THE MASTER PLAN STUDY
ON
RURAL TELECOMMUNICATIONS NETWORK PROJECT
IN
THE REPUBLIC OF HONDURAS

SUMMARY

NOVEMBER 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the Republic of Honduras, the Government of Japan decided to conduct a master plan study on the Rural Telecommunications Network Project and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Honduras a survey team headed by Mr.Kazushige KOMATSUZAKI, NTT International Corporation, twice between January 1992 and September 1992.

The team held discussions with officials concerned of the Government of Honduras, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

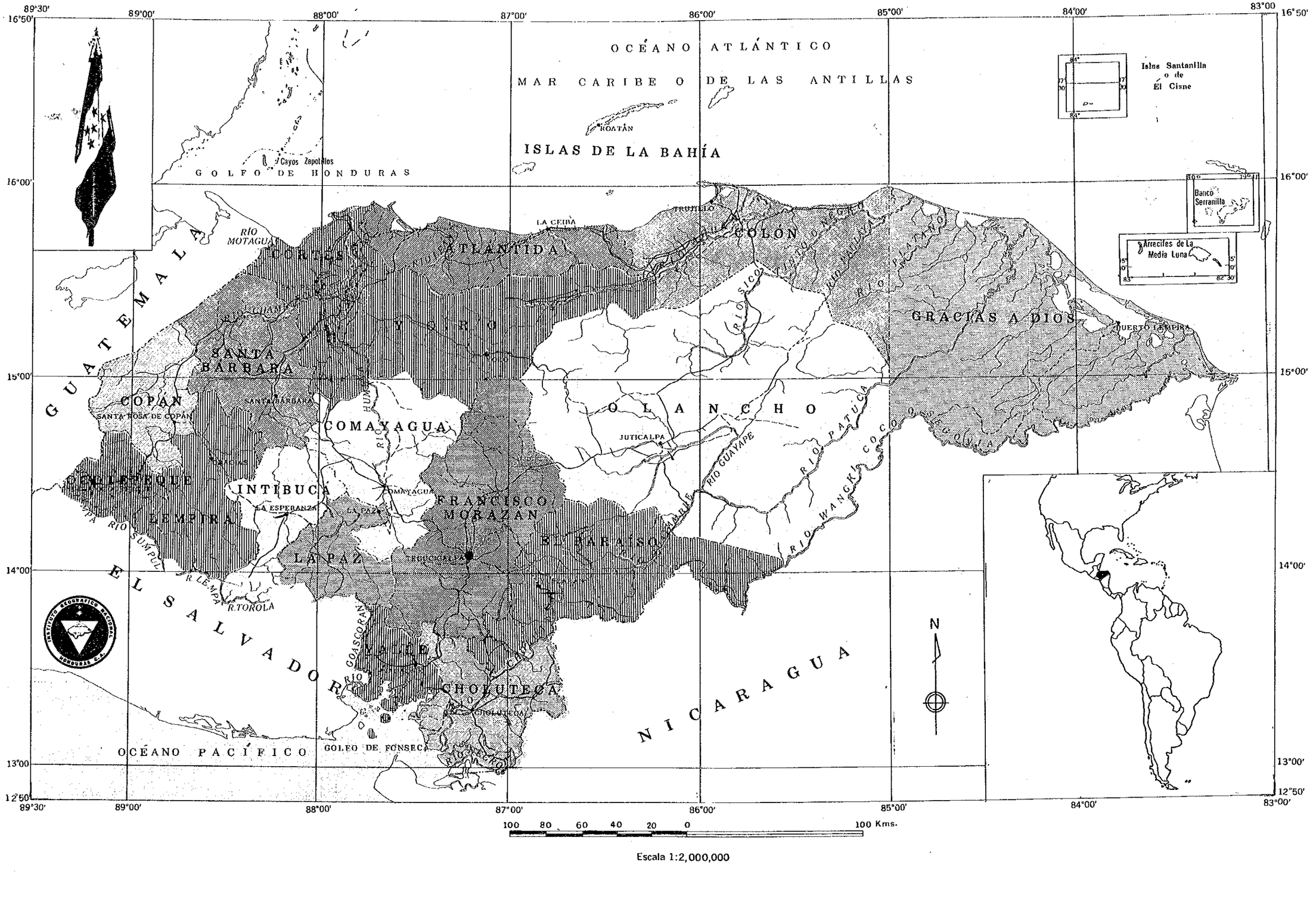
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Honduras for their close cooperation extended to the team.

November 1992

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

THE REPUBLIC OF HONDURAS



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CONTENTS

CODE AND ABBREVIATIONS

1. Exchanges and radio stations

Code	Exchange & Radio Station
AGU	AGUA CALIENTE
CAT	CATACAMAS
CBA	LA CEIBA
CHL	CHOLAMA
CHO	CHOLUTECA
COM	COMAYAGUA
CRQ	CORQUIN
CSS	CENTRO SECUNDARIO SAN PEDRO SULA
CST	CENTRO SECUNDARIO TEGUCIGALPA
CUY	CUYAMEL
DAN	DANLI
FDP	SAN FRANCISCO DE LA PAZ
FLD	FLORIDA
FLE	LA FLECHA
GOA	GOASCORAN
GUA	GUANAJA
INT	INTERNACIONAL (INTERNATIONAL)
JOT	JESUS DE OTORO
JUT	JUTICALPA
LAN	LANGUE
LEM	LEMPIRA
LIM	LA LIMA
LLB	LA LIBERTAD
MIN	MINAS DE ORO
MIR	MIRAFLORES
MRZ	MORAZAN
NAC	NACAOME
NOC	NUEVA OCOTEPEQUE
NRJ	NARANJITO
OCO	NUEVA OCOTEPEQUE
OLA	OLANCHITO
ORI	OAK RIDGE
PAR	EL PARAISO
PAZ	LA PAZ
PCO	PUERTO CORTES
POT	POTRERILLOS
PRI	PRINCIPAL
PRO	EL PROGRESO
PRV	EL PORVENIR

Code	Exchange & Radio Station
PSP	PESPIRE
RIO	RIO LINDO
ROA	ROATAN
SBA	SANTA BARBARA
SBN	SABANAGRANDE
SCY	SANTA CRUZ DE YOJOA
SIG	SIGUATEPEQUE
SLO	SAN LORENZO
SMO	SAN MARCOS OCOTEPEQUE
SPS	SAN PEDRO SULA
SRC	SANTA ROSA DE COPAN
TAL	TALANGA
TAU	TAULABE
TEG	TEGUCIGALPA
TEL	TELA
TOC	TOCOA
TON	TONCONTIN
TRU	TRUJILLO
UTI	UTILA
VAL	VALLE DE ANGELES
VIL	VILLANUEVA
YOR	YORO
ZAM	EL ZAMORANO

2. Others

Abbreviation	Full spelling
COMTELCA	Comision Tecnica Regional de Telecomunicaciones
ITU	International Telecommunication Union
IADB	Inter-American Development Bank
IBRD	International Bank for Reconstruction and Development
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
USAID	US Agency for International Development
ENEE	Empresa Nacional de Energia Electrica
HONDUTEL	Empresa Hondurena de Telecomunicaciones
SANAA	Servicio Autonomo Nacional de Acueductos y Alcantarillados
SECOPT	Secretaria de Comunicaciones, Obras Publicas y Transporte
LE(LO)	Local Exchange (Local Office)
PC	Primary Center
SC	Secondary Center
M.D.C.	Municipio del Distrito Central
GNP	Gross National Product
GDP	Gross Domestic Product
erl.	Erlang
Lps.	Lempiras
p.a.	per annum
mn	million
N.A.	Not available

CHAPTER 1 INTRODUCTION

1.1 Preface

This report is the summary of the report for the master plan study on rural telecommunications network project in the Republic of Honduras which was prepared by Japan International Cooperation Agency (hereinafter referred to as "JICA").

1.2 Background of the Study

The Honduran economy relies primarily on agricultural production, such as banana, coffee, and timber, which is mainly in the rural areas. These three items account for 87% of all Honduran exports. Therefore, it is beneficial for Honduras to develop the agricultural sector in the rural areas. However, rural areas have an underdeveloped infrastructure, with few schools, hospitals, drinking water facilities, or electricity services. The standard of living in rural areas is much lower than that in urban areas.

The development of rural areas, where two thirds of the population live, is very important for the Honduran Government as it is to achieve well-balanced growth. This is also necessary if the government is to encourage continued production in the rural areas and prevent urban migration.

In telecommunications, the total number of main telephone lines was 88,193 in 1990, with a penetration rate of 1.85 lines per 100 inhabitants. This rate is quite low compared with the average for Central America, which was 2.73 per 100 inhabitants. In Honduras, most telephones are in cities having a population over 20,000. In rural areas, telephone and telegraph services are available at public telephone and telegraph-telephone service offices, but these facilities are not enough for the development of the rural community areas.

The Government of Honduras has given high priority to developing a telecommunications network because it is indispensable for social and economic development. The state-owned enterprise responsible for telecommunications services in Honduras, Empresa Hondurena de Telecomunicaciones (hereinafter referred to as "HONDUTEL"), also has made great efforts to expand telephone services in rural areas. However, HONDUTEL cannot afford to set up telephone services in rural areas because of technical and financial difficulties.

Under these circumstances, the Government of Honduras requested the Government of Japan to make a master plan for a rural telecommunications network offering automatic telephone service in January 1990.

In response to this request, the Government of Japan decided to conduct a master plan study on the Rural Telecommunications Network Project and entrusted the study to JICA. JICA dispatched the preliminary study team to Honduras in April, 1991. As a consequence, the scope of work of the main study to follow was determined. Based on the agreement signed among the Ministry of Communications, Public Works and Transportation (Secretaria de Comunicaciones, Obras Publicas y Transporte, hereinafter referred to as "SECOPT"), HONDUTEL and JICA on April 17, 1991, JICA dispatched the Study Team to execute the Master Plan Study.

1.3 Objective of the Study

The objective of the Study is to formulate a master plan covering until the year 2002 for a rural telecommunications network offering automatic telephone service to 223 rural community areas.

CHAPTER 2 OUTLINE OF THE REPUBLIC OF HONDURAS

2.1 Country Profile

2.1.1 Location and geographic features

Honduras is located between 13 and 17 degrees north, 83 and 90 degrees west, almost in the middle of the Central American Isthmus.

The total area is 112,088 square kilometers of which 65% is mountainous. The central and western parts of Honduras have mountain range each with an average elevation of 1,000-1,500 meters. Cultivation is limited to the plains of the coastal areas and the valleys.

2.1.2 Climate

As a characteristic of the tropical countries, its climate varies with the zone: hot, humid and rainy in the north and south, and moderate in the central region. The dry season is from December to May, and the rainy season is from June to November.

2.1.3 Population

The population of Honduras was approximately 4.76 million in 1990 with an annual growth rate of 3.3% over the past decade.

2.1.4 Administration

Honduras is divided into 18 Departamentos (hereinafter referred to as 'Departments') for the purpose of local administration. These are subdivided into autonomous Municipios (hereinafter referred to as 'Municipalities'). Each Municipality consists of several villages.

2.1.5 Education

The illiteracy rate in 1990 was 30.9%. Enrollment ratios, which are expressed as the ratios of pupils to the population of school-age children, in primary school and secondary school were approximately 90% and 20%, respectively in 1990.

2.2 Economic Trends

2.2.1 Economic performance in the 1980s

1) Economic Structure

The agricultural sector, which produces bananas, coffee, and timber, represents the main activity of the Honduran economy. It generates a quarter of gross domestic product (GDP), 90% of exports, and employs half of the economically active population. Its growth rate has stagnated recently.

The manufacturing sector generates 17% of GDP, and employs 12% of the work-force. This sector in Honduras is still labor intensive, and producing processed-food, textile, lumber & wood, and chemicals. Most of these products are for the domestic market.

Over the past decade, no major change in the economic structure was noted, except that the labor share of the agricultural sector decreased from 57% in 1979 to 47% in 1990. Figure 2.2.1-1 and 2.2.1-2 show the share of GDP and labor by sectors.

Figure 2.2.1-1 GDP Share by Sectors

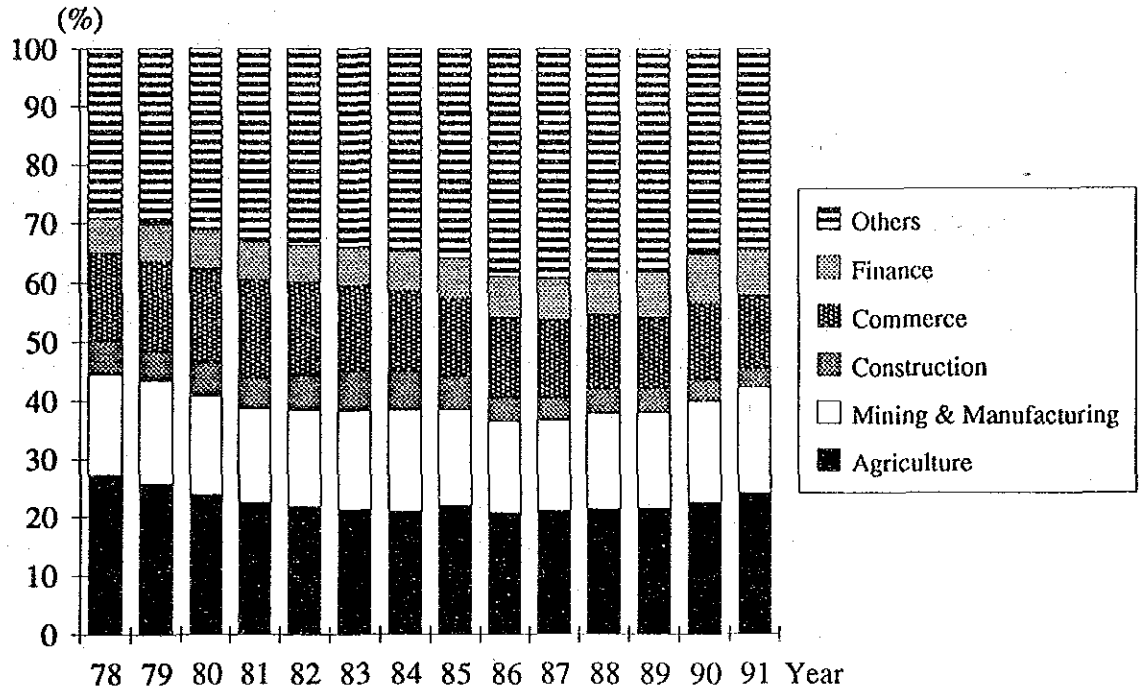
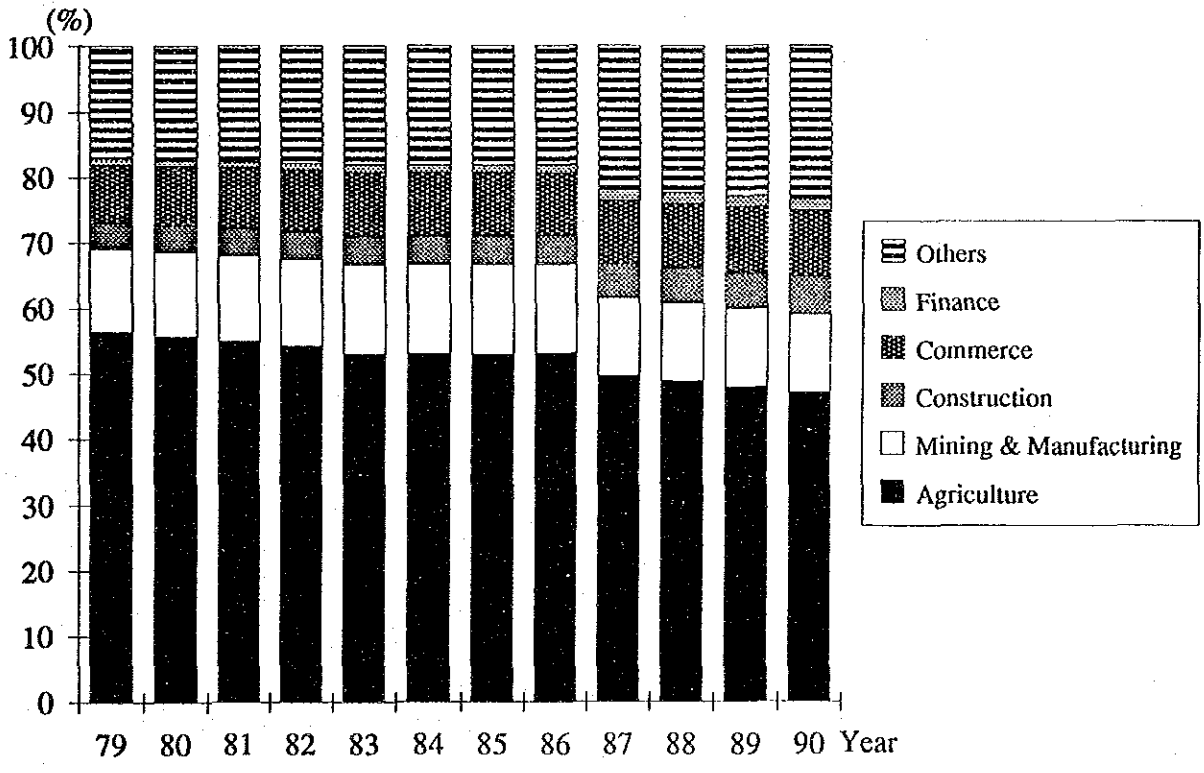


Figure 2.2.1-2 Labor Share by Sectors

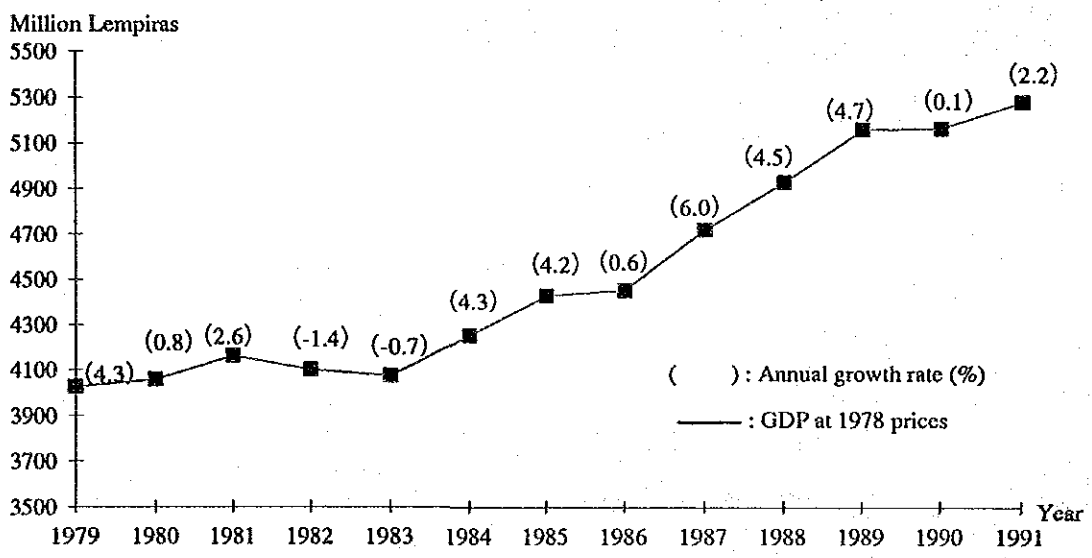


2) Economic growth

The main reasons for the economic recovery between 1984 and 1986 are the increases of public investment concerning the El Cajon dam Project (1981-85), good harvests, and the increase in exports of bananas, crops and coffee.

The economic growth rates in 1987, 1988, and 1989 were 6%, 4.5%, and 4.7% respectively. The growth rate in 1990 was almost zero as a result of flood damage in the northern area, the strike of workers in the banana sector, and fiscal austerity implemented by the new cabinet. Figure 2.2.1-3 shows GDP at constant prices of 1978 and annual growth rate of GDP.

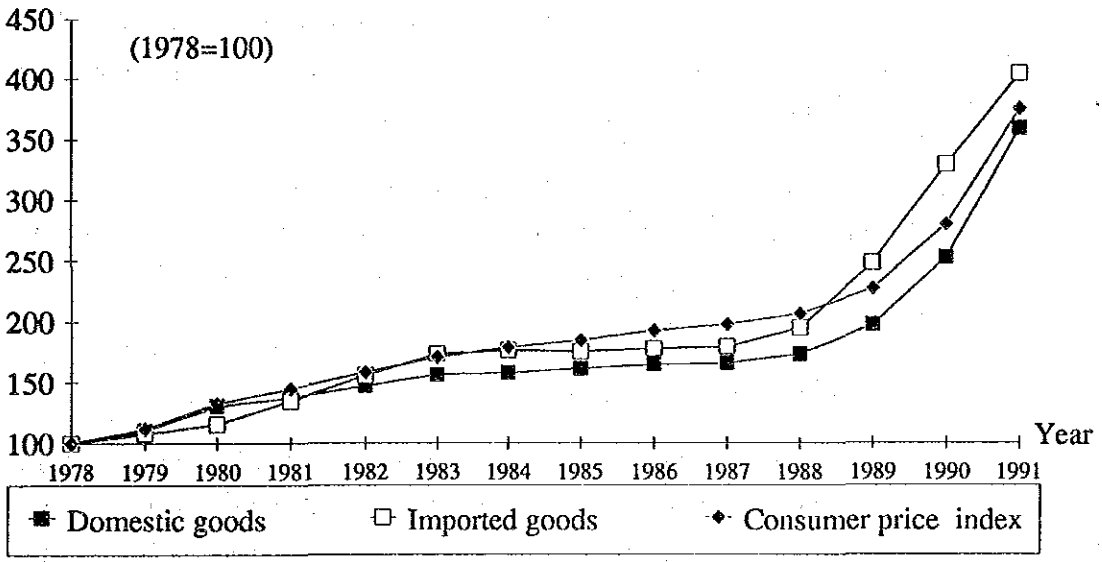
Figure 2.2.1-3 GDP at Constant Prices



3) Prices

The inflation rate in Honduras had been relatively low: the average rate between 1974 and 1979 was 7.6%. From 1980 to 1983, the rise in the prices of primary products and the imported goods caused the inflation rate to stay high. From 1984 to 1987, the stable prices of the main trading partners, and the increased supply of agricultural products and imported goods kept the inflation rate between 2-4%. But in 1989, the rate exceeded 10%. In 1990, the devaluation of Lempira, the increase in charges for public utilities, government-controlled prices, and fruit prices produced an average annual inflation rate of 23%. Figure 2.2.1-4 shows the changes of prices.

Figure 2.2.1-4 Consumer Price Index



4) Public finance

From 1982 to 1984, the increased investment in the El Cajon dam Project, the slow increase of tax revenue caused by weakened prices in the primary markets, and the recession in the national economy increased the deficit to 14.3% of GDP in 1983. The deficit was reduced as a result of tax reform in 1985-86, but increased again after that and was 7.7% of GDP in 1989. After 1990, the new cabinet's fiscal austerity measures such as tax reform and salary reduction for government officials reduced the deficit to 5.3% of GDP in 1990.

5) Balance of payments

a) Trade

For commodity trade, the proportion of bananas and coffee is more than half of the total exports. Others include shrimp, lobster, beef, sugar, wood, lead, zinc, and silver. For imports, raw materials, oil and lubricants account for about 50%, consumption goods and capital goods, 25% each.

The main trading partner, the U.S.A., takes about 50% of the total exports, and provides about 40% of the total imports. Other main destinations for exports are Germany, Italy, and Japan. Japan, Venezuela, and Mexico follow the U.S.A. for providing imported goods.

b) Trend in the balance of payments

There was a deficit in the trade balance during the 1970s which became large during the 1980s. In 1986, there was a surplus in the balance of trade. In 1987, it returned to a deficit again, but in 1989 a surplus was achieved mainly by a rise in zinc exports. There has been a deficit in the services account of the balance of payments primarily caused by the remittance of profits and the increase in the debt interest payment.

6) Exchange

The fixed exchange rate of Lps. 2 (two Lempiras) to the dollar was used for more than a half century. But in the 1980s, the government introduced the parallel exchange rates; the official rate, the interbank rate, and the free rate. In 1990, Callejas cabinet unified the rate.

7) Trade

In March 1990, the range of tariffs was reduced from 0-90% to 2-40%. After March 13, 1990, the export tax on traditional goods was 12% and that on non-traditional goods was 9%. In September 1990, the export tax on non-traditional goods was repealed.

8) Foreign debt

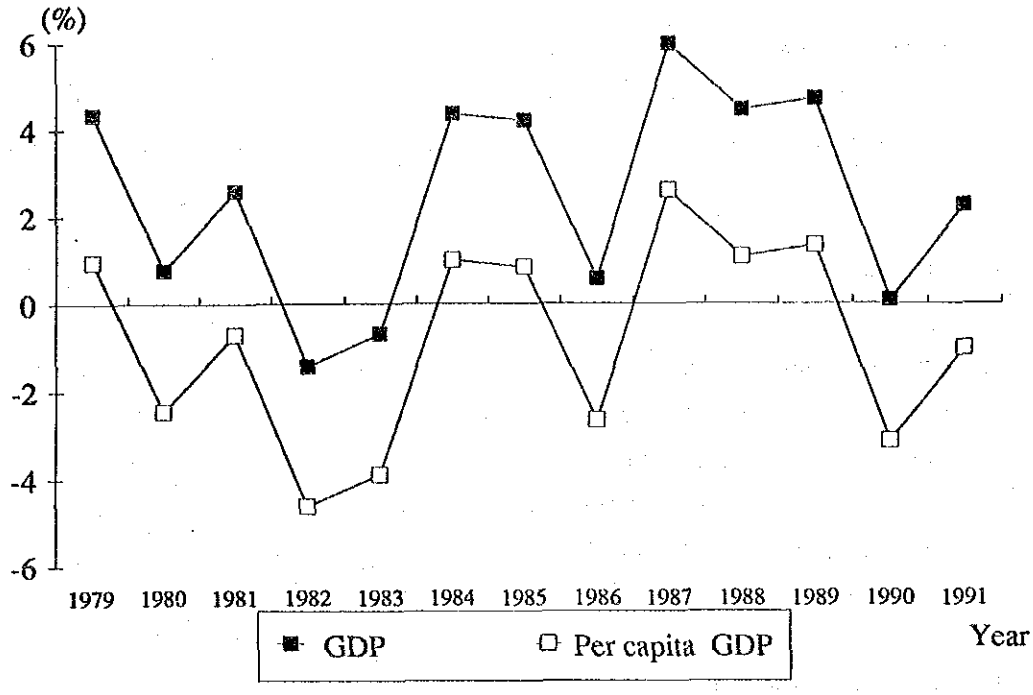
The external debt of US$1,842 mn, or 69% of GNP in 1982, increased to US$2,732 mn, or 82% of GNP in 1985. After 1985, the difficulty in borrowing new loans slowed the increase rate of foreign debt, however, the debt reached US$3,300 mn, or 86% of GNP in 1987. As the debt became large compared to the scale of the national economy, Honduras negotiated with the creditors for the rescheduling of repayment in 1986 and 1989.

2.2.2 Recent economic trends

1) Economic growth

The growth rate of real GDP in 1990 was almost zero and estimated at 2.2% in 1991. As the population growth rate is higher than the economic growth rate, per capita GDP has not increased. Figure 2.2.2-1 shows the growth rate of GDP.

Figure 2.2.2-1 Real GDP Growth Rate



2) Prices

Consumer prices had been quite steady until 1989. In the first quarter of 1991, the year-to-year rise in consumer price exceeded 39%. This was because of "imported" inflation due to the decline of the lempira. Figure 2.2.2-2 and 2.2.2-3 show the change in inflation rate.

Figure 2.2.2-2 Inflation Rate (1986-91)
(Quarterly year-to-year rate)

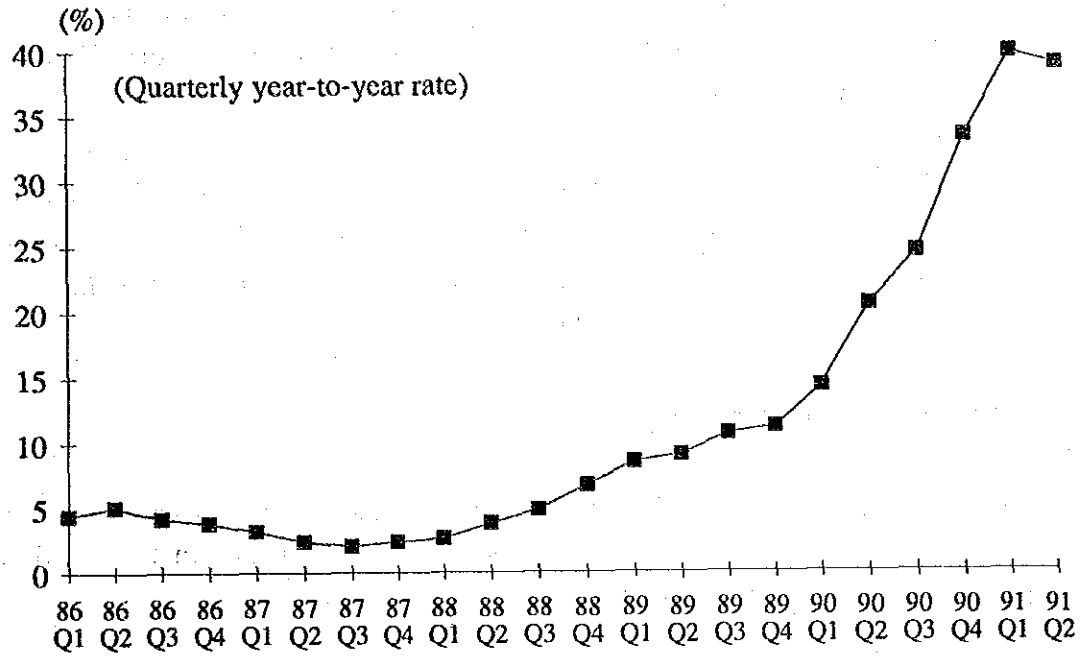
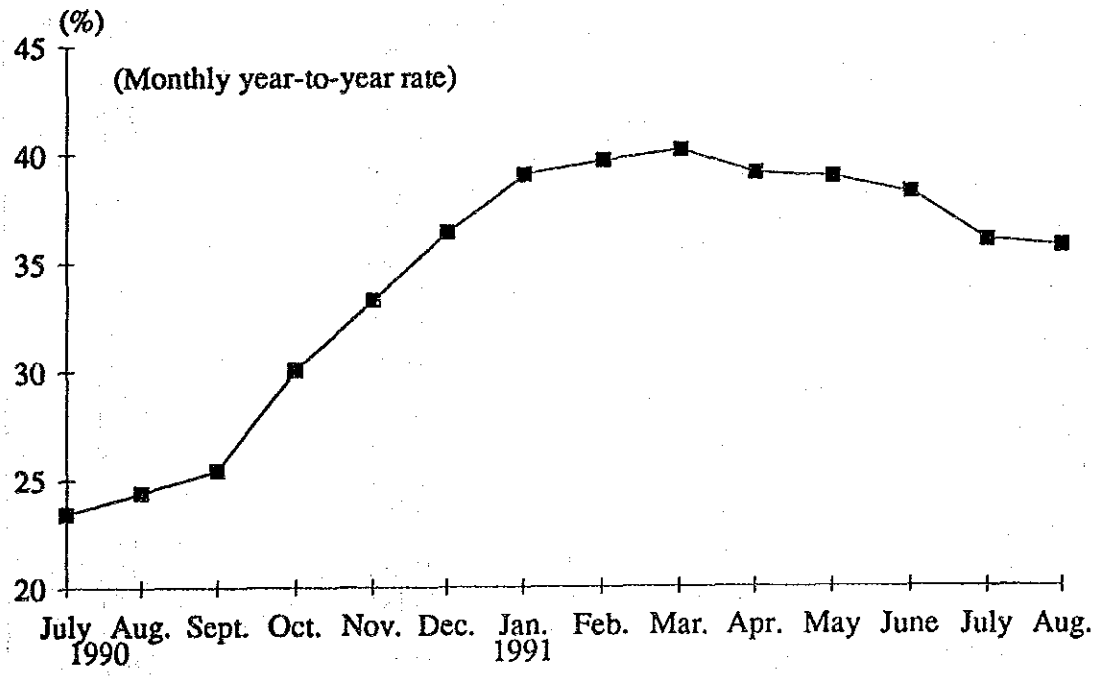


Figure 2.2.2-3 Inflation Rate (1990-91)
(Monthly year-to-year rate)



3) Foreign debt

After the first disbursement of US$25 mn of the Structural Adjustment Loan (SAL) from IBRD in September 1988, the rest was suspended because of the failure in achieving the World Bank conditions in January 1989.

The Callejas administration has given a high priority to solving the debt problem. In June 1990, Honduras tied up a bridging loan with the U.S.A., Venezuela, Mexico, and Japan to clear its arrears with IBRD, IADB, and IMF. This opened the way for a stand-by agreement with the IMF.

4) Economic imbalance between urban areas and rural areas

Table 2.2.2-1 shows income tax by each Department. As can be seen, the differences in annual income taxes per taxpayer are quite large. This means that there exists large economic imbalances among regions.

Table 2.2.2-1 Individual Income Tax by Department

Department	[A] (*) Individual income tax (1990) (Thousands of Lempiras)	[B] (**) Economically active population (1988) (Persons)	[C] [A] / [B] (Lempiras/Persons)
FRANCISCO MORAZAN	67,471.6	289,861	232.8
COMAYAGUA	2,739.3	70,350	38.9
LA PAZ	243.3	30,901	7.9
OLANCHO	688.7	77,720	8.9
ATLANTIDA	7,281.2	71,367	102.0
COLON	357.9	41,453	8.6
CORTES	67,031.8	230,349	291.0
ISLAS DE LA BAHIA	352.2	7,862	44.8
YORO	2,244.2	96,741	23.2
GRACIAS A DIOS	7.9	9,033	0.9
COPAN	1,571.7	68,497	22.9
INTIBUCA	43.7	35,417	1.2
LEMPIRA	51.7	52,518	1.0
OCOTEPEQUE	81.1	22,121	3.7
SANTA BARBARA	289.1	87,384	3.3
EL PARAISO	1,176.8	77,654	15.2
CHOLUTECA	1,972.9	89,656	22.0
VALLE	104.6	34,181	3.1
TOTAL	153,709.7	1,393,065	110.3

Source: (*) Information presented for this Study by Ministerio de Hacienda y Credito Publico
(**) "DIAGNOSTICO EMPRESARIAL 1990", HONDUTEL

2.3 National Development Plan

2.3.1 Macroeconomical goals

For the 1991-1995 period, an economic recuperation is projected with a growth rate ranging between 3% and 4%. This performance will be due to an expected increase in exports and private investment. The total amount of financial requirements for 1990-94 is US$2,489 mn.

2.3.2 Social goals

- During the 1991-1994 period, literacy training to 260,000 people is expected to provide.
- For peasant women, 200 centers will be opened to provide literacy training for 10,000 women.
- The student/teacher ratio is expected to be reduced from 80 to 30-40 students per teacher.
- 100 agro-industrial technical education centers are expected to be created, with a capacity of 80 students each.
- The drinkable water supply will cover 73% of the rural areas.
- Nearly all of the children under one year old is planned to be vaccinated.

2.4 Regional Development Plans

The average number of the plans per Department (a.d.) and the average number of the plans per Municipality (a.m.) are as follows:

- a.d. : 18.3 plans
- a.m. : 1.71 plans

The plans were projected such that provision for the improvement of the infrastructure was given priority in each Department in Honduras.

- Construction and maintenance of schools : 66 plans
- Construction and maintenance of roads : 61 plans
- Construction and maintenance of water supply facilities : 47 plans
- Construction and maintenance of sewerage drain facilities : 39 plans
- Installation and supply of electric power facilities : 36 plans

2.5 Features of Rural Areas

The features of 191 villages that the Study Team actually visited are as follows:

1) Most villages are isolated by mountains, rivers, and wilderness.

2) Villages in the northern part exist among banana or palm trees.

3) 49 villages do not have electricity service.

4) 191 villages do not have general telephone service.

5) 11 villages do not have water supply service.

6) 23 villages do not have postal service.

7) 169 villages have health centers.

8) 191 villages have elementary schools.

9) 124 villages have secondary schools.

10) Most houses gather in an area of one square kilometer surrounding the center of each village.

11) The population of more than half villages is 1000-3000.

12) Service qualities of electricity and water supply are poor.

13) Access road conditions to the villages are bad.

14) Some rivers have no bridge.

15) Most people are engaged in the agricultural sector.

16) The scale of agriculture and stock-farming is very small.

17) Large scale agriculture and stock-farming can be seen only in the plains.

CHAPTER 3 PRESENT STATE OF TELECOMMUNICATIONS IN HONDURAS

3.1 Organization

Governmental organizations in charge of telecommunications are the Ministry of Communications, Public Works and Transportation (Secretaria de Comunicaciones, Obras Publicas y Transporte, hereinafter referred to as "SECOPT") and HONDUTEL.

SECOPT, which controls HONDUTEL, oversees policies on telecommunications and coordinates them with other policies.

3.2 Present State of Telecommunications Services

3.2.1 Present state of telecommunications services in Honduras

1) Menu of telecommunications services

In addition to the general telephone service, other telecommunications services available in Honduras are paging service, telex service, data communications service by means of a packet switching system, telegraph service, and leased circuits service.

All telecommunications services are offered by HONDUTEL except the paging service, which is offered by two companies in the private sector: MELECTRO and RADIO SISTEMA BUSCA PERSONAS (R.B.P.).

2) General telephone service

The general telephone service is provided by automatic or manual connection. In the automatic connection telephone service, the local, toll, and international calls are connected automatically by subscriber's dialing. For toll and international calls, operator assistance is available.

The number of the main lines was 92,386 and the telephone penetration rate was 1.88 main lines per 100 inhabitants at the end of 1991. The number of main lines increased by around 10% per year until 1991 and was double the number in 1985.

Table 3.2.1-1 shows the growth in the number of main lines and the penetration rate from 1980 to 1991.

Table 3.2.1-1 Growth of Telephone Lines

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Main Lines												
Automatic	28,944	31,468	33,159	35,365	43,105	45,909	49,659	53,858	65,787	78,014	87,466	91,666
Manual	492	584	629	629	629	310	467	543	689	675	727	720
Total	29,436	32,052	33,788	35,994	43,734	46,219	50,126	54,401	66,476	78,689	88,193	92,386
Ratio to the year before	1	1.09	1.05	1.07	1.22	1.06	1.08	1.09	1.22	1.18	1.12	1.05
Population (thousand)	3,431	3,545	3,663	3,785	3,911	4,041	4,175	4,313	4,457	4,605	4,758	4,913
Main Lines /100 Inhabitants	0.86	0.90	0.92	0.95	1.12	1.14	1.20	1.26	1.49	1.71	1.85	1.88

Source:

Main lines: Data presented by HONDUTEL for this Study.

Population: "Honduras en Cifras" by Central Bank of Honduras, except for the year 1991, which was estimated by average increase rate, or 3.3%.

The general telephone service is offered by automatic or manual connection. 99% of the service is offered by automatic connection.

3) Telecommunications service in rural area

Rural telecommunications service is offered through service offices of HONDUTEL located throughout the country. These offices are classified into four types: Telegram service office, Telegram and telephone service office, Telephone service office, and Radio service office. They number 200, 152, 47, and 21 respectively.

The telegram service offices of HONDUTEL are equipped with a Morse telegraph device that is very old and obsolete.

The telephone set equipped at the telephone service offices is an old type magnetic telephone set connected to a manual board.

The present situation of telecommunications services at the 223 subject areas are as follows:

a) Telephone service

HONDUTEL service offices are located in these areas to offer public telephone service as follows:

- Public telephone and telegram service office : 75 areas
- Public telephone service office : 13 areas

b) Telegram service

Telegram service is available at HONDUTEL service offices where public telegram service is offered, are located in the following areas.

- Public telephone and telegram service office : 75 areas
- Public telegram service office : 94 areas

3.3 Present State of Telecommunications Facilities

3.3.1 Exchange

Exchanges are local, toll, local-toll combined, and international. At all levels, digital exchanges, analog electronic exchanges, crossbar exchanges, crosspoint exchanges, step by step exchanges, and manual exchanges are used in Honduras.

1) Local Exchange

Local exchanges are used to connect subscribers. Two digital exchanges, two analog electronic exchanges, 14 crossbar exchanges, 12 crosspoint exchanges, one step by step exchange, and eight manual exchanges are installed.

2) Toll Exchange

One crossbar exchange was installed each in Tegucigalpa and San Pedro Sula in 1973.

3) Local-toll Combined Exchange

One digital exchange for local-toll exchange was installed in each of Tegucigalpa, San Pedro Sula, and La Ceiba in 1987 and one crossbar exchange for local-toll exchange was installed in each Comayagua and Choluteca in 1973.

4) International Exchange

One digital exchange to handle international calls was installed in Tegucigalpa in 1989.

3.3.2 Outside plant facilities

1) Configuration of subscriber line system

a) Subscriber line facilities

The flexible distribution system is used in large cities such as Tegucigalpa. HONDUTEL is planning to adopt the flexible distribution system gradually in Honduras. The direct distribution system is used at small exchange sites in rural areas.

b) Civil facilities

HONDUTEL has many conduit pipes and manholes in urban areas. There are no civil facilities in the rural area except for some short sections of a small scale in a few areas.

2) Configuration of the junction cable network

HONDUTEL has junction cable facilities in Tegucigalpa mainly.

3.3.3 Transmission facilities

Two transmission systems, namely radio and wire transmission systems, are utilized in Honduras.

The earth station named "Lempira" is installed for international telecommunications through the INTELSAT satellite.

1) Radio transmission facility

a) Digital microwave facility

Digital microwave links in Honduras are classified into two groups; trunk links which use an 8 GHz frequency band and spur links which use a 2 GHz frequency band.

b) Analog microwave facility

Analog microwave links were installed to connect the five capitals of Central America (Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica). They are international radio links which use the 4GHz frequency band and have a capacity of 960 channels. However, the digitalization of those links is currently being performed.

c) Analog VHF and UHF radio facility

Four kinds of low capacity VHF and UHF radio links using 900 MHz, 400 MHz, 160 MHz, and 150 MHz frequency bands have been installed to connect local cities.

d) Domestic satellite telecommunications facility

24 satellite earth stations have been installed to connect the isolated rural cities. The satellite was launched by PANASAT of the U.S.A.

e) International satellite facility

A Standard-A earth station has been installed in Honduras.

f) Radio-telephone and radio-telegraph facility

Six radio-telephone stations and 21 radio-telegraph stations which use high frequency bands have been installed.

2) Wire transmission facility

a) Optical fiber transmission facility

Two optical fiber transmission links which connect Palacio-Miraflores, Palacio-Toncontin have been installed.

b) PCM transmission facility

There is a link of PCM transmission system.

c) Pair wire transmission facility

There are seven links of pair wire transmission system.

3.3.4 Telecommunications facilities in the subject areas

There are two kinds of transmission systems for these rural areas. One is the wire transmission system using mainly open wire, another is the radio transmission system.

In the area near a city, two-wire circuit (open wire) is widely used for the telephone circuit with metallic cable sometimes being used.

On the other hand, a single open wire system named the B-WIRE SYSTEM is used for telegraph service in the areas far from city.

The telecommunications media in the service office is a single and obsolete Morse telegraph set and magnet telephone set.

CHAPTER 4 DEMAND FORECAST

4.1 Method of Estimation

All the subject areas are located in rural areas and have similar socio-economic conditions such as population distribution and product per capita, even with some differences in the industrial and geographical conditions. Therefore, the sampling method for a field survey study will be applied to the Study for demand forecast.

4.2 Macroscopic Demand Forecast

The trends in population increase, number of subscribers and the economic growth in Honduras are shown in Table 4.2-1

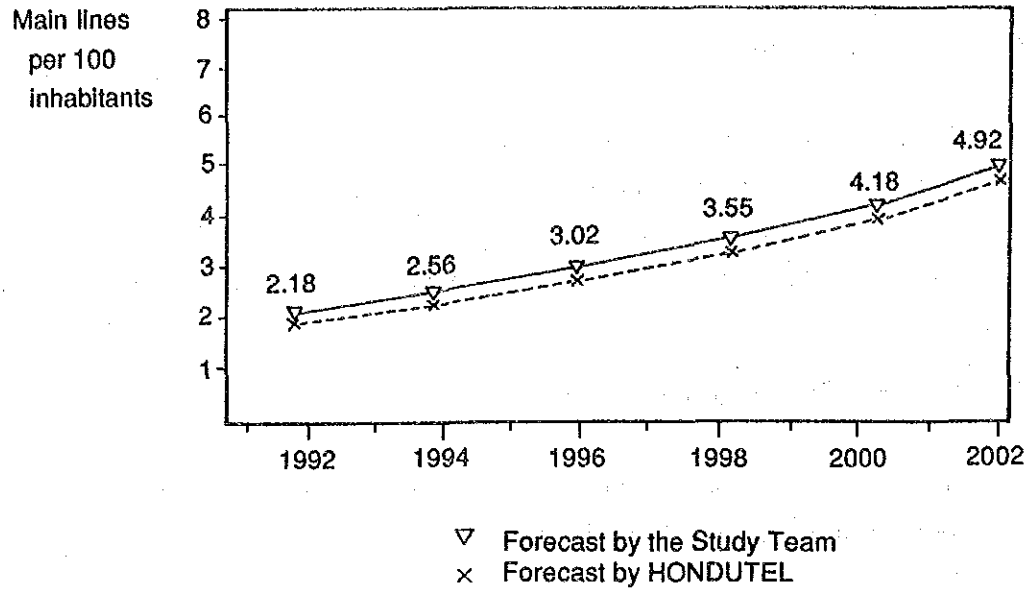
Table 4.2-1 Trend of Socio-economic Condition and Telecommunications Development

			1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
*1	Main line	thousand lines	28.6	31.2	33.3	34.4	43.1	45.9	50.1	54.4	66.5	78.7	88.0
*2	GDP (at 1978 prices)	million Lempiras	4057	4162	4102	4073	4250	4428	4453	4719	4929	5161	5165
*3	Population	thousand inhabitants	3431	3545	3663	3785	3911	4041	4175	4313	4457	4605	4759
	Telephone density	lines/ 100 inhabitants	0.83	0.88	0.91	0.91	1.10	1.14	1.20	1.26	1.49	1.71	1.85

Source: * 1 HONDUTEL
* 2 CENTRAL BANK OF HONDURAS
* 3 CENTRAL BANK OF HONDURAS

The chronological model is extrapolated for the demand forecast in the Study. The results of estimation are shown in Figure 4.2-1.

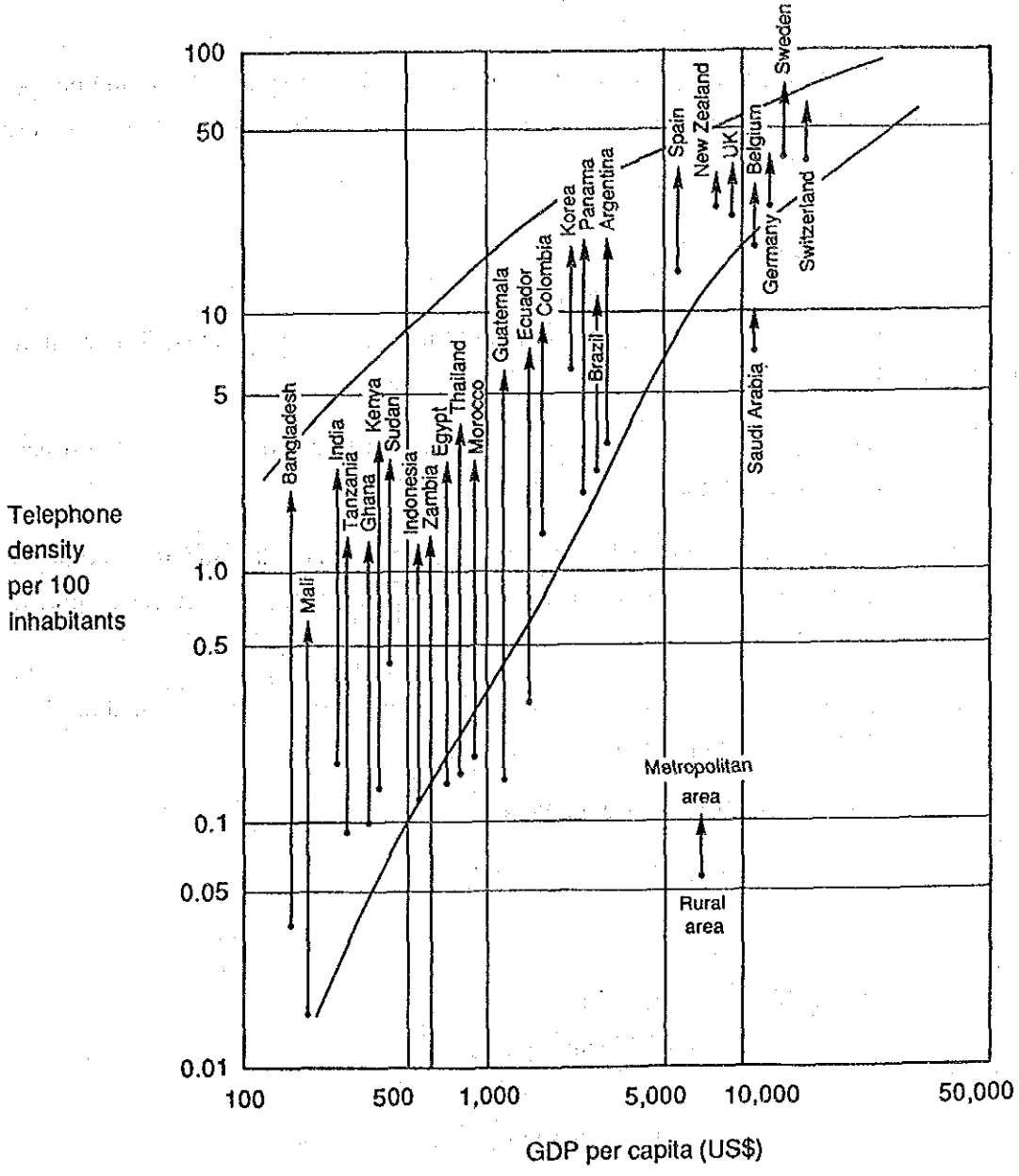
Figure 4.2-1 Demand Forecast in Honduras



In general, there is a correlation between telephone density in the metropolitan areas and the rural areas and GDP per capita as shown in Figure 4.2-2. An average range for the demand rate in the subject areas was estimated from the correlation.

The demand rate in the rural areas is approximately 1/10 to 1/20 of the demand rate in the metropolitan areas. Since the demand in metropolitan areas was estimated to be 13.49 main lines per 100 inhabitants in the year 1992, the demand in rural areas was estimated from 0.7 to 1.4 lines per 100 inhabitants. For the demand forecast, the chronological model is extrapolated.

Figure 4.2-2 Telephone Density in Metropolitan Areas and Rural Areas



Source: ITU, "The Missing Link" Addendum IV, 1984

4.3 Microscopic Demand Forecast

4.3.1 Field survey

The results of the field survey showed that the average demand was 1.19 main lines per 100 inhabitants. The demand is roughly classified as 70% private use, 23% official use and 7% public telephones.

4.3.2 Analysis and building model

A model was built to estimate telephone demand for the non-survey areas. The methods are as follows :

a) All the subject areas were classified into one of four groups: general, tourism, factory, and border area.

b) The general areas are distributed throughout the country and they could be grouped appropriately into 9 regional blocks according to their geographical, cultural, and socio-economic conditions.

c) Important factors considered to exert influence on demand were selected. They should be obtained in the non-survey areas.

d) The model equation is shown below.

$$Y = (X_1)^A \times (X_2)^B \times (X_3)^C \times (X_4)^D \times E$$

where

Y : Telephone demand
(X_1) : Tax income of Municipality
(X_2) : Population of subject area
(X_3) : Time required to main city
(X_4) : Capital of Municipality or not
A, B, C, D, E: Coefficients

4.3.3 Telephone demand in total subject area

Telephone demand in 191 survey areas was estimated using the results of the field survey. Telephone demand in non-survey areas was estimated using the model equation.

The results of estimation for the total subject area show that the total demand was 6,077 and the demand rate per population was 1.19 lines per 100 inhabitants.

4.3.4 Future telephone demand

Telephone demand up to the year 2002 was forecast based on the demand in 1992, considering the future population and penetration rate.

In the first half of the decade from 1992 to 2002, the rate of increase in demand is anticipated to keep pace with the rate of increase in population, which is 3.39%, 3.43%, 3.46%, 3.49%, and 3.52% p.a. respectively. In the latter half of the decade, the rate of increase is assumed to be the same as that in urban areas, which is estimated to be 10.9% p.a.

The result of the forecast for the total of the subject areas shows that the total demand in 2002 will be 12,090. This means the demand will be 1.66 lines per 100 inhabitants, as shown in Table 4.3-1. HONDUTEL's estimate produced a similar figure (1.5-2.0).

Table 4.3-1 Total Telephone Demand for the Subject Areas

	Unit	1992	1994	1996	1998	2000	2002
Population	10^3	508.8	544.1	582.6	624.5	670.4	729.5
Demand	lines	6,077	6,512	6,978	8,023	9,837	12,090
Demand rate	%	1.19	1.20	1.20	1.28	1.47	1.66

Note : Demand rate(%) = (Demand / population) x 100

CHAPTER 5 TRAFFIC FORECAST

5.1 Base of Traffic Forecast

It is preferred to forecast the rural telephone traffic in the future based on factors given through analysis of existing data, though these data are not available in a classified form in many cases. The raw data are then collected to estimate the factors.

In this Study, reliable raw data in the form of communications tickets for the rural public telephones and telegrams were obtained in addition to the partial statistic data for the telephone exchanges in the urban network. Useful statistics for the rural network traffic were not obtained.

5.2 Traffic on the Existing Network

5.2.1 Rural public telephone traffic

Rural telephones are located at about 200 HONDUTEL offices throughout the country. Complete communication tickets for the five public telephone offices shown in Table 5.2.1-1 were obtained. They were the tickets of calls made for one month from January to February 1992 and counted 438 in total. In addition, traffic data from the Tegucigalpa manual boards, which indicated the date and destination of 538 calls of 12 offices made from September 1991 to January 1992 through the boards, were obtained.

Through analysis of the communication tickets of the five offices, it was found that the day with highest traffic was Thursday, and about 19% of one-day traffic was concentrated in the hour starting from 8:00 in the morning. The average calling rate of busiest traffic hour of those public telephones was calculated to be 0.049 erl. per line.

Table 5.2.1-1 Selected HONDUTEL Offices of Rural Public Telephone Service

HONDUTEL office	Department	Abbreviation	Population
Villa de San Antonio	Comayagua	AN	3,741
Ajuterique	Comayagua	AJ	3,734
Lejamani	Comayagua	XW	2,861
El Rosario	Comayagua	SA	1,843
Yarumera	La Paz	YR	2,152

Note: The populations are according to the National Census 1988, except for Yarumera, which is an estimation of HONDUTEL for the year 1990.

An analysis result of the traffic data of Tegucigalpa manual boards indicated that the calls to M.D.C. accounted for 89% of the total, while those to other communities in Francisco Morazán Department accounted for 3% with the other 8% going out of the Department.

5.2.2 Telegram traffic

Telegram service is offered at about 350 HONDUTEL offices located in the country. As a rule 50 completed telegram forms were collected from each of ten HONDUTEL offices shown in Table 5.2.2-1. The forms were those made from December 1991 to January 1992.

According to the analysis results, on average, those directed to destinations within its own Department accounted for 19.4%, those to Francisco Morazán, where the capital is located, accounted for 23.44%, those to Cortés, where San Pedro Sula, the second largest city of Honduras is located, accounted for 13.3% of a total, and the rest were directed to different points in the country.

Table 5.2.2-1 Selected HONDUTEL Offices of Telegraph Service

Office	Department	Population
Limón	Colón	2,174
Minas de Oro	Comayagua	2,937
La Entrada	Copán	9,570
Corquín	Copán	3,397
Santa Cruz de Yojoa	Cortés	5,144
Triunfo	Choluteca	4,670
Magdalena	Intibucá	721
San Francisco de la Paz	Olancho	4,344
San Marcos	Santa Bárbara	3,229
Langue	Valle	2,921

Note: The populations are according to the National Census 1988, except for that of La Entrada, which is an estimation of HONDUTEL for the year 1990.

5.2.3 Automatic telephones in the urban telecommunications network

Urban telephone traffic data was collected for the purpose of finding a tendency in the calling rate of subscriber telephones. The calling rate of selected exchanges in 1990 and 1992 is shown in Table 5.2.3-1.

Table 5.2.3-1 Calling Rate of Selected Exchanges (Total of origination and termination)

Exchange	Year		Exchange	Year	
	1990	1991		1990	1991
PRI-II	0.86	0.13	CHO	0.07	0.07
MIR	0.26	0.10	COM	0.05	0.07
TON	—	0.07	SIG	0.03	0.06
DAN	0.03	0.06	PAR	—	0.02
JUT	0.06	0.07	PAZ	—	0.02
CAT	0.08	0.07	SLO	—	0.02

Source: Presented by HONDUTEL for this Study.

5.3 Traffic Estimation Factors

5.3.1 Calling rate

The average calling rate of busiest one hour of rural public telephones to be introduced in the rural network was settled to be 0.10 erl. per line in total and that of general subscriber telephones to be 0.05 erl. per line in total, by referring to CCITT GAS-6 and in reference to the collected data analysis results.

5.3.2 Percentages of traffic categories

Using the case of the smallest exchange of the exchange model of CCITT GAS-6, 25% of the total origination traffic was applied to the traffic terminating in its own community area.

For the Departments other than Francisco Morazán, the traffic going to its Department capital, to other communities in the same Department, and going out of the Department were determined, by to be 6%, 13%, and 81%, respectively, of outgoing traffic. For the Francisco Morazán Department, they were determined, to be 89%, 3%, and 8%, respectively, of outgoing traffic.

5.3.3 Holding time

HONDUTEL's average measured holding time is as follows. Those values should be referred to in making a system design.

- Local call: 180 seconds
- Toll call: 264 seconds
- International call: 306 seconds

CHAPTER 6 BASIC TELECOMMUNICATIONS NETWORK PLAN

6.1 General

The new national telecommunications network will be developed as one which incorporates the rural telecommunications network in it. In other words, the rural telecommunications network will be added to the national telecommunications network as parts to develop the latter, being structured compatible technically with the existing national telecommunications network.

6.2 Structure of National Telecommunications Network

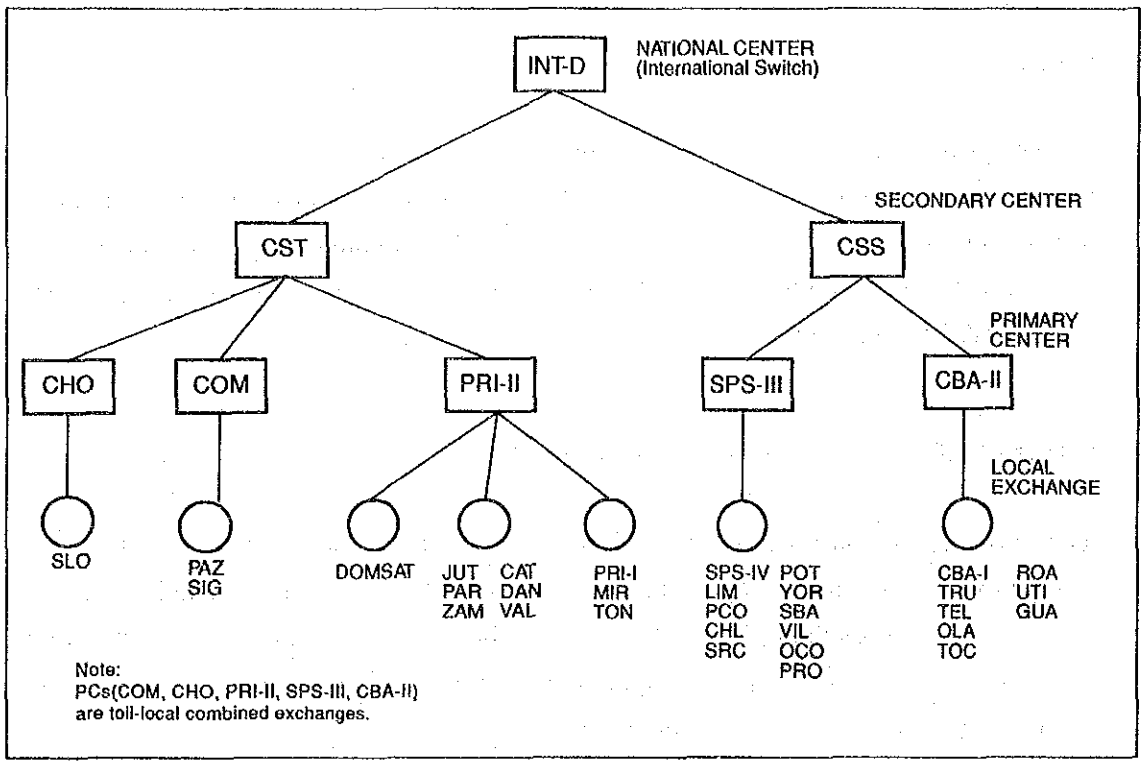
The existing national telecommunications network places the national center, or the international switch at the top of the network hierarchy. Secondary centers, primary centers, and local exchanges are placed under the national center to form a pyramid shape. Figure 6.2-1 shows the corresponding position of each exchange in the hierarchy of the existing national telecommunications network.

The international switch is placed in the national capital Tegucigalpa. The secondary centers are located in two cities; Tegucigalpa and San Pedro Sula. The service area of the secondary center is called the secondary area. The primary centers are located in Tegucigalpa, San Pedro Sula, La Ceiba, Comayagua, and Choluteca. The service area of the primary center is called the primary area. The local exchanges are located in major cities in the country. Local exchange service area is called the local area.

The existing primary centers are all toll-local combined exchanges, using the same hardware. It is split into two parts: the local function part and the toll function part.

The new national telecommunications network will be integrated in a form which incorporates the rural telecommunications network with the existing telecommunications network. Accordingly, the existing telecommunications network will be made larger and remain substantially unchanged. Rural subscribers will be connected to a local exchange directly or incorporated into the new national telecommunications network via exchanges in urban areas.

Figure 6.2-1 Exchange Hierarchy



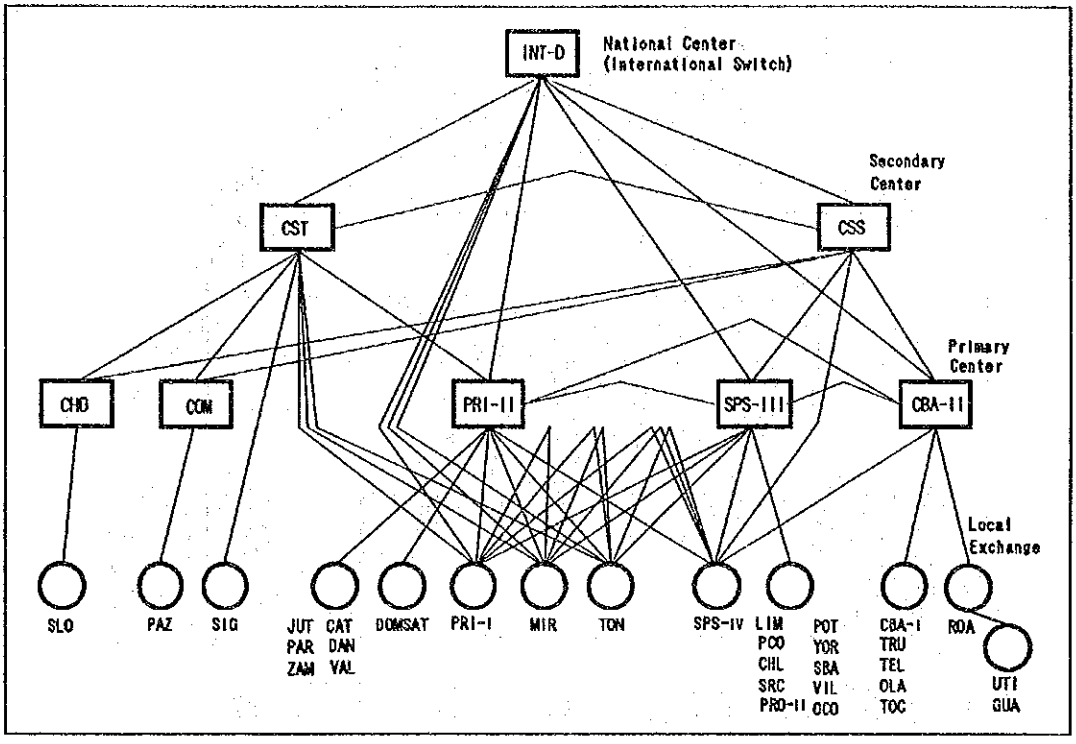
6.3 Routing Plan

6.3.1 Existing routing plan

Honduran switching stages are structured into hierarchy levels of the national center, secondary center, primary center, and local exchange. All the exchanges are classified into one of these levels and connected to the other exchange by means of inter-exchange circuits.

This routing plan is established taking into consideration the geographical conditions, traffic volume, and/or switching system functions. The existing routing plan is shown in Figure 6.3.1-1.

Figure 6.3.1-1 Existing Routing Plan



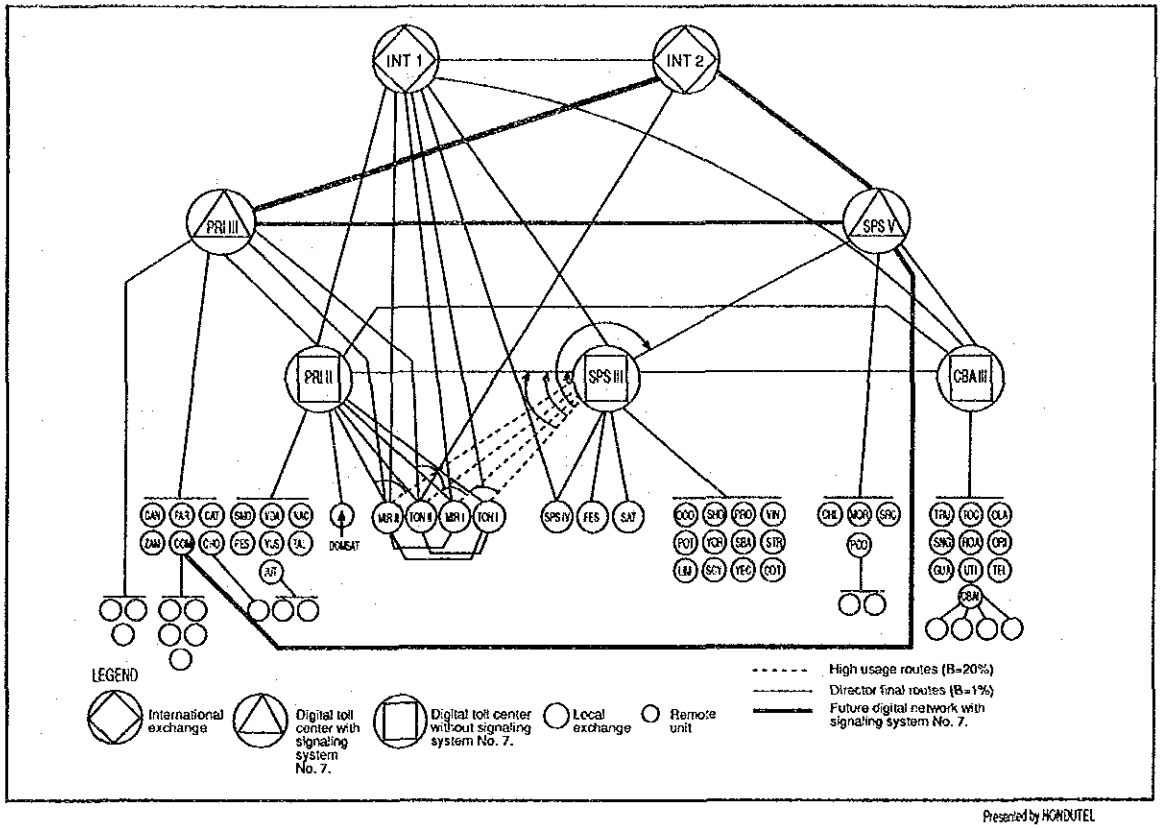
Presented by HONDUTEL

6.3.2 Future routing plan

HONDUTEL has an expansion plan for 1992-1996 which aims to introduce digital local exchanges (LE) and transit exchanges to make a modern national telecommunications network. In keeping with the digital exchange introduction, No. 7 Common Channel Signaling System will be introduced for linking the digital exchanges. Accordingly, the conventional analog network will coexist with the new digital network by means of the No. 7 system. Figure 6.3.2-1 shows the national routing plan for the year 1996 that HONDUTEL has drawn up, in this context.

All the subject rural communities will be incorporated into the national telecommunications network and links will be established in addition to those illustrated in the figure.

Figure 6.3.2-1 Routing Plan for the Year 1996



6.4 Exchange Location Plan

6.4.1 Local exchange

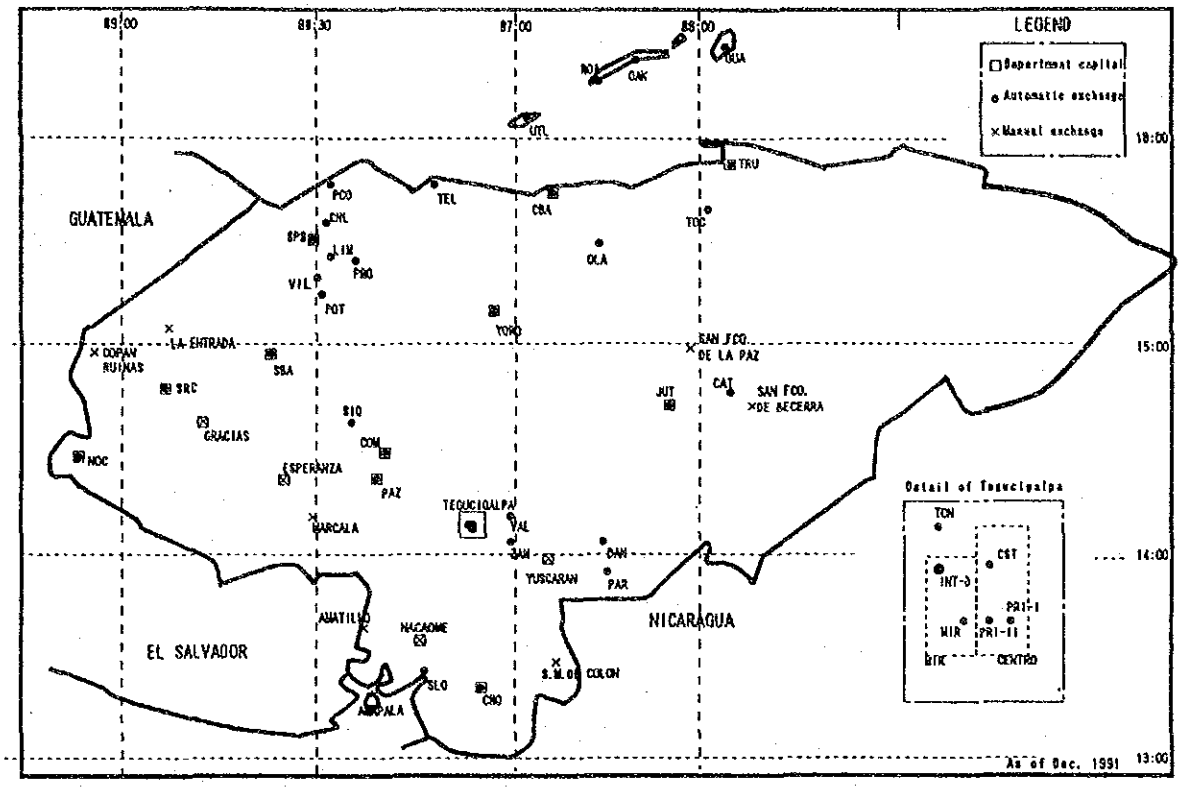
The existing location plan of exchanges, which is shown in Figure 6.4.1-1, was used in this Plan without modification.

The service area or subscriber lines of a local telephone exchange can be extended, from a technical point of view, to a distance of about 14 Km by means of ordinary metallic pair cables. Therefore, existing local telephone exchange service area should be extended up to this limit when connecting rural area subscribers around the exchange.

Rural area subscribers in a area without a telephone exchange should be connected to a nearest telephone exchange by means of a rural telecommunications system.

The telephone exchanges in rural telecommunications network should be located in adequate places in accordance with demand forecast and taking into consideration the economical provision of service.

Figure 6.4.1-1 Exchange Location



6.4.2 Toll exchange

The primary centers are now located in Tegucigalpa, San Pedro Sula, La Ceiba, Choluteca, and Comayagua.

6.5 Numbering Plan

6.5.1 Principles

Telephone exchange codes or the toll codes were assigned in accordance with the following principles.

- Exchange codes are assigned, in succession to the existing numbering plan, not to bring about substantial change in the existing assignment of the codes.
- In principle, exchange codes are assigned in a pyramid-shaped structure, i.e., the first digit represents the zone in the numbering plan, the second represents the Department, and the third represents the Municipality. If necessary, the fourth digit also represents the Municipality.

– Codes and numbers are assigned to the Municipality or a group of Municipalities as a unit of area for charging.

6.5.2 Existing numbering plan

The national telephone number consists of six digits. The prefix code for an international call is "00", while the discrimination code for a toll call is not used in the existing network. Accordingly, all local and toll calls are connected using 6-digit dialing.

The numbering capacity for subscribers with the existing numbering plan is 800,000 terminals.

6.5.3 New numbering plan

The telephone number in the rural network was assigned in the same way as the existing subscribers in the urban network, using 6-digit numbering.

The numbering capacity for the rural telecommunications network was estimated by multiplying the number of subject rural community areas, or 223 areas, by the assumed range of numbering provided that the telephone number is assigned in the same way as in the urban network. Each of the municipalities of subject rural areas was assigned a numbering range suitable for to each of them. The average size for the numbering range of each community was assumed to be 300 for the calculation, or about six (6) times the demand average of 223 subject communities. The numbering range necessary in the year 2002 was calculated as follows:

$223 \times 300 = 66{,}900$. This was rounded up to 67,000.

6.6 Signaling Plan

The existing signaling system should be kept in accordance with the principles stated in Section 6.1. Inter-exchange signaling systems now in use in Honduras are R2(D), R2(A), DC/MFC, and DC/DP for domestic channels, and R2(D) and System No. 5 for international channels.

For the section to be introduced in relation to this Plan, as a rule, the signaling system R2(D) will be applied. However, if the counterexchange is not equipped with this function, a signaling system equipped for the counterexchange will be applied.

6.7 Charging Plan

The existing charging method should be kept and the switching equipment should be programmed in accordance with specified requirement when introducing actually. When a rural subscriber is connected to an existing or a new exchange, the subscriber will be charged by the method applied to the exchange.

The rural network subscribers should be charged in the same way as that effective now in the urban network in order to maintain a unified charging system in the country. That is, the call should be charged in such way that the local call is charged in accordance with its duration, the toll call in accordance with its duration and distance, the international call in accordance with its duration and destination. The toll call and the international call should be charged by the method having a bill of detailed call information.

6.8 Engineering Standard

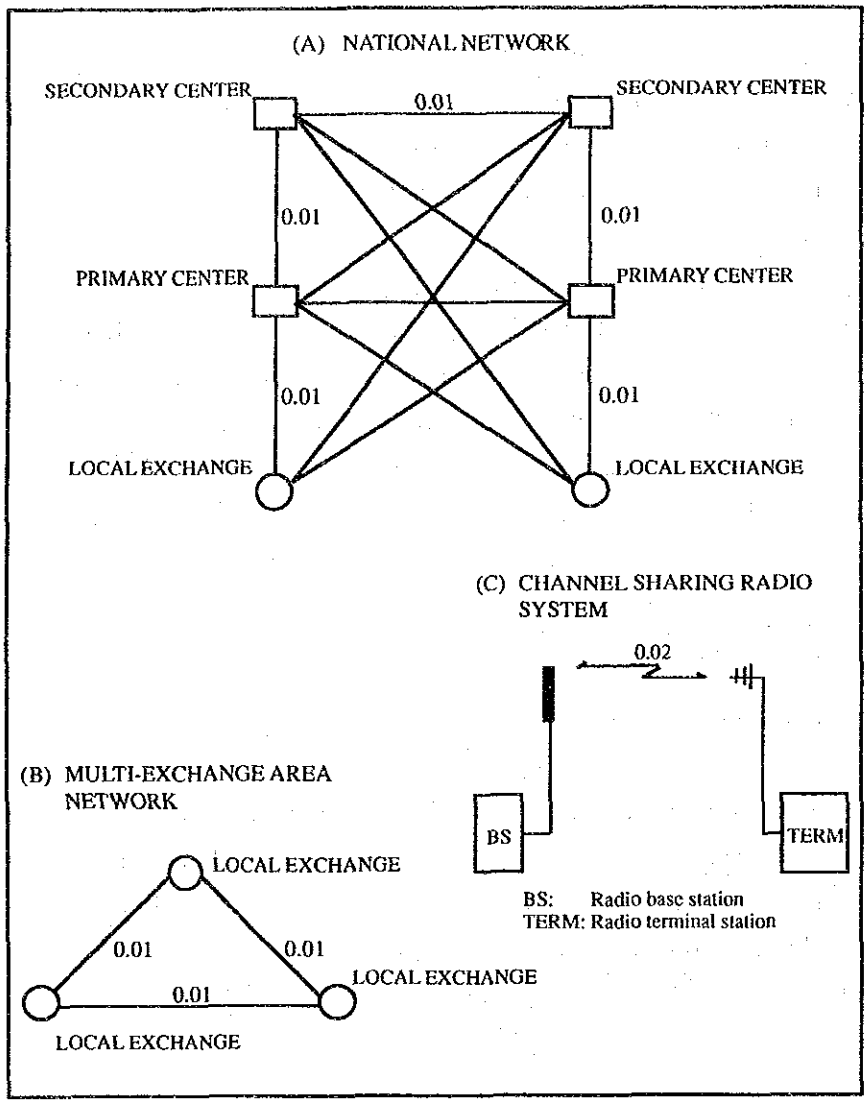
6.8.1 Connection loss probability

The connection probability now applied to the existing urban telecommunications network should be kept. For the exchanges to be introduced in relation to this Plan, the connection loss probability or the rate of call attempts which are blocked or excessively delayed within the exchange should be designed as shown in Table 6.8.1-1. Connection loss probability in route selection in the network should be shown in Figure 6.8.1-1, in accordiance with the existing standard.

Table 6.8.1-1 Connection Loss Probability at Switching Point

Type of connection	Probability
Internal	10^{-2}
Originating	5×10^{-3}
Terminating	5×10^{-3}
Transit	10^{-3}

Figure 6.8.1-1 Connection Loss Probability



6.8.2 Transmission loss assignment

The transmission loss assignment now applied to the existing telecommunications network should be kept. The standard transmission loss is 23 dB for digital-to-digital connection and 30 dB for analog-to-analog connection. However,it is proposed, for structuring an economical network, that the same transmission loss as analog-to-analog connection presently effective or 30 dB be allowed for rural subscriber connection even if the rural subscriber is connected to a digital exchange.

6.9 Network Synchronization Plan

The base of the existing synchronization plan will be kept without change. The exchanges to be introduced in the rural telecommunications network will be distributed clock pulses from PC in the existing national telecommunications network.

CHAPTER 7 RURAL TELECOMMUNICATIONS NETWORK PLAN

7.1 Basic Policy of Plan Making

7.1.1 Base of design

The rural telecommunications network was designed based on the principles of HONDUTEL, which intended to establish a network mainly by means of digital radio technology.

In addition to this, the initial cost and the operating cost were to be kept as low as possible.

7.1.2 Target of rural telecommunications network plan

This Plan aims to provide 12,090 telephone lines, which was the result of the telephone demand forecast for the year 2002 performed on the subject communities, based on the information obtained by the field survey in Honduras. The telephone density will increase to 1.66 main lines per 100 inhabitants, when the 12,090 telephones are provided.

7.1.3 Services to offer

This Plan aims to offer the automatic subscriber dial telephone service in the subject areas. The public telephone service is assumed to be realized with operator assistance by means of the general telephone line.

7.1.4 Term of the Plan

This Plan aims to design the facilities of a telecommunications network that will satisfy telephone demand in the year 2002.

7.1.5 Consideration for present facilities

For planning an economical rural telecommunications network, land and facilities owned by HONDUTEL were used as much as possible.

This Plan was made up in conjunction with and assumption of the expansion plans of HONDUTEL, which aims to bring the installed capacity to 241,000 in the three major cities and 62,200 in other important cities.

7.1.6 Facilities for the rural telecommunications network

1) Exchange

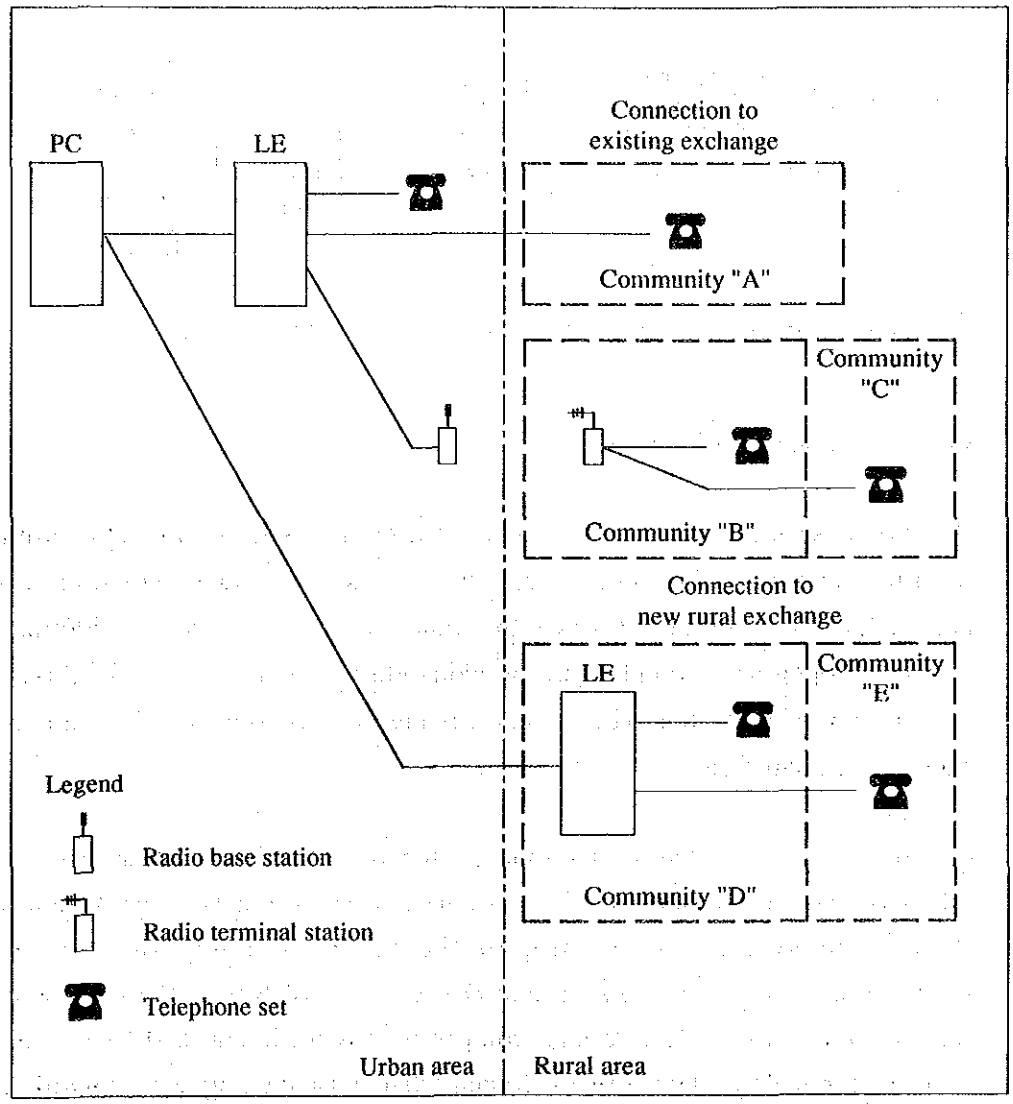
The rural subscribers will be connected to the exchanges in the following ways. The first case is where the rural subscribers are connected to the exchange, existing or planned, in the existing national telecommunications network. The second one is where the rural subscribers are connected to the exchange to be newly introduced for this rural telecommunications network. Figure 7.1.6-1 shows this modes of incorporation.

The exchanges to be introduced in the rural telecommunications network should have functions to offer same services as available to urban telecommunications network subscribers.

In consideration of flexibility of replacement or transfer which may be caused by increasing demand in the future, the exchanges to be introduced in the rural telecommunications network in the future should be the digital, independent, and portable (or container) type. The exchanges should be have the following hardware and software conditions.

- Enough capacity to meet the forecast demand
- Stored program control system
- Load control function
- Detailed billing function
- Number storage function to meet ISDN requirements
- MFC-R2(D), MFC-R2(A) signaling system

Figure 7.1.6-1 Incorporation Modes of Rural Communities

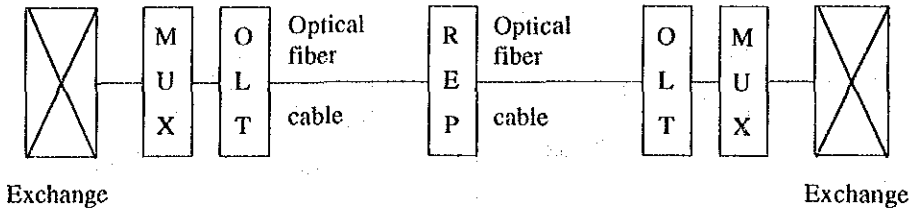


2) Inter-exchange transmission systems

The inter-exchange transmission system to be introduced in this Plan should be a digital system for consistency with the digital exchanges. The transmission system between exchanges can be provided by cable transmission technology or by radio transmission technology. Either one of those technologies will be adopted after considering the economy, topographic condition and maintainability.

A cost comparison was made on those two technologies and the optical fiber cable transmission system was found more advantageous. A schematic diagram of the optical fiber cable transmission system is shown in Figure 7.1.6-2.

Figure 7.1.6-2 Schematic Diagram of Optical Fiber Transmission System



MUX: Multiplexer OLT: Optical line terminal REP: Repeater

3) Subscriber line extension system

The subscriber line extension technology is used for a section where the ordinary metallic cable system cannot be applied because of distance conditions. The technology to be introduced under this Plan was selected after considering the economy, topographic condition, maintainability and future expandability. The metallic cable system should be used in as many cases as possible if the engineering standards are satisfied.

The subscriber line extention technology includes 1) digital multi-access system (DMAS), 2) digital subscriber cable system (DSCS), 3) single channel system, and 4) satellite system. According to the technical study in relation to the demand density, it was found that DMAS and DSCS were the most suitable systems among them. Then a cost comprison was made and DMAS was found more economical than DSCS by the forecast demand and topograghic conditions of the subject rural areas. The comparison of DSCS and DMAS is shown in Table 7.1.6-1.

Table 7.1.6-1 Comparison of Subscriber Line Extension Systems

	DSCS	DMAS
Topographical condition	(1) If all demand for telephone subscriber is covered by this sytem, a total of over 5,000km of optical fiber cable will be required. Much difficulty is predicted for laying the optical fiber cable because it must go over the mountains and across the rivers. (2) Optical fiber cable is laid along the roads. However, the road condition is extremely bad in the mountain areas.	(1) This system is suitable for connecting the local communities scattered over a vast area. It is hardly affected by the topographical problems. (2) Although a good line-of-sight is required between the repeater stations, an appropriate system can be constructed by building repeater statios at appropriate points. (3) Existing repeater stations can be utilized.
Maintainability	(1) Difficulties of maintenance operation are expected as the total length of optical fiber cable is great. (2) Cable laying route is affected by the topographical conditions, which may degrade the maintainbility of optical fiber cable.	(1) Building appropriate access roads enables the maintenance of repeater stations.
Future expandability	(1) Transmission capacity can be increased by replacing the equipments of digital subscriber cable system with MUX and OLT equipments.	(1) Although dependent on the accommodation capacity of the radio base station, the number of subscribers can be increased easily by installing a terminal station with the permitted capacity.
Result of examinaiton	Compared with the digital multi-access system, this system is less advantageous as the subscriber line extension system.	Compared with the digital subscriber cabel system, this system can be judged more advantageous as the subscriber line extension system.

The characteristics of DMAS are shown below.

- Connects multiple service areas in scattered locations with the central base station via a radio system.
- Locates each service area with an independent set of frequencies for sending and receiving.
- Concentrates lines by dividing a radio channel into several tens of time slots.
- Supervises and controls the system with the on-line terminal devices installed at the base station.
- Enables about 10 hops of repeating.
- Uses the frequency bandwidth of 400 to 2,500 MHz.

4) Combination of applicable technologies

Another way for accommodating rural subscribers to the national telecommunications network, involves installing an exchange in the service area, in place of providing subscriber line extension systems, DMAS for example, which was discussed previously.

In the case of DMAS, however, applicable frequencies are limited and this in turn limits the margin for the future expansion of the system. Consequently, it is better to introduce a telephone exchange in an area with telephone demand higher than a certain level. A comparison result indicated that the introduction of exchange would be advantageous if the demand was about 200 or more.

5) Outside plant

a) Facilities of inter-exchange circuits

The optical fiber cable transmission system was found to be advantageous in the preceding comparison of inter-exchange transmission system. Since non-gas single mode type cables are widely used in establishing the inter-exchange circuits, they are chosen in this Plan. The cables will be laid overhead by means of poles.

For the case of repair of faults and checking operation, the cable route should be along the roads. Such roads should be passable during the rainy season.

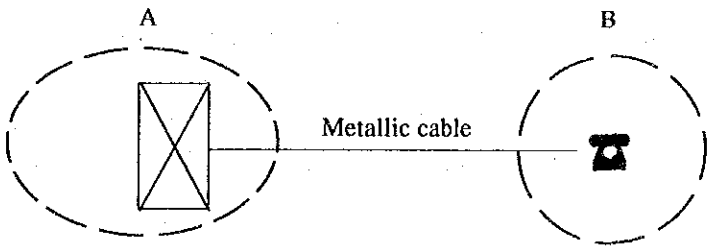
The necessary cable core number should be the number of necessary system line plus a spare core.

b) Facilities of subscriber line

Wiring types in this Plan are as follows:

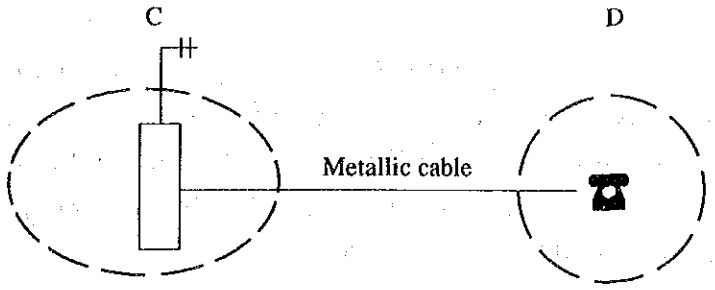
Type-I: To accommodate subscribers, cable will be laid in a community having an exchange like community "A" or in a community "B" which is several kilometers away from "A". In the case of the latter, the limit distance is 14 Km.

Figure 7.1.6-3 Wiring Type I



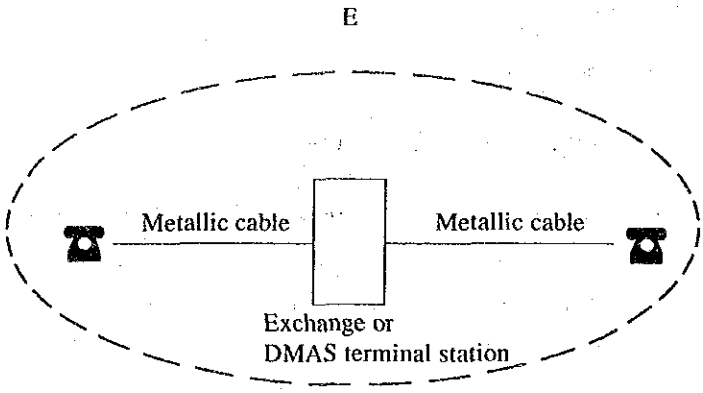
Type-II: This is the same as Type-I except that the exchange is replaced with a digital multi-access terminal station.

Figure 7.1.6-4 Wiring Type II



Type-III: The subscriber line is wired within the community.

Figure 7.1.6-5 Wiring Type III



The wiring types of the 223 subject rural communities are classified as shown in Table 7.1.6-2.

Table 7.1.6-2 Number of Communities by Wiring Types

Type	Number of communities
I (to existing exchange)	13
(to new exchange)	14
II	7
III	189
Total	223

Color corded polyethelene (CCP) cables are widely used for local telecommunications network to reach subscriber terminals and thus the CCP cable should be chosen in this Plan. In areas with higher possibility of lighting damage, aluminium polyethelene sheathed (ALPES) cables are preferred. The cables will be laid overhead by means of poles.

6) Power equipment

a) Power equipment for exchange

The power system for exchanges should run by commercial power. The power system consists of power receiving equipment, a generator, rectifier, and batteries.

b) Power equipment for transmission system

The power system consists of power receiving equipment, rectifier, and batteries. Normally, commercial power should be applied. A generator or a solar cell system will be applied in the case where commercial power is not available. The solar cell system will be chosen when the power consumption is not great, in other cases the generator will be applied.

7.1.7 Application to the rural telecommunications system

In accordance with the previous stated study results, the Plan was designed based on the policies stated below.

- The rural telecommunications network should be established using a digital multi-access system.
- Subscribers in a rural community should be connected by metallic pair cables if the community is located within a radius of 14 Km or less from an exchange and/or radio terminal station.
- An exchange should be introduced if the forecast demand is 200 or more in the year 2002.
- The new rural exchange should be connected to the existing national telecommunications network by means of optical fiber cables.

7.2 Rural Telecommunications Network Plan

7.2.1 Principles of designing the network

The principles for designing the rural telecommunications network are as follows:

- The existing and/or planned facilities in the existing national telecommunications network should be used where possible.
- The rural telecommunications network should be designed in harmony with the expansion plans of HONDUTEL.
- The system should be free from foreseen problems, especially those on charging.
- The rural telecommunications network should be flexibile to allow evolution in the future.

7.2.2 Preparation of alternative plans

In formulating the network plan, various plans, such as use of existing or new rural satellite telecommunications, installation of an exchange in each area, etc., were examined. This was done in relation to the geographic situation, size of areas, location of existing and new exchanges, disposition and technical level of maintenance personnel, provision of economical systems, etc. As a result, the following three plans can be considered possible alternative plans.

a) Plan 1

The country is divided into two parts. The rural subscriber lines are connected to the existing digital exchanges, or to new digital exchanges to be introduced for rural telecommunications service, in Tegucigalpa and San Pedro Sula.

b) Plan 2

Each of the rural subscriber lines is connected to the nearest exchange.

c) Plan 3

Rural subscriber lines are, in principle, connected to the digital exchanges in the cities where the primary center is located. If a digital exchange is located at a nearer place than those exchanges, the rural subscribers are connected to it.

7.2.3 Comparison of the plans

1) Plan 1

Advantage:

- Charging problems will not occur.

Disadvantages:

- Many rural communities are connected to one exchange, so a problem in one exchange will be spread over a wide area.
- It will be difficult to connect all rural communities to two exchanges when the number of rural communities is increased in the future.
- Links connecting rural subscribers are extremely long in comparison with the other plans.

2) Plan 2

Advantages:

- Links connecting rural subscribers are the shortest of the three plans.
- Problems at one exchange will have the least effect of the three plans.
- Compatibility is not a problem when the number of rural communities increases in the future.

Disadvantage:

- Most analog exchanges have no detailed billing functions.

3) Plan 3

Advantages:

- Charging problems will not occur.
- Problems in one exchange will not have much effect elsewhere.
- Compatibility is assured when the number of rural communities increases in the future.

Disadvantage:

- Links connecting subscribers are longer than in Plan 2.

Comparing these three plans, Plan 3 is generally the best for building the rural telecommunications network because the lack of charging problems is very important.

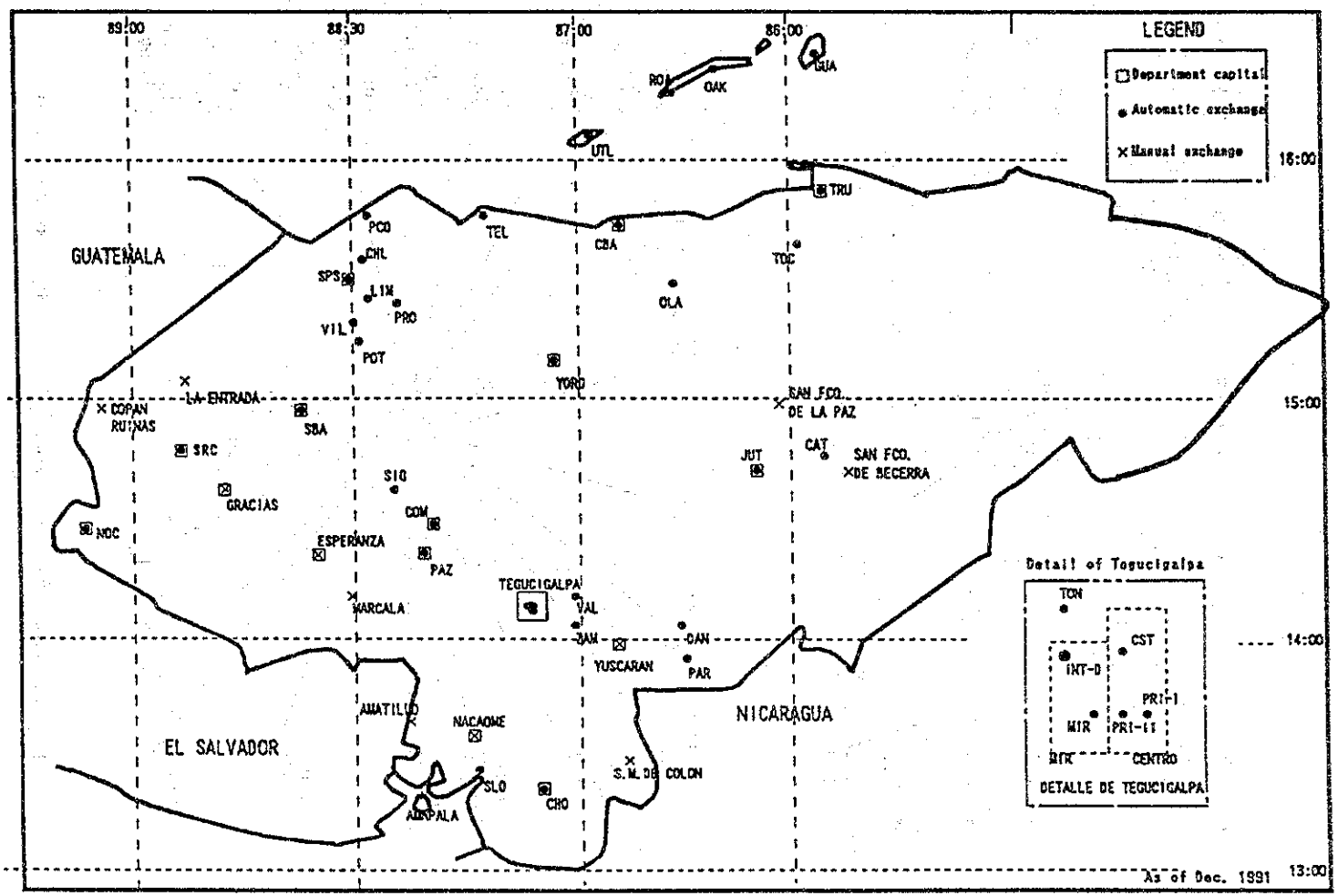
7.2.4 Basic network structure

The rural exchanges are planned to be introduced in accordance with the principles stated in the application of technology and the results of comparing the three plans.

The constitution of the rural telecommunications network was designed based on the Study results of the applicable technology and the comparison of three plans.

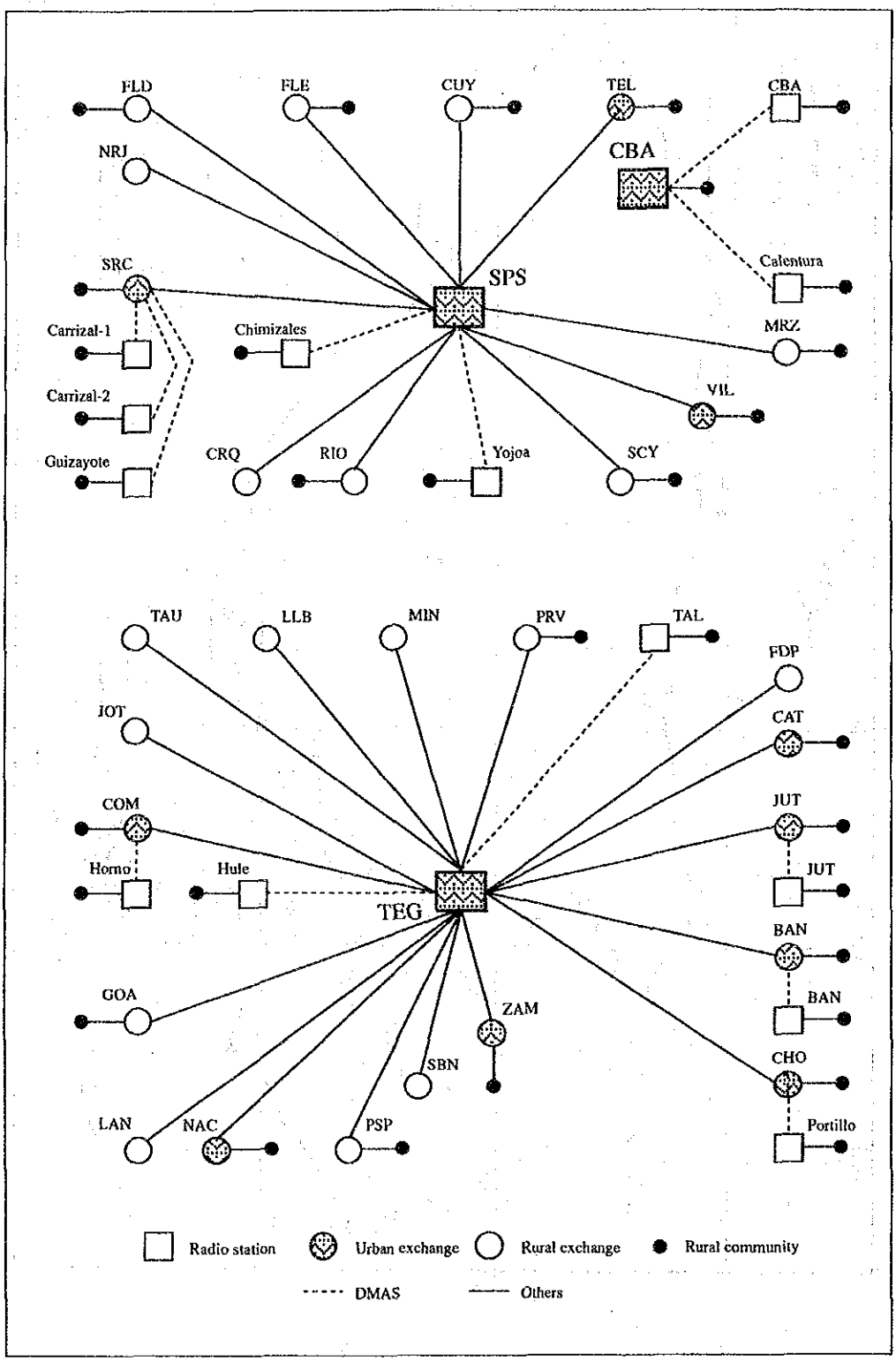
A new rural exchange location plan and a rural telecommunications network constitution plan are shown in Figure 7.2.4-1 and 7.2.4-2, respectively.

Figure 7.2.4-1 New Rural Exchange Location Plan



Note: Automatic exchanges are as of December 1991.

Figure 7.2.4-2 Constitution of Rural Telecommunications Network



CHAPTER 8 FACILITIES PLAN

8.1 Basic Policy of the Facilities Plan

8.1.1 Subject of the facilities plan

The subject facilities are those necessary to offer the telephone service to the 223 subject communities in the rural areas. These facilities are listed below.

- Exchanges to be introduced in the rural areas.
- Transmission systems connecting the exchanges in the rural area to those in the existing national network.
- Digital multi-access system (DMAS) for the rural areas.
- Transmission systems connecting the DMAS for the rural areas to the existing national network.
- The facilities connecting the rural subscriber terminals to the exchanges and/or DMAS terminal stations for the rural areas. The subscriber terminals are not included.

8.1.2 Use of existing facilities

Existing facilities were used as much as possible to make up the rural network. The facilities listed in the existing expansion plans, including the Telecommunications Expansion Plan 1992-1996, were all included in making the rural telecommunications network.

8.1.3 Capacity of facilities

The capacity of the facilities to be introduced in Phase-I was designed to meet the forecast demand in the year 2002. For the facilities to be introduced in Phase-II, a certain amount of capacity margin was included; that is, for the demand three (3) years after the installation of the exchanges, transmission systems, and DMAS, and approximately five (5) years for the subscriber network. (The detail of the phases will be described in Chapter 10.)

8.1.4 Consideration for new services in the future

The exchange and transmission systems to be introduced by this Plan were designed with digital technology, for possible incorporation into an ISDN system in the future, and also considering the worldwide trend of the digital telecommunications network.

8.2 Facilities Plan

8.2.1 Subscriber line extension system

1) Digital multi-access system

As stated in Chapter 7, it was decided that the DMAS be used for the subscriber line extension system. A total telephone demand of 6,786 in the year 2002 in 178 areas was designed to be accommodated using a total of 13 systems. (The demand in the rest 45 areas was designed to be directly connected to exchanges without using DMAS.)

2) Power supply equipment for DMAS

For the radio base station, the power supply equipment of existing telephone exchanges and repeater stations will be applied.

The power supply equipment of radio repeater stations, except those supplied by existing repeater stations, will consist of a solar power system and battery banks having a retention period of seven (7) days.

The power supply equipment for terminal stations will be a combination of a solar power system and battery banks having a retention period of five (5) days.

3) Main work items

Table 8.2.1-1 outlines the number of main work items of the digital multi-access system. In case an exchange is not installed with the radio base station signal transmitter-receiver, the tie cable shall be installed under a separate project of HONDUTEL.

Table 8.2.1-1 Number of Main Work Items of Digital Multi-Access System

Phase	Number of Systems	Number of Repeater stations	Number of Terminal Station
I	7	23	104
II	6	18	67
Total	13	41	171

Note: The phases are stated in Chapter 10.

8.2.2 Exchange and power equipment

1) Type of exchange

The exchanges to be introduced in the rural areas (the rural exchanges) were defined as follows:

- Digital, stored program control, independent, and portable (or container) type exchange.
- Small exchange with about 500 subscriber line terminals at its final stage.

2) Subscriber line terminals

- Rural exchanges

The number of subscriber line terminals, or subscriber line interface, to be equipped to each exchange in the rural telecommunications network is 4,900.

- Exchanges in the existing national telecommunications network

The number of subscriber line terminals to be equipped to each of the exchanges in the existing national telecommunications network should be determined taking into consideration the forecast demand. In the demand forecast, 515 public and 6,824 general telephones are assumed to be connected to the existing exchanges for the year 2002.

3) Power equipment for exchange

The power equipment applied to the rural exchange is as follows. An engine generator was assumed for each exchange in addition to the power equipment listed below.

- Power receiving panel
- Rectifier
- Battery banks
- Air conditioning equipment.

4) Main work items

Eighteen (18) telephone exchanges were planned according to the rural community connection plan. The main work items are shown in Table 8.2.2-1.

Table 8.2.2-1 Number of Main Work Items for Rural Exchanges

Phase (Year)	Exchange	Lines	Switching equipment	Power equipment	Building (container)	Land	Remarks
Phase I							
1995	GOA	210	1	1	1	1	
1995	LAN	110	1	1	1	1	
1995	MRZ	430	1	1	1	1	
1995	PSP	320	1	1	1	1	
1995	RIO	210	1	1	1	1	
1995	SCY	300	1	1	1	1	*
1996	FLD	290	1	1	1	1	
1996	JOT	160	1	1	1	1	
1996	LLB	300	1	1	1	1	
1996	NRJ	200	1	1	1	1	
1996	TAU	400	1	1	1	1	
1997	CRQ	290	1	1	1	1	
Phase II							
	MIN	400	1	1	1	1	
	PRV	210	1	1	1	1	
	CUY	200	1	1	1	1	
	FLE	190	1	1	1	1	
	FDP	450	1	1	1	1	
	SBN	230	1	1	1	1	
Total		4,900	18	18	18	18	

*: The container exchange ACC-23 will be transferred from CAT in the year 1995 and be replaced by a digital exchange in 1999.

Note : The phases are stated in Chapter 10.

5) Inter-exchange circuits

The number of inter-exchange circuits was calculated for the terminal to be equipped, in accordance with the technical standard. The exchange traffic volume for equipped terminals and the number of inter-exchange circuits are shown in Table 8.2.2-2.

Table 8.2.2-2 Inter-exchange Circuits (in 2002)

Exchange	Terminals equipped	Inter-exchange To/from	Circuits traffic (erl.)	Circuits
CRQ	290	SPS	11.64	20
CUY	200	SPS	8.02	15
FDP	450	TEG	18.06	28
FLD	290	SPS	11.64	20
FLE	190	SPS	7.63	15
GOA	210	TEG	8.43	16
JOT	160	TEG	6.42	13
LAN	110	TEG	4.42	10
LLB	300	TEG	12.04	21
MIN	400	TEG	16.05	25
MRZ	430	SPS	17.26	27
NRJ	200	SPS	8.02	15
PRV	210	TEG	8.43	16
PSP	320	TEG	12.84	22
RIO	210	SPS	8.43	16
SBN	230	TEG	9.23	17
SCY	300	SPS	12.04	21
TAU	400	TEG	16.05	25
Total	4,900		196.65	342

8.2.3 Inter-exchange circuit transmission equipment

1) Selection of system

The inter-exchange circuit transmission equipment is designed by using the optical fiber transmission system. In other words, the 18 telephone exchanges to be newly established will be connected to the existing telephone exchange or radio repeater stations with optical fiber transmission equipment.

2) Transmission capacity

The transmission capacity of the inter-exhcange circuit transmission equipment for respective sections should be designed to meet the telephone demand for the year 2002.

The transmission capacity of the optical fiber transmission equipment should match the traffic volume of the related exchanges. The transmission system was provided with a transmission speed of 8 Mb/s and/or 34 Mb/s.

3) Power equipment for the transmission equipment

The optical fiber transmission equipment to be newly introduced should have the following equipment and air conditioner.

- Rectifier unit
- Battery banks
- Air conditioner

4) Main work items

Table 8.2.3-1 shows the number of main work items for the inter-exchange circuit transmission.

Table 8.2.3-1 Number of Main Work Items for Inter-exchange Circuit Transmission

Phase	Number of exchanges to be connected	Number of sections
I	12	12
II	6	6
Total	18	18

Note: The phases are stated in Chapter 10.

8.2.4 Outside plant

1) Inter-exchange circuit line facilities

a) Selection of cable

Optical fiber cable of the non-gas system, single mode (SM) type, should be used.

b) Selection of line type

An aerial type line should be used.

c) Decision on the number of cable cores

The required number of cores for respective sections in the year 2002 is 3. However, the closest cable commercially available that meets the above core number requirement is a 4-core one.

d) Main work items

Main work items should be calculated as follows:

i) Optical fiber cable should be constructed to the exchange located approximately at the center of the respective communities.

ii) Telephone poles should be erected at intervals of 40 meters. The power distribution poles should be jointly used for about one half of the planned telephone poles.

Table 8.2.4-1 shows the main work items for inter-exchange circuit line facilities.

Table 8.2.4-1 Main Work Items for Inter-exchange Circuit Line Facilities

Phase	Optical fiber cables (core × Km)	Poles (Number of Poles)
I	1,944	6,075
II	784	2,450
Total	2,728	8,525

Note: The phases are stated in Chapter 10.

2) Subscriber line facilities

The results obtained in Chapter 6 should form the basis for the construction of subscriber line facilities.

a) Selection of line type

An aerial type line should be applied.

b) Selection of cable

Color corded polyethylene (CCP) cable should be used. A self-supporting type cable should mainly be used. Moreover, where necessary for the purpose of maintenance operation, alpeth cable and flame resistant cable should be used.

Cable conductor diameter should be determined so as to meet the allowable transmission loss value.

c) Determining the number of cable pairs

An allowance of 20% was taken in to the forcast demand.

d) Main work items

The main work items are calculated as follows:

- A rural community is defined as having a radius of 0.5km.
- New telephone exchanges and terminal stations should be established at the center of the communities.
- Cables should be laid bi-directionally from the center with a radius of 0.5km.
- Telephone poles should be erected at intervals of 40m. The power distribution poles should be jointly used for about one half of the planned telephone poles.

Table 8.2.4-2 shows the main work items for subscriber line facilities.

Table 8.2.4-2 Main Work Items for Subscriber Line Facilities

Phase	Metallic cables (pair × Km)	Poles (Number of poles)	Drop wires (Number of lines)
I	15,670	3,713	7,544
II	14,850	2,538	4,546
Total	30,520	6,251	12,090

Note: The phases are stated in Chapter 10.

3) Telephone set

The characteristics of the telephone set should satisfy normal operation with a loop resistance of 1,800 ohms including the internal resistance of the telephone set.

8.2.5 Buildings

Fifty-seven (57) buildings will be provided by this Plan as shown in Table 8.2.5-1.

Table 8.2.5-1 Buildings to be provided

For	Quantity
Public telecommunications service stations	41
Optical fiber transmission system stations	16
Total	57

8.2.6 Sites

One hundred and eight (108) sites will be provided by this Plan as shown in Table 8.2.6-1.

Table 8.2.6-1 Sites to be provided

For	Quantity
Public telecommunications service stations	41
New rural exchanges	18
Optical fiber transmission system stations	16
Digital multi-access system stations	33
Total	108

8.2.7 Access roads

Thirty-three (33) access roads will be provided for the digital multi-access system by this Plan.

CHAPTER 9 OPERATION AND MAINTENANCE PLAN

9.1 Present State of Operation and Maintenance

The present state of operation and maintenance is as follows:

1) Operation and maintenance control organization

The existing telecommunications equipment of HONDUTEL is controlled by the Central-South Region Telecommunication Division, the North-West Region Telecommunication Division, and the Atlantic Coast Region Telecommunication Division located in Tegucigalpa, San Pedro Sula, and La Ceiba respectively. This divides the nation's eighteen Departments into three maintenance areas.

The respective telecommunication divisions perform the operation and maintenance through their maintenance departments that consist of the sections of exchange, transmission, outside plant, electric power, and civil works, and service centers. Their service centers respond to the subscribers' calls received by the fault acceptance telephone number 194.

2) Maintenance of Telecommunications Network

a) The transmission section of the maintenance depertment carries out centralized remote supervision and maintenance of inter-exchange transmission equipment within the maintenance area.

b) Staff in charge of exchange systems of respective telephone offices are responsible for the supervision and maintenance activities of the exchange systems of their own office (Part of system is centrally supervised).

c) Staff in charge of the outside plant of the respective telephone offices carry out the operation and maintenance of the outside plant of their own office.

d) The electric power sections of the Tegucigalpa, San Pedro Sula, and La Caiba Telephone Offices carry out the operation and maintenance of the electric power equipment of the telephone offices and radio repeater stations within their assigned maintenance areas.

9.2 Operation and Maintenance Plan

9.2.1 Basic Policy

The basic policy for the preparation of the operation and maintenance plan for the telecommunications system in the rural areas is as follows:

1) Organization

The existing operation and maintenance sector in the current organization shall be responsible for the operation and maintenance of the rural telecommunications system. The establishment of a new organization or integration and/or abolition of existing organizations shall not be made for the rural telecommunications system. The operation and maintenance of the rural telecommunications system shall be covered by increasing the number of staff required.

2) Staff

a) An appropriate number of staff shall be positioned at the TEG, SPS, CBA, SRC, CHO, COM, DAN, and JUT telephone offices considering the amount of equipment to be introduced to these offices and the facts that it is highly reliable equipment with a low fault rate.

b) New staff shall not be positioned in the existing public telecommunications service offices in the rural areas.

c) An appropriate number of staff shall be positioned at the newly established public telecommunications service offices.

d) Security staff shall be positioned at the newly established rural exchanges, radio base stations, and repeater stations.

e) The current number of staff shall be maintained if possible, by providing them with necessary training in the future.

3) Service

The existing telegram service in the rural areas shall be provided continuously.

4) Training

Necessary training shall be provided so as to perform smooth operation and maintenance of the rural telecommunications system.

5) Others

a) A new public telecommunications service office shall be established for a rural area currently having no such office. An appropriate number of employees shall be deployed to provide the users with public telephone service and public telegram service via telephone.

b) Employees of the public telecommunications service offices in the rural areas shall handle the public telephone and public telegram services of the respective areas. In addition, they shall perform the simple repair of faults of telephone sets, wiring, transmission and radio equipments, and exchange in their area according to the instruction given by the Maintenance Telephone Office.

9.2.2 Operation and maintenance system

1) Operation and maintenance control sector

The operation and maintenance shall be controlled by the three telecommunication divisions.

2) Telephone office in charge of maintenance

a) Maintenance classification

i) Employees of the following eight telephone offices that will be connected and installed with the exchange system, transmission equipment, and telephone sets for the rural telecommunications service shall be responsible for the maintenance of the exchange system, transmission equipment, outside plant, and telephone sets.

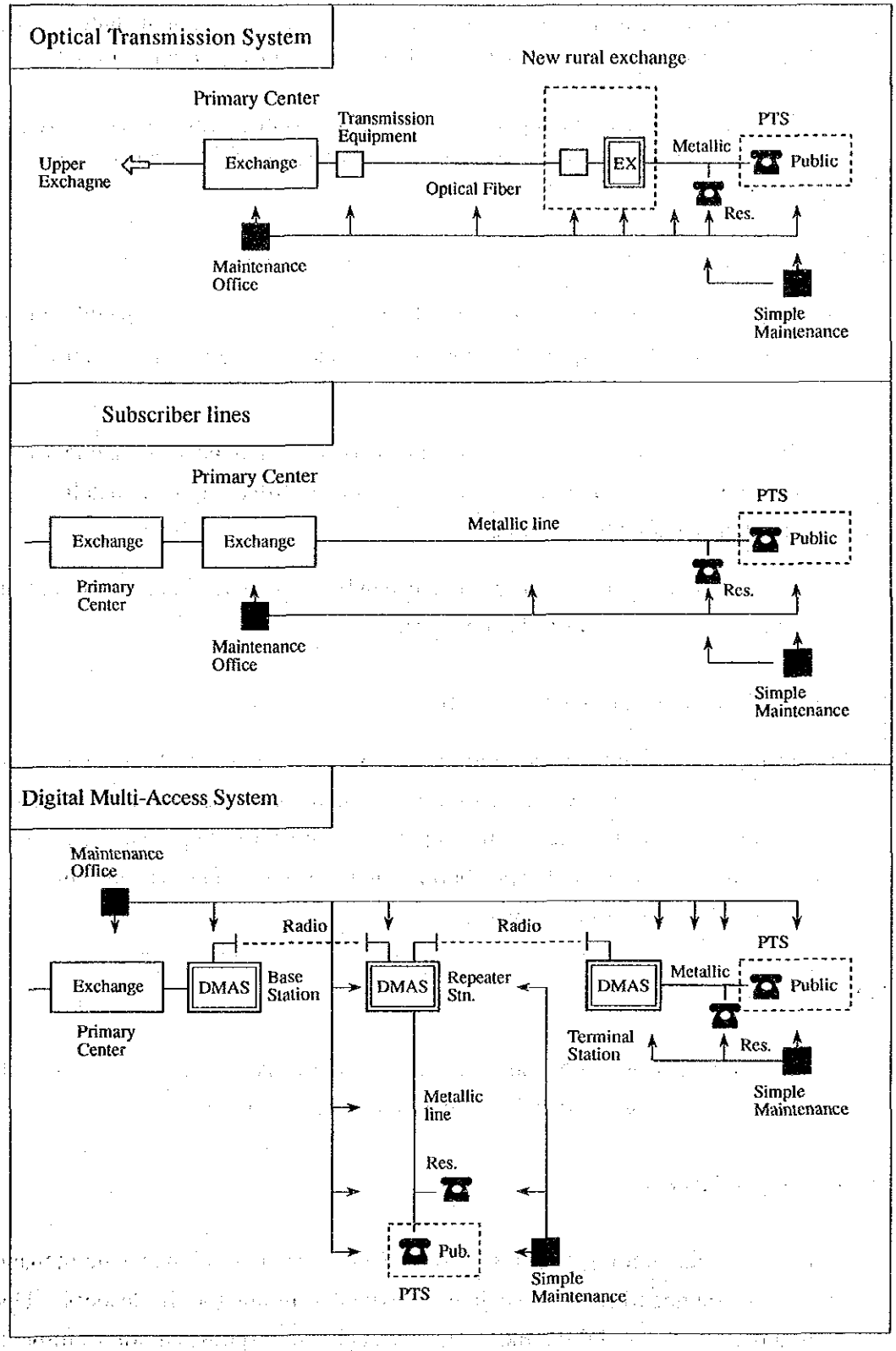
- The telephone offices in charge of operation and maintenance for the rural telecommunications equipment (maintenance telephone offices):

TEG, SPS, CBA, SRC, CHO, COM, DAN, JUT

ii) The three telephone offices of TEG, SPS, and CBA shall provide assistance to the other maintenance telephone offices upon receiving a request.

iii) Figure 9.2.2-1 shows the of maintenance classification of respective equipment.

Figure 9.2.2-1 Maintenance Classification of Respective Equipment



PTS: Public telecommunications service office

b) Staff

i) Maintenance staff of DMAS and transmission equipment shall be newly posted at five telephone offices having no transmission personnel.

ii) The number of maintenance staff for the optical fiber cable, subscriber line, and telephone sets shall be increased taking into consideration the amount of equipment involved.

3) Rural exchanges, radio base stations, and repeater stations

a) Employees of a maintenance telephone office shall be responsible for the maintenance of equipment at the rural exchanges, radio base stations, and repeater stations.

b) Employees of a maintenance telephone office shall be responsible for the supervision by using remote supervisory and control equipment installed at the maintenance telephone office.

c) Security staff shall be posted at the newly constructed radio base stations, repeater stations, and rural exchanges.

4) Public telecommunications service office

a) Employees of public telecommunications service offices shall handle the public telephone and telegraph services of the related area. In addition, they shall be responsible for making simple repairs of faults to telephone sets, wiring, transmission equipment, and the exchange system (such as replacement of panels, fuses, or resetting alarm, etc.).

9.2.3 Training plan

To promote smooth operation and maintenance of newly installed equipment, the training shall be conducted according to the following policy:

1) Training of leaders

Instructors at the training center, managers in charge of operation and maintenance, and senior engineering staff shall be provided training for the leaders. Upon completion of the training, these leaders shall be responsible for training the technicians.

2) Training of engineers

Assistant managers and chief technicians of telephone offices shall be provided necessary training for the engineers of operation and maintenance (capable of repairing complicated faults).

3) Training of general maintenance technicians

Necessary training for routine operation and maintenance (performance of daily maintenance activities, and simple repair of faults) shall be provided to the general technicians in the engineering sector of the telephone offices.

4) Training of staff at the public telecommunications service offices

Staff of the public telecommunications service offices shall be provided with the necessary training for the simple repairing of faults of the telephone sets, exchange, transmission and radio equipments, and outside plant.

The contractor of the construction should provide training for the leaders and engineers of the transmission and radio equipments and exchange system. The personnel who have completed the training course should be assigned as instructors at the training center and leaders at the maintenance telephone offices. Table 9.2.3-1 indicates the training implementation plan.

Table 9.2.3-1 Training Implementation Plan

Course	Term	Contents	Section	Trainees	Place / Instructor
Leaders Course	3 Months	* Digital Exchange	Exchange	6	* Contractor's factory etc. / Contractor
		* Digital Multi-Access System * Optical Transmission * Optical Fiber Cable	Transmission	7	
		* Optical Fiber Cable	Outside Plant	4	* Houduras / Contractor
Engineers Cource	3 Months	* Digital Exchange	Exchange	11	* Contractor's factory etc. / Contractor
		* Digital Multi-Access System * Optical Transmission * Optical Fiber Cable	Transmission	18	
		* Optical Fiber Cable	Outside Plant	14	* Honduras / Contractor
General Maintenance Technicians Course	1 Month	* Digital Exchange	Exchange	13	* Training Center, Telephone Office / Instructor or Engineer, who finished the leaders course.
		* Digital Multi-Access System * Optical Transmission * Optical Fiber Cable	Transmission	27	
Staff Training Course	1 Month	* Outline of Rural Telecommunications Facilities * Telephone set Repairing * Tel. & Telegraph Services	Public Telecommunications Service Office	669	* Maintenance Telephone Office / Engineer who finished the leaders course or engineers course.
Total				769	

CHAPTER 10 IMPLEMENTATION PLAN

10.1 Division of the Areas into Some Phases

This rural telecommunications network project involves 223 rural communities which are spread over almost the whole country. Therefore, it is preferable to divide the Project into various phases, assigning an appropriate number of subject communities to each phase. The division into phase should consider the economic aspects, project implementation organization, and personnel training, etc. At the same time, regional development plans of each local area should be taken into consideration as well as the importance of each community. For smooth implementation in harmony with the above mentioned national projects and importance of respective areas, it is necessary to divide the plan by Department into two (2) phases as follows:

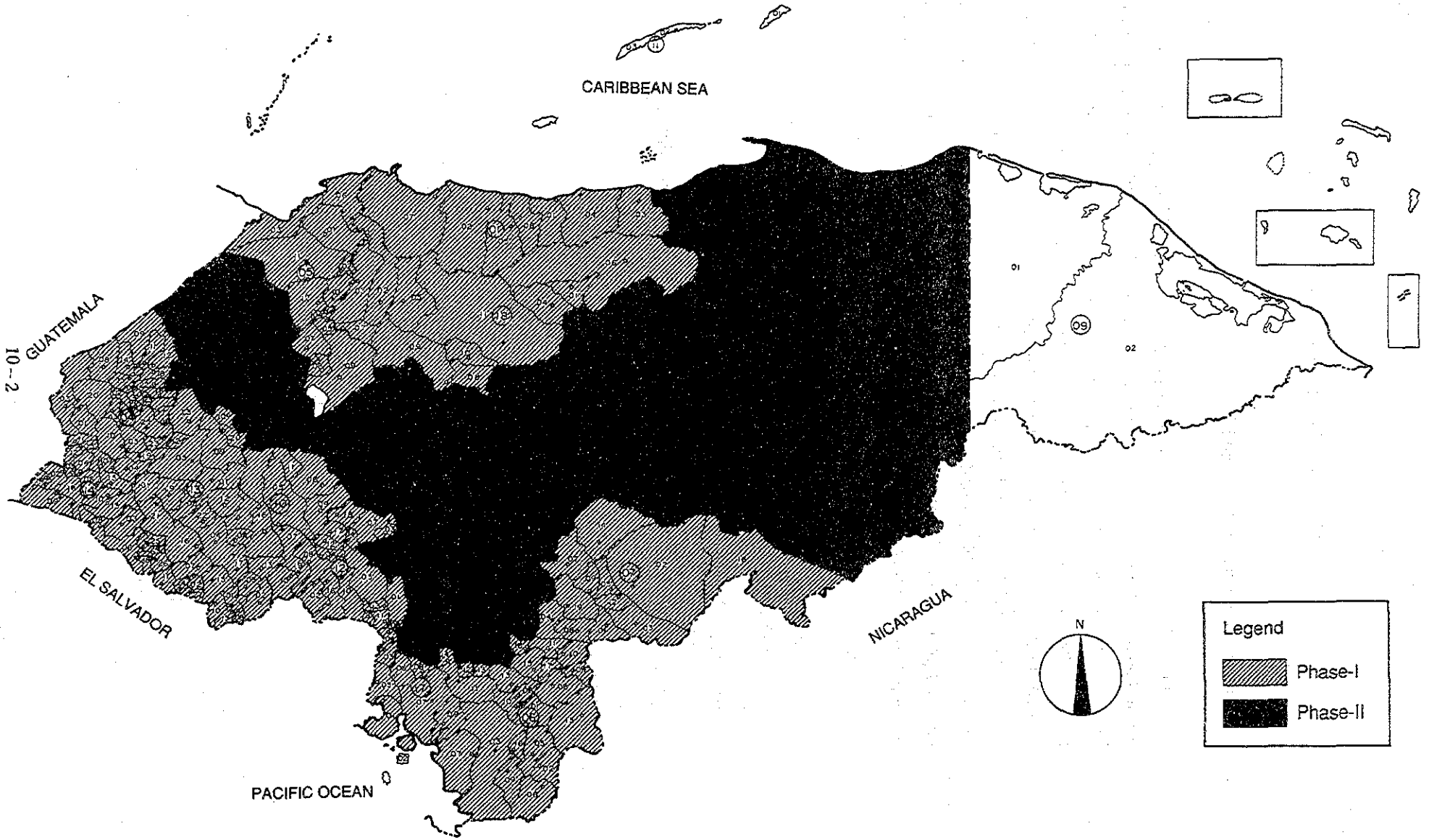
a) Phase-I

Choluteca, El Paraíso, Intibucá, Lempira, Ocotepeque, Copán, Valle, La Paz, Cortés, Atlántida, Yoro

b) Phase-II

Comayagua, Colón, Santa Bárbara, Francisco Morazán, Olancho

Figure 10.1-1 Map of Subject Areas by Phase



10.2 Implementation Schedule

The Plan consists basically of the digital multi-access system. The following table shows the segments of the Plan divided by units of the digital multi-access system.

Table 10.2-1 Segment by the Unit of Digital Multi-Access System

No.	Segment (RBS* name)	Department	Demand in the year 2002	Number of the subject rural areas	Population of the subject rural areas
1	Yojoa	Cortés, Yoro	1,739	25	78,011
2	Portillo	Choluteca El Paraíso Valle	1,414	33	63,293
3	Horno	La Paz, Comayagua	1,543	16	40,399
4	La Ceiba	Atlántida	563	16	38,279
5	Carrizal-1	Copán	1,044	16	33,495
6	Güizayote	Lempira Ocotepeque Intibucá	831	23	29,981
7	Carrizal-2	Copán	410	7	12,326
8	Danlí	El Paraíso	540	17	53,724
9	Talanga	Francisco Morazán Comayagua	1,038	15	30,954
10	Chimizales	Santa Bárbara	1,054	23	51,622
11	Calentura	Colón	399	9	21,291
12	Juticalpa	Olancho	1,049	14	44,299
13	Hule	Francisco Morazán	466	9	10,812
Total			12,090	223	508,486

* RBS : Radio Base Station

In consideration of the regional development projects of each area and the importance of the border areas, it is assumed here to group No.1 to No.7 in Phase-I and the rest in Phase-II.

The order of the implementation is presented below, considering the benefit to the population and the development of industry in the subject areas.

(1) Yojoa

(2) Portillo

(3) Horno

(4) La Ceiba

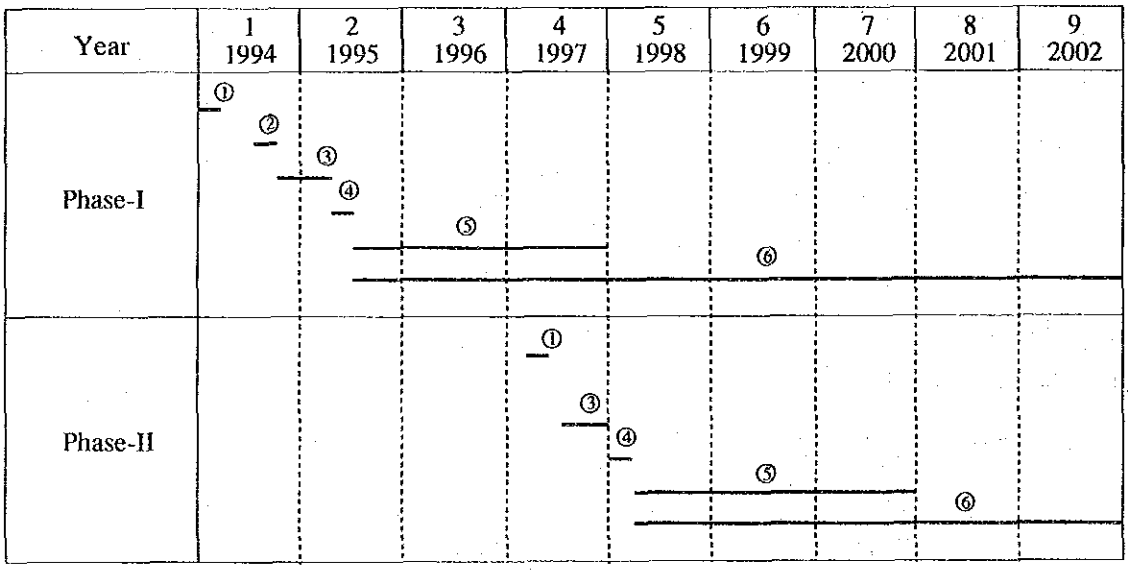
(5) Carrizal-1

(6) Güizayote

(7) Carrizal-2

The implementation schedule is shown in Figure 10.2-1. Phase-I and Phase-II should be completed by the years 1997 and 2000, respectively.

Figure 10.2-1 Implementation Schedule



10.3 Investment for the Plan

1) Preconditions in estimating investment.

The preconditions in estimating the investment for this Plan are shown below.

a) The subject facilities for estimating investment are as follows:

- The facilities between the MDF terminal of the existing exchanges and the subscriber terminal boxes are involved.
- The facilities between the outlets of the newly established exchanges and the subscriber terminal boxes are involved.
- The existing facilities are not involved.

b) Construction costs are estimated, based on the broad design.

c) Construction costs do not include the expenses involved in the removal and/or transfer of existing facilities.

d) Construction costs are calculated at the exchange rate of US$1 = 5.4 Lempira.

e) Construction costs take into account the HONDUTEL standards and include the testing equipment for maintenance, measuring equipment, and spare parts expected to be required for one year.

f) Investments are estimated separately in local currency and foreign currency.

g) The price of imported goods is the CIF (cost insurance and freight) price.

h) Contingencies are estimated at 10 percent of the construction costs.

2) Work items

Table 10.3-1 shaws the main work items for the Plan.

Table 10.3-1 Main Work Items

Main work items		Unit	Quantity		
			Phase-I	Phase-II	Total
Digital exchange		Number of exchanges	12	6	18
		Number of lines	2,920	1,980	4,900
Transmis-sion	Optical fiber cable transmission	Section	12	6	18
	DMAS	System	7	6	13
Inter-exchange lines		Core × kilometers	1,944	784	2,728
Subscriber lines		Pair × kilometers	15,670	14,850	30,520
Power facilities		Set	150	97	247
Buildings		Number of buildings	40	17	57
Access roads		Number of roads	20	13	33
Sites		Number of sites	72	36	108

Note: The newly established exchanges are all container type.

3) Investment cost

The investment cost is shown in Table 10.3-2. Since the total number of rural subscribers to be accommodated by this Plan is 12,090, the cost per line is around 3,880 US dollars if it is calculated in relation to the cost of the systems and equipment, or the Item 1, in the Table.

Table 10.3-2 Investment Cost

Unit: Foreign currency in ('000) US dollars; Local currency in ('000) Lempiras.

Description	Phase-I		Phase-II		Total	
	Foreign	Local	Foreign	Local	Foreign	Local
1. Systems and equipment	1,574	0	1,038	0	2,612	0
1.1 Exchanges	13,288	5,229	9,679	3,647	22,967	8,876
1.2 Transmission systems	5,532	4,473	2,232	1,800	7,764	6,273
1.3 Outside plant of transmission system	2,197	5,035	1,661	3,404	3,858	8,439
1.4 Outside plant of local network	3,192	760	1,950	482	5,142	1,242
1.5 Power equipment	25,783	15,497	16,560	9,333	42,343	24,830
1.6 Sub-total (1.1 to 1.5)						
2. Others						
2.1 Buildings	0	2,000	0	850	0	2,850
2.2 Roads	0	20,000	0	13,000	0	33,000
2.3 Sites	0	472	0	269	0	741
2.4 Common	92	0	62	0	154	0
2.5 Consultancy	2,500	194	2,052	194	4,552	388
2.6 Training	579	991	45	618	624	1,609
2.7 Sub-total (2.1 to 2.6)	3,171	23,657	2,159	14,931	5,330	38,588
3. Total (1+2)	28,954	39,154	18,719	24,264	47,673	63,418
4. Contingency	2,895	3,915	1,872	2,426	4,767	6,342
5. Grand total	31,849	43,069	20,591	26,690	52,440	69,760
6. For reference (in '000 US dollars)	39,825		25,534		65,359	

CHAPTER 11 PROJECT EVALUATION

11.1 Financial Analysis

11.1.1 Underlying assumptions

1) Project life is assumed to be 20 years. This takes the life of the equipment into consideration.

2) The salvage value of the equipment having a longer service life than the Project duration is entered as a negative cost at the end of the Project. The salvage value of the equipment after the end of its service life is assumed to be nil.

3) Inflation of the initial investment cost is not taken into account because the initial investment cost is determined by the contract. After the initial investment, the escalation of the operating and maintenance costs is taken into consideration because the wage of HONDUTEL personnel will be raised in accordance with the inflation rate. However, the operating and maintenance costs per main line will remain at the same level until the year 2002 by streamlining the operation and maintenance activities. Therefore, in this analysis, it is assumed that the operating and maintenance costs increase 2 % every year after the year 2003.

4) The exchange rate applied to this analysis is 5,4 lempiras per US dollar.

5) Telephone revenue per main line in the future is assumed to be the same as the current revenue.

11.2 Estimate of the Project Revenue

11.2.1 Number of new subscribers

The estimated number of new subscribers in the subject areas is shown in Table 11.2-1.

Table 11.2-1 Number of New Subscribers

Year	New Subscribers	Cumulative
1995	1,765	1,765
1996	1,876	3,641
1997	870	4,511
1998	1,540	6,051
1999	1,714	7,765
2000	2,072	9,837
2001	1,061	10,898
2002	1,192	12,090

The result of the field survey showed the following breakdown by category share of potential subscribers.

Table 11.2-2 Category Share of Potential Subscribers

Category	Share (%)
Residential	45%
Commercial	25%
Official	23%
Public telephone	7%

11.2.2 Estimate of revenue

According to the statistics of HONDUTEL, the average annual charges for telephone use are as follows:

Residential	Lps. 1582
Commercial	Lps. 4272
Official	Lps. 3526

Data for public telephones are not available. According to the statistics of ITU, the average charge for public telephones is one and a half times that of the commercial user. So 6408 lempiras are assumed in this analysis.

By considering that twenty-five per cent of the total telephone calls are local calls as mentioned in Section 5.3.2 of Chapter 5 and the local call charge of rural areas is half that of urban areas, the average annual charges per subscriber are estimated as follows:

Residential	Lps. 1384
Commercial	Lps. 3738
Official	Lps. 3085
Public telephone	Lps. 5607

11.3 Estimate of the Project Cost

11.3.1 Investment costs

The same as mentioned in Section 10.3 in Chapter 10.

11.3.2 Operating and maintenance costs

Annual operating and maintenance cost per main line until the year 2002 is assumed to be 640 lempiras because of the following reasons.

The employees of the telephone section increased from 2,303 in 1986 to 2,735 in 1990. During the period, the number of main lines increased from 50,126 to 88,038. Therefore, the number of main lines per employee also increased from 21.76 to 32.19. However, the these figures are low compared with the data from other countries.

Personnel expenses occupies about 80 % of operating and maintenance expenses. Personnel expenses may increase every year in order to compensate for the decrease in real wages caused by inflation. However, operating and maintenance cost per main line can be kept to be 640 lempiras by increasing the number of main lines per employee. Therefore, operating and maintenance cost per main line until the year 2002 is estimated to be 640 lempiras in this analysis.

After 2003, as new subscribers can not be accepted because of the limitation in capacity, the number of main lines per employee will not increase. So, a raise in salary causes a rise in the operating and maintenance costs. However, even in this case, it will be possible to keep a lower increase in the rate of operating and maintenance costs than that of salary by streamlining the operation and maintenance activities. Therefore, the increase rate of the operating and maintenance costs is assumed to be 2 % after 2003 in this analysis. Furthermore, other increase rates are studied in the sensitivity analysis.

11.3.3 Working capital

Working capital can be recovered within a short time through business activities. It includes current deposits as cash on hand, and accounts receivable as funds necessary until call charges are collected. Although working capital is counted as an annual expense, it should be recovered during the last year of the project life.

In this analysis, working capital is estimated by the following equation.

$$K_i = E_i - E_{i-1}$$

where

K_i = working capital of the year of i
E_i = operating and maintenance cost of the year of i

11.3.4 Tax

Since HONDUTEL is a state-owned enterprise, HONDUTEL does not pay taxes.

11.4 Result of Financial Analysis

11.4.1 Financial internal rate of return (FIRR)

Table 11.4.1-1 is a revenue and expenditure statement summarizing the operating revenue, operating expenditure and capital costs of the Project over its total life-span. The Project has an internal rate of return of 2.25 %.

The reasons why the FIRR is so low are as follows:

1) As the subject areas are rural areas, the population and the telephone demand are not large compared with the urban areas.

2) As villages are thinly scattered, it is difficult to install equipment effectively. Therefore the installation cost per subscriber is high compared with that of the urban areas.

3) The average income of the inhabitants in the rural areas is not high, so much revenue from those areas can not be expected.

Table 11.4.1-1 Cash Flow Table for the Caiculation of FIRR

(Unit: thousand lempiras)

Year	Subscriber (New)	Subscriber (Cumulative)	Installation fee	Telephone charge	Total revenue [A]	Investment (Foreign) (Currency)	Investment (Local) (Currency)	Operating and Mainte-nance cost	Working capital	Total expense [B]	Net inflow [A] - [B]
1993	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	34,397	8,614	0	0	43,011	-43,011
1995	1,765	1,765	271	4,694	4,965	85,992	21,535	1,130	1,130	109,786	-104,821
1996	1,876	3,641	288	9,683	9,971	51,595	12,921	2,330	1,201	68,047	-58,076
1997	870	4,511	134	11,997	12,131	22,238	5,338	2,887	557	31,020	-18,890
1998	1,540	6,051	236	16,093	16,329	55,596	13,345	3,873	986	73,799	-57,470
1999	1,714	7,765	263	20,651	20,914	33,357	8,007	4,970	1,097	47,431	-26,517
2000	2,072	9,837	318	26,162	26,480	0	0	6,296	1,326	7,622	18,858
2001	1,061	10,898	163	28,983	29,146	0	0	6,975	679	7,654	21,492
2002	1,192	12,090	183	32,153	32,336	0	0	7,738	763	8,500	23,836
2003	0	12,090	0	32,153	32,153	0	0	7,892	155	8,047	24,106
2004	0	12,090	0	32,153	32,153	0	0	8,050	158	8,208	23,945
2005	0	12,090	0	32,153	32,153	0	0	8,211	161	8,372	23,781
2006	0	12,090	0	32,153	32,153	0	0	8,375	164	8,540	23,614
2007	0	12,090	0	32,153	32,153	0	0	8,543	168	8,710	23,443
2008	0	12,090	0	32,153	32,153	0	0	8,714	171	8,885	23,269
2009	0	12,090	0	32,153	32,153	0	0	8,888	174	9,062	23,091
2010	0	12,090	0	32,153	32,153	0	0	9,066	178	9,244	22,910
2011	0	12,090	0	32,153	32,153	0	0	9,247	181	9,428	22,725
2012	0	12,090	0	32,153	32,153	0	0	9,432	185	9,617	22,536
2013	0	12,090	0	32,153	32,153	0	0	9,621	189	9,809	22,344
2014	0	12,090	0	32,153	32,153	0	0	9,813	192	10,006	22,148
2015	0	12,090	0	32,153	32,153	0	0	10,009	196	10,206	21,948
2016	0	12,090	0	32,153	32,153	-7,667	0	10,210	-10,009	-7,467	39,620

IRR = 2.25%

The FIRR of 2.25 % is lower than the market rate of return (MRR) of Honduras. The MRR of Honduras is estimated to be 17 % because the interest rate of the long-term bond of Honduras is 17 %. Therefore, implementing all the projects by internal funding from HONDUTEL is not so profitable.

11.4.2 Sensitivity analysis

In order to see the effect of the variation of the conditions surrounding the Project, a sensitivity analysis was done by changing the value of the parameters.

Table 11.4.2-1 Results of Sensitivity Analysis (FIRR)

	FIRR		Whole
	Phase-I	Phase-II	project
Basic case	1.75%	3.83%	2.25%
1) Contingency			
- where no contingency is needed	2.64%	4.85%	3.21%
- where contigency is doubled	0.96%	2.93%	1.41%
2) Exchange rate			
- Lps. 4.9 per US$1	2.47%	4.66%	3.02%
- Lps. 6.0 per US$1	0.97%	2.94%	1.43%
3) Telephone revenues			
- where annual increase rate is 4%	6.93%	9.21%	7.33%
- where annual increase rate is 2%	4.42%	6.60%	4.85%
4) Operating and maintenance costs			
- where annual increase rate is 4%	1.34%	3.18%	1.82%
- where annual increase rate is 6%	0.82%	2.30%	1.26%

11.5 Economic Evaluation

In this section, the economic benefits are quantified and the economic internal rate of return (EIRR) is calculated by the following method.

11.5.1 Economic benefit

In this study, economic benefits are defined as the benefits which belong to the telephone users. The benefit which belongs to the telephone users is the benefit value minus the call charges that the users pay. In other words, economic benefit is the difference between the maximum willingness to pay of the users and the actual payment for the telephone use. This difference is called the "Consumers' surplus" in the field of economics.

11.5.2 Method of analysis

The idea of a consumers' surplus is convenient to explain the benefits to the users. In order to quantify the benefits, the benefits have to be grasped concretely. However, it is impossible to measure all of the benefits. Therefore, in general, the consumers' surplus is calculated from the demand function which shows the relationship between the price and the demand.

In this evaluation, based on the questionnaires, the demand function derived from the multiple regression is used in order to calculate the consumers' surplus.

11.5.3 Derivation of the demand function and consumers' surplus

1) Demand function

The data shown in Table 11.5.3-1 were used for the multiple regression to derive the demand function. These figures were obtained by taking the average of the collected data in the field survey.

Table 11.5.3-1 Collected Data by each Department

Deparment	Calls/month (Frequency)	Charge/call (Lps.)	Charge/month (Lps.)
Atlántida	15.2	13.7	208.2
Colón	16.0	9.1	145.6
Comayagua	28.3	5.8	164.1
Copán	5.2	17.5	91.0
Choluteca	15.0	6.8	102.0
El Paraíso	17.6	6.1	107.4
Francisco Morazán	40.0	2.3	92.0
Intibucá	6.0	9.8	58.8
Lempira	6.0	20.0	120.0
Ocotepeque	4.5	12.0	54.0
Olancho	17.5	6.0	105.0
Santa Bárbara	4.5	16.6	74.7
Total	175.8	125.7	1,322.8

Average annual income taxes per worker are shown in Table 11.5.3-2. These figures were calculated based on the data presented by the Ministry of Finance of Honduras.

Table 11.5.3-2 Average Annual Income Tax per Worker (1990)

Deparment	Average annual income tax per worker (Lps.)
Atlántida	102.0
Colón	8.6
Comayagua	38.9
Copán	22.9
Choluteca	22.0
El Paraíso	15.2
Francisco Morazán	232.8
Intibucá	1.2
Lempira	1.0
Ocotepeque	3.7
Olancho	291.0
Santa Bárbara	3.3

Note: Calculated based on the data presented by the Ministry of Finance of Honduras.

From the result of the multiple regression analysis using the data shown in Table 11.5.3-1 and 11.5.3-2, the following equation was derived.

$$\begin{array}{lllll} \text{Log (T)} = & 3.814 & - & 0.767 \text{ Log (P)} & + & 0.123 \text{ Log (Y)} \\ & (11.70)*** & & (3.789)*** & & (1.824)* \end{array}$$

$R^2 = 0.834$

Figures in ( ) are T-value.

'***' indicates a significance level of 0.5 %.

'*' indicates a significance level of 5 %.

where

T = Average number of monthly calls per user

P = Average charges per call

Y = Average annual income tax per worker in the originating areas

R^2 = Coefficient of determination

2) Consumers' surplus

The following equations are derived from the above equation.

$$\text{Log}(P) = 3.814/0.767 - (1/0.767)\,\text{Log}(T) + (0.123/0.767)\,\text{Log}(Y)$$

or

$$P = \exp(3.814/0.767) * T^{-1/0.767} * Y^{0.123/0.767} \quad \ldots\ldots\ (1)$$

By substituting the average value of T and Y of each department for T and Y of the above equation, the demand curves for each department are obtained. Furthermore, by calculating the amount of the triangle area between the demand curve and the horizontal line which is drawn at the level of the actual payment for the charge of telephone use, the consumers' surplus can be calculated.

Table 11.5.3-3 shows the benefits which belong to the consumers calculated by the above method.

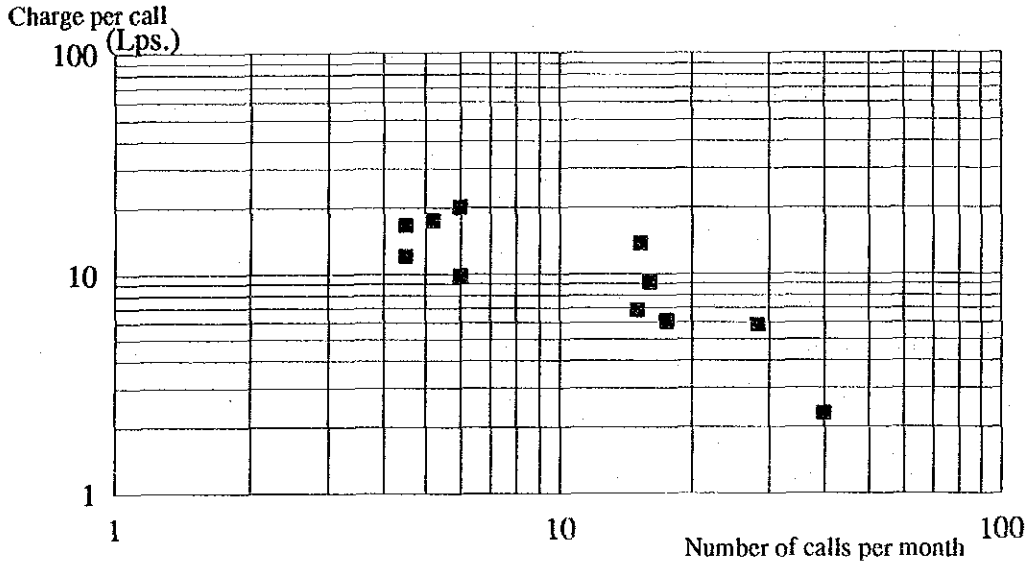
Table 11.5.3-3 Benefits to Consumers of each Department

Deparment	Benefits to Consumers (Lps.)
Atlántida	618.9
Colón	423.9
Comayagua	692.1
Copán	313.9
Choluteca	480.8
El Paraíso	482.2
Francisco Morazán	1,106.8
Intibucá	209.0
Lempira	203.0
Ocotepeque	217.1
Olancho	774.2
Santa Bárbara	213.2
Total	5,734.9

From Tables 11.5.3-1 and 11.5.3-3, the amount of benefits which belongs to the consumers can be estimated at 4.34 times as large as the call charge. (5,734.9 divided by 1,322.8 is 4.34.) Therefore, the consumers' surplus is 3.34 times as large as the call charge because 4.34 minus 1 is equal to 3.34.

Figure 11.5.3-1 shows the relationship between the charge per call and the number of calls per month.

Figure 11.5.3-1 Relationship Between Charge/Call and Number of Calls/Month



11.6 Economic Internal Rate of Return (EIRR)

11.6.1 Underlying assumptions

The underlying assumptions are the same as that for the financial analysis.

Shadow price adjustment is not applied to this evaluation because of the following reasons.

1) Exchange rate

In Honduras, the floating exchange rate system has been introduced. So, this rate can be considered as the effective exchange rate.

2) Wage level

Under the circumstance that the unemployment ratio is very high, the wages of workers sometimes exceed the marginal productivity of labor. In this case, shadow price adjustment is needed for economic evaluation. How-ever, this adjustment should be applied mainly to the wages of unskilled labor. The labor in telecommunications sector seems to be skilled labor. Therefore, the wages applied to the financial analysis are also used for economic evaluation.

11.6.2 Estimate of benefits

The consumers' surplus which is generated from the completion of the Project is taken as the benefit.

Using the equation (1) derived in Section 11.5.3, the consumers' surplus was calculated to be 3.34 times as large as the call charges. (Total benefits to the users are 4.34 times as large as the call charges, so the surplus is 3.34 times as large as the call charges.)

11.6.3 Estimate of costs

The cost of the Project is the same as that for the financial analysis.

11.6.4 Cash flow table

Table 11.6.4-1 shows the cash flow table for the EIRR.

11.6.5 Result of the EIRR calculation

The result of the calculation shows that the EIRR is 30.2 %. This means that the Project will bring a large economic benefit to the Honduran communities.

Table 11.6.4-1 Cash Flow Table for the Calculation of EIRR

(Unit: thousand lempiras)

Year	Subscriber (New)	Subscriber (Cumulative)	Benefit [A]	Investment cost	Operating and Maintenance cost	Working capital	Total cost [B]	Net benefit [A] - [B]
1993	0	0	0	0	0	0	0	0
1994	0	0	0	43,011	0	0	43,011	-43,011
1995	1,765	1,765	20,372	107,527	1,130	1,130	109,786	-89,414
1996	1,876	3,641	42,025	64,516	2,330	1,201	68,047	-26,022
1997	870	4,511	52,067	27,576	2,887	557	31,020	21,047
1998	1,540	6,051	69,842	68,941	3,873	986	73,799	-3,957
1999	1,714	7,765	89,626	41,364	4,970	1,097	47,431	42,195
2000	2,072	9,837	113,541	0	6,296	1,326	7,622	105,920
2001	1,061	10,898	125,788	0	6,975	679	7,654	11,8134
2002	1,192	12,090	139,546	0	7,738	763	8,500	131,046
2003	0	12,090	139,546	0	7,892	155	8,047	131,499
2004	0	12,090	139,546	0	8,050	158	8,208	131,338
2005	0	12,090	139,546	0	8,211	161	8,372	131,174
2006	0	12,090	139,546	0	8,375	164	8,540	131,006
2007	0	12,090	139,546	0	8,543	168	8,710	130,836
2008	0	12,090	139,546	0	8,714	171	8,885	130,661
2009	0	12,090	139,546	0	8,888	174	9,062	130,484
2010	0	12,090	139,546	0	9,066	178	9,244	130,302
2011	0	12,090	139,546	0	9,247	181	9,428	130,118
2012	0	12,090	139,546	0	9,432	185	9,617	129,929
2013	0	12,090	139,546	0	9,621	189	9,809	129,737
2014	0	12,090	139,546	0	9,813	192	10,006	129,541
2015	0	12,090	139,546	0	10,009	196	10,206	129,340
2016	0	12,090	139,546	-7,667	10,210	-10,009	-7,467	147,013

IRR = 30.2%

11.7 Suggestions in Project Implementation

As described in the financial analysis in Section 11.4, the internal rate of return in case of implementing the whole project entirely by internal funding from HONDUTEL will be slightly positive. It means that the operating and maintenance cost in each year after putting the Project into service can be paid for by the income, resulting in sound business management.

From the economic view point, the benefit of the Project brought to the rural communities in Honduras will be great. Therefore, it is very meaningful for Honduras to implement the Project.

Some suggestions in implementing the Project will now be described.

1) Fund management

a) Implementation entirely by internal funding from HONDUTEL

The internal rate of return in case of implementingthis Project entirely by internal funding from HONDUTEL is 2.25 %. Although this figure shows a profit for HONDUTEL, the rate is very low and the investment can not be regarded as favorable for HONDUTEL.

b) Financing by loans

Even when the Project is divided into Phase-I and Phase-II, implementing each phase of the Project by internal funding from HONDUTEL will be difficult. One conceivablesolution is to borrow funds from local and foreign financial organizations. As the internal rate of return of the Project itself is 2.25 %, soft loans with a grace period will be necessary instead of hard loans. When assuming implementation of Phase-I and II of the Project using soft loans at an interest rate of 2.7 % for the foreign currency portion (US$31.85 million for Phase-I and US$20.59 million for Phase-II) and a repayment period of 30 years (including a 10 year grace period), the internal rate of return on equity is 6.57 %. (This figure includes the advance repayment of the capital which is discounted by the market rate of interest of Honduras at the end of the Project.)

c) Financing by governmental subsidy

Implementing this Project entirely by internal funding from HONDUTEL is a heavy burden in view of the large amount of funds required. Raising the funds by soft loans is desirable if realized smoothly but may require a long time. It is therefore necessary to implement this Project by raising the fund using gratuitous governmental subsidy.

If it is difficult to obtain a large amount of funds at a time, therefore it is necessary to study the method as shown below in implementing this Project.

i) Dividing the Project

Divide Phase-I and II further into small segments and implement in the order of priority according to the obtained funds. One example of this division is to divide the Project into 13 segments with the DMAS base stations as the core as described in the Facilities Plan in Chapter 8. In this case, the scale of each project segment is about US$5.03 million on average.

ii) Packaging the Project

Regional development plans are generally implemented with the provision of socioeconomic infrastructure to satisfy basic human needs (BHN) in rural areas. This has as its objective the elimination of territorial differences. Since in underdeveloped areas, little effect can be expected without lateral coordination among different types of small scale projects, they are most generally packaged.

Therefore, it is suggested to discuss with related governmental agencies to incorporate the implementation of telecommunications facilities in a package for execution as a part of a regional development plan.

iii) Making the beneficiary bear the installation cost

Installation work in the rural areas will be more expensive than in the urban areas. (3 to 4 times according to the CCITT data) It is therefore conceivable to set the telephone installation fee in rural areas higher than in urban areas on the basis of the benefit theory. Since the money will still be insufficient, it is suggested to negotiate for subsidies from local and central governments.

2) Other methods for implementation

a) Combination with urban telephone network projects

In general, telecommunication services in rural areas only are not so profitable. It is therefore suggested to form projects by combining the rural telecommunication project with the urban telephone project which is more profitable because the higher demand for telephone service will increase the profitability. To be more definite, it will be one solution in forming a highly profitable project through combination with the telephone facility expansion project of the 13 base station cities as described in the Facilities Plan (Chapter 8).

b) Raising the telephone tariff

At present, telephone service is provided only in the urban areas. In promoting future nationwide development, it is necessary to expand the telephone service in the whole country. In introducing the telephone service in the rural areas, the cost for installation and maintenance there will be higher than that in the urban areas. To cover the cost differential, it will be necessary to raise the telephone tariff to get the required funds.

Implementation of telephone service in rural areas will not only be convenient for inhabitants in those areas but also enable urban inhabitants to communicate with them. This means improvement in the service compared with the previous state. This will justify raising the tariff to make users bear the cost required for such a service improvement.

In conclusion, implementing the whole project by funding from only one source will be difficult in view of the investment amount and the necessity of investment on other projects, such as urban projects, by HONDUTEL. Out of the suggestions proposed above: project implementation by governmental subsidy and other funding sources is recommended. To be more precise, it is desirable to divide the Project into phases I and II and try to get subsidies from the government for the funds required for each phase. A desirable result may be obtained if 54% (US$17.3 million) of the required amount in foreign currencies can be obtained as a governmental subsidy for Phase-I and about 36% (US$7.4 million) for Phase-II. If such funds are assumed to be obtained, 8% or more can be expected as the internal rate of

return of the Project and investment by internal funding will be financially possible. Even in this case, since the investment scale is large, it is desirable to additionally obtain low interest long-term loans from local and foreign financial organizations.

If the amount of subsidy expected to be obtained is not great, it is suggested that the Project be divided into 13 segments as described in the Facilities Plan in Chapter 8. They should be implemented in the order of priority or in combination with the urban project.

CHAPTER 12 OVERALL EVALUATION AND SUGGESTIONS

12.1 Evaluation of Social Benefit Expected from the Introduction of a Telephone Service

The economic benefit to be brought about by the Project was measured in Chapter 11. However, the value of a telephone service is not limited to the volume of traffic, but the transmitted information is also an important factor. Everyone admits the effect of the transmitted information to society, but quantitative evaluation of the effect is very difficult because telecommunication is a part of infrastructure and its impact is mostly indirect. Therefore, the following examines the indirect benefit according to the following aspects:

(1) Agriculture

(2) Non-agricultural sector

(3) Administrative services

(4) Living conditions

(5) Differential in standard of living

1) Agriculture

Agriculture (including forestry and stock-farming) is naturally the major industry in the rural areas. Development of rural areas as the sources of food supply is very important for the whole country. Agriculture in rural areas, however, presently remains at the traditional self-supporting level. Products are rarely shipped to remote markets. Transformation from self-supporting agriculture to market-economy type agriculture is desirable for Honduras.

For this purpose, however, generation of surplus agricultural products is necessary in rural areas. To generate surplus agricultural products, introduction of new and improved farming technologies for modernization of agriculture will be needed in addition to implementation of irrigation and the use of fertilizers. Introduction of new fertilizers and HYV (high-yield varieties) is an example.

Farmers having only traditional agricultural knowledge are likely to respond conservatively to these introductions. Introduction of new technologies without

correct knowledge will lead to a poor result instead of increasing the yield. It is important to increase the opportunities of getting correct knowledge and information to farmers while spreading new technologies. Implementation of telecommunication networks in rural areas will enable farming instructors and farmers to obtain appropriate information, resulting in the strengthening of the productivity in the farming areas. It will also be possible to minimize the damages caused by calamities by providing information on blight and noxious insects and unusual changes of weather.

When surplus agricultural products are generated in this way, it is possible to obtain income by shipping them to markets. Implementation of the telecommunications facilities will lead to an enlargement of the sales routes and acquisitions of more favorable markets as well as switching to more favorable products.

According to the information obtained by the survey team, there is almost no information interchange between farming villages as a source of production and cities as a place of consumption at present. This results in no incentives for selection of favorable markets and products on the side of the producers.

2) Non-agricultural sector

Along with the development of agriculture in rural areas, transportation of goods between farming villages and cities will frequently call for implementation of a physical distribution mechanism. This will make the telecommunications system indispensable for communication with the collecting areas and destinations. Also with the increase in physical distribution, implementation of banking organizations for settlement of transactions will naturally be required. Telecommunication for correct information transfer and efficient management of banking organizations will be indispensable. In a situation involving the movement of goods and money, the role of telecommunication is very important.

3) Administrative services

Administration in rural areas is mostly supported by the subsidy from the central government. Because of insufficient finance, the numbers of local government officials, facilities for health and medical cares, and educational facilities are not sufficient. Efficient management of rural administration is required to make up for

the insufficiency. Introduction of telecommunications in such a situation will lead to improvement of the administrative job efficiency. Frequent communication between local administrative organizations and the central government as a result of the improved telecommunications network will activate information interchange. This will increase the opportunities of rural inhabitants to get the information, leading to a qualitative improvement of administrative services.

Of the various administrative services, health and hygiene services are most closely related to the inhabitants in rural areas. During the field survey, a cholera epidmic broke out in some rural areas and warning posters were seen in many places. Warnings may be possible through mass media such as TV, radio, newspapers and magazines but these are one-way communication media.

Introduction of the telecommunications service will enable remote areas to be informed of the outbreak and spreading of diseases. Furthermore, communication between the Ministry of Welfare and doctors at local hospitals and public health centers will become possible in addition to giving instructions to individual patients who cannot come to hospitals or health centers.

4) Living conditions

In Honduras, paved roads account for 12.7% of all roads. About 55% of the unpaved roads allow traffic throughout the year and the remaining 45% are not passable in the rainy season. Mountainous terrain accounts for 65% of Honduras. Most rural communities are located in the folds of the hills and mountains. Most of the access roads to such communities are unpaved and require tremendous effort for traveling on foot or horses because of the terrain.

For some roads, one hour is required to travel several kilometers by car. Furthermore, such roads cross rivers here and there allowing passage in the dry season but not when it rains. Many villages, therefore, become isolated in the rainy season.

For such villages, telecommunications services will play an important role in preventing the inhabitants from being isolated.

It is not rare in rural areas that some family members work away from home. Telecommunications services will be helpful for communication between family members.

5) Differential in the standard of living

In Honduras, there is a great difference in the standard of living between rural areas and urban areas. For example, the infant mortality in rural areas is twice that in urban areas. The illiteracy rate is 42.4% in rural areas, which is above the 32% average for the whole country. (Source: "Strategy for 1990–1994 integral development") There is also a great difference in the amount of individual income tax collected by Departments.

The GNP per capita of farmers is about half the national average which is far less compared to other industries. Since agriculture is the main industry in the rural areas of Honduras, there is a great differential in the standard of living between rural areas and urban areas. Elimination of this differential is an important task for the government.

It has been known empirically that there is a correlation between telecommunication service and economic development. Implementation of telecommunications will accelerate development of rural areas.

12.2 Overall Evaluation

As the economy in Honduras depends on primary products, development of primary industries is of vital importance for the nation. In rural areas, however, social infrastructure such as education, medical care, water, and electricity have not been implemented. Telecommunications services are concentrated only in cities whose population is over 20,000. The differential in the standard of living is great. The government, therefore, is actively promoting the development of rural areas.

When the Project is implemented, automatic telephone service will be provided in 223 communities, each with a population below 20,000, in 16 of the 18 Departments in the country. It will facilitate information interchange with most areas in the country and with foreign countries. It has so far been clarified that the influence on HONDUTEL and on the society, economy and culture in Honduras will extend over a very wide range. In other words, the Project not only contributes to the development of the economy and industries in Honduras but also bring about very large development effects such as convenience to inhabitants and improvement of administrative services. During the

field survey, many Departmental governors, district headmen and regional inhabitants strongly requested early telephone installation. Since the implementation of the Project is very meaningful for Honduras, the government of Honduras and HONDUTEL should give a higher priority to the investment and implementation of the Project than in the past.

Rural areas are targeted to be covered by this Project. Unlike urban areas, the population is small and scattered making efficient construction of telecommunication facilities very difficult. As described in the financial analysis section, it is possible to maintain and manage the facilities within the range of income after the end of construction, but not much profit can be expected. In the analysis from the aspect of the economic benefit, the effect is great and a certain degree of profit can be confirmed. It is, therefore, necessary to ensure long-term low-interest loans or subsidies from the central government as funds for construction. In other words, it is necessary to implement the Project in combination with development projects in other fields or to adopt the benefit theory in the bearing of the construction cost. Another method is to implement the Project in combination with the urban telephone network project. It is also necessary to divide the Project into multiple segments as the required amount of funds is too large for execution as one project.

This project is to provide 223 rural areas with automatic telephone service. For this purpose, construction of office buildings, switching units, transmission equipment, radio equipment, power cabling and subscriber lines should be done without delay. It is necessary to make communication among related parties closer and to obtain cooperation and assistance from regional administrative organizations etc. The system for executing the construction takes these situations into consideration. Since the Project adopts the radio system for establishing the rural telecommunications network, aerial expansion of the telecommunications facilities is possible without much increase in the number of necessary maintenance personnel. Implementation by division into two phases in view of the work scale will eliminate possible problems when proceeding with the construction and training of maintenance personnel.

As described above, the Project has sufficient socioeconomic merits for the regional communities. Since the merits are sufficient and smooth work is possible, early implementation of the Project is desirable.

12.3 Suggestions

The Project will not only provide economic merits for rural communities but also contribute much to activation of their economy in rural areas by bringing about a strong impact in a wide range to society and administrative services. Providing the telephone service in areas where telephone service has not been available will contribute to improving the convenience to regional inhabitants. The necessity of the Project having diversified development effects is very high. Since this survey has revealed the effects and feasibility of the Project, the following suggestions are proposed.

12.3.1 Determining the priority of development

The necessity and effects of the Project have been confirmed as economic merits to the whole society and will have a strong impact on the activation of the economy in rural areas. It is therefore suggested that the government of Honduras and HONDUTEL should take necessary actions for giving higher priority to the investment and implementation of the Project than before.

12.3.2 Establishing the system for construction work

The Project is to provide automatic telephone service in 223 rural areas in the country. It is therefore important to execute the various work for office building construction, switching, transmission and radio equipment installation, and telephone terminal installation. Any problem arising in the course of such construction work should be solved quickly and appropriately through good coordination among related parties. For execution of the heavy construction work load, parallel operation of many kinds of work is required, calling for tremendous man-hours. In executing such work, cooperation and support from regional administrative organizations are necessary. For smooth execution of the Project, it is suggested that HONDUTEL ensure the necessary operation in view of these circumstances and establish a system for execution of the construction work. This should be provided with the follow-up function for the work in progress and the coordinating function for problems that may occur in the process of execution.

12.3.3 Division into phases

The Project covers 223 rural areas distributed throughout the country. Implementing the Project as a single step project will be difficult financially in view of the large amount of investment necessary and relatively low profitability. Implementation matching the