stage of both projects in around 1988/1989. Summary of the production is presented in the following table together with the cultivated areas. (Details of the production estimate are given in Annex III -2).

/1: Includes possible exports to the neighboring borders.

/2: Fresh fruits bunch.

Future Crop Production in the Influence Area

(1988/1989)

Crops	Area (ha)	Products (tons)
Upland Rice	29,900	34,460
Swamp Rice	6,000	17,390
(Sub-total)	(35,900)	(51,850)
Coffee	7,900	4,220
Cocoa	7,700	3,920
Oil Palm /1	1,800	17,200

/1 fresh fruits bunch

6) Surplus Production in the Future

Surplus production of the major crops in the future is estimated on the basis of the same assumptions mentioned in the preceding paragraph taking into account 10% increase in per capita consumption of rice and the expected population growth in the influence area. The projected marketable surpluses in around 1987/88 are 7,850 tons of rice (4,710 tons of clean rice), 4,220 tons of coffee, 3,920 tons of cocoa and 4,300 tons of palm kernel.

Forecast of Marketable Surplus /1 of Crops in 1988/89

Crops	Marketable Surplus (tons)
Clean Rice	2,060
(Paddy)	(3,430)
Coffee	4,220
Cocoa	3,920
Palm Kernel	4,300
Total	14,500

/1: Includes possible exports to the neighboring borders

Compared with the surplus volume in 1978/79, the marketable surplus to the outside of the influence area is expected to grow at around 11.5% per annum. After 1989, the growth of the surplus volume will slow down upto around 8% due to the decreasing marginal productivity of the said two projects.

In addition, considerable inputs will be required for sustaining the expected agricultural production. According to the LCADP and BCADP, around 2,700 tons of fertilizer including urea and compound fertilizer are estimated to be required annually in around 1989.

3.6.2 Rubber

In the influence area, rubber is planted mostly along the Gbarnga - Zorzor section. Total area of the rubber farms is estimated at around 2,650 ha on the basis of the previous study/1 and the recent information from Liberian Rubber Development Unit (LRDU). All the rubber farms are owned by Liberians, which are Liberian commercial farms or traditional farms, and are, in general, small in the scale. (Only two farms are operating with more than 200 ha in the influence area.)

Since there is no continuous production records of the farms, annual production of rubber in the influence area is estimated on the basis of the information from farmer's interview and LRDU with the following assumptions:

1) About 32%/2 of the rubber farms is now under tapping; and

/1 : Feasibility Study of the Liberian-owned Rubber Industry, 1975.

/2 : Agricultural Census, 1971

2) Yields[1] are 0.8t/ha and 0.3t/ha for plantation farm and small holder farm, respectively.

The estimated current annual production of rubber is around 370 tons in the influence area as presented below:

Production of Rubber in 1978/79

Farm	Tapping Area (ha)	Yield[1] (t/ha)	Production (tons)
Larger Farms	230	0.8	184
Small Holder	620	0.3	186
Total	850		370

/1 Coagulum

Most of the products are sold to the Liberian Processing Corporation at Gbarnga in the form of specification and non-specification coagulum. Larger farms sell their products to the Firestone in the form of latex.

In order to strengthen the Liberian-owned rubber industry, a rubber development project is being implemented under IBRD finance. Included in the project are Marshall and Bomi Territories, Montserrado, Grand Bassa, Bong and Nimba Counties. The rubber project plans to improve the income and welfare of small and medium farmers, and increase exports through replanting of 16,000 ha of old rubber and rehabilitation of 9,500 ha of matured untapped rubber. About two thirds of the rubber farms within the influence area are included in the IBRD Project.

/1 :Specification or non-specification coagulum

Estimate of future production is rather difficult since rubber production is quite sensitive to the international price changes. However, for the calculation of future traffic projection future rubber production is roughly made in due consideration of the IBRD Project with the following assumptions:

1) The present cultivating area for the rubber will not change in the future; and

2) About 13% of the existing farm will be replanted during next 5 years.

The estimated annual production is around 1,060 tons of coagulum at the full development stage in around 1994, as presented in the table below. Annual increase rate of the rubber production will be around 11.0% during 1984 - 1994, but from the period of 1979 - 1984 no production increase is expected since no tapping will be made for the replanting tree during that period. After 1994, the increase rate is expected to go down to around 8%.

Future Rubber Production in 1994

Farm	Tapping Area (ha)	Yield /1 (t/ha)	Production (tons)
Farms Tapping at Present	700	0.3 /2	210
Re-plant Farms	340	2.5 /3	850
Total	1,040		1,060

/1: Coagulum

/2: Productivity on the farms tapping at present will reduce to 0.3.

/3: This high yield will be attained at 15th year after replanting the trees.