Fig. E.1.7 Irrigation & Rotation Block
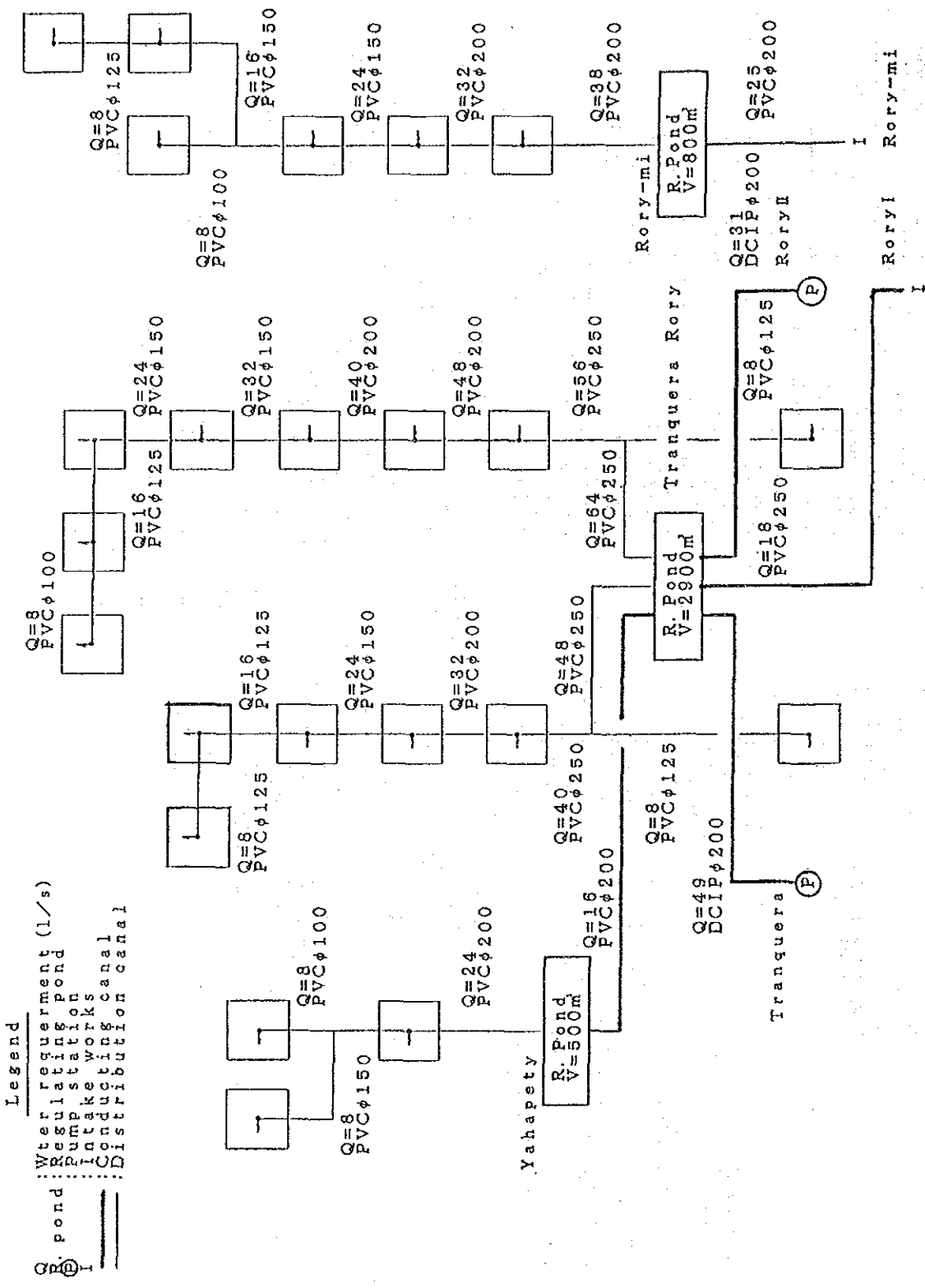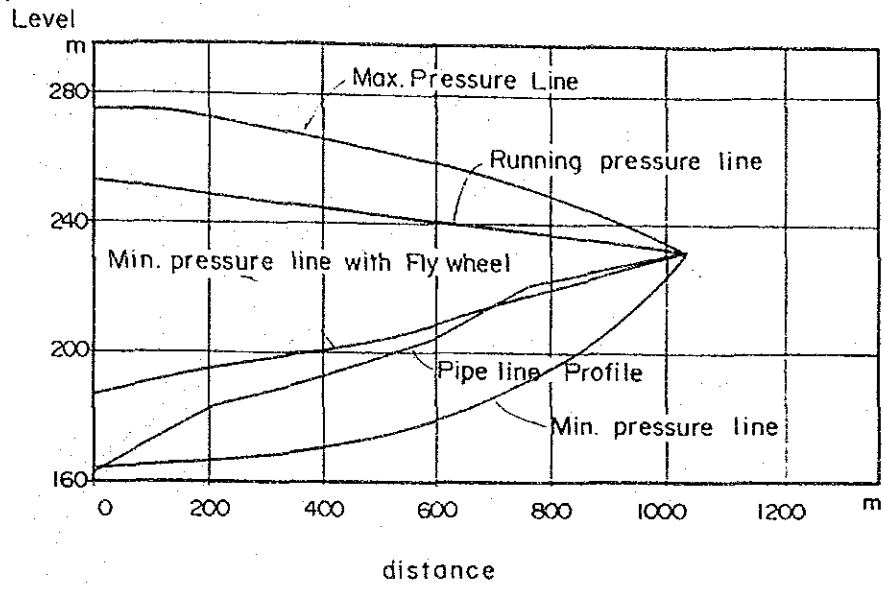
Fig. E.1.8 Diameter of Pipeline Networks

Legend

R. pond ......Wter requerment (1/s)
Reg.pond ......Regulation pond
P ......Pump station
□ ......Intake works
═══ ......Conducting canal
——— ......Distribution canal

Q=8
PVCφ125

Q=8
PVCφ100

Q=16
PVCφ150

Q=24
PVCφ150

Q=32
PVCφ200

Q=38
PVCφ200

R.Pond
V=800㎥

Rory-mi

Q=25
PVCφ200

Rory-mi

Q=31
DCIPφ200

RoryⅡ

RoryⅠ

Q=8
PVCφ125

Q=24
PVCφ150

Q=32
PVCφ150

Q=40
PVCφ200

Q=48
PVCφ200

Q=56
PVCφ250

Q=8
PVCφ100

Q=16
PVCφ125

Q=64
PVCφ250

Tranguera Rory

Q=18
PVCφ250

Q=16
PVCφ125

Q=24
PVCφ150

Q=32
PVCφ200

Q=48
PVCφ250

Q=8
PVCφ125

Q=8
PVCφ125

Q=40
PVCφ250

Q=8
PVCφ125

R.Pond
V=2900㎥

Q=8
PVCφ100

Q=16
PVCφ200

Q=8
PVCφ150

Q=24
PVCφ200

Yahapety

R.Pond
V=500㎥

Q=49
DCIPφ200

Tranguera

E - 40

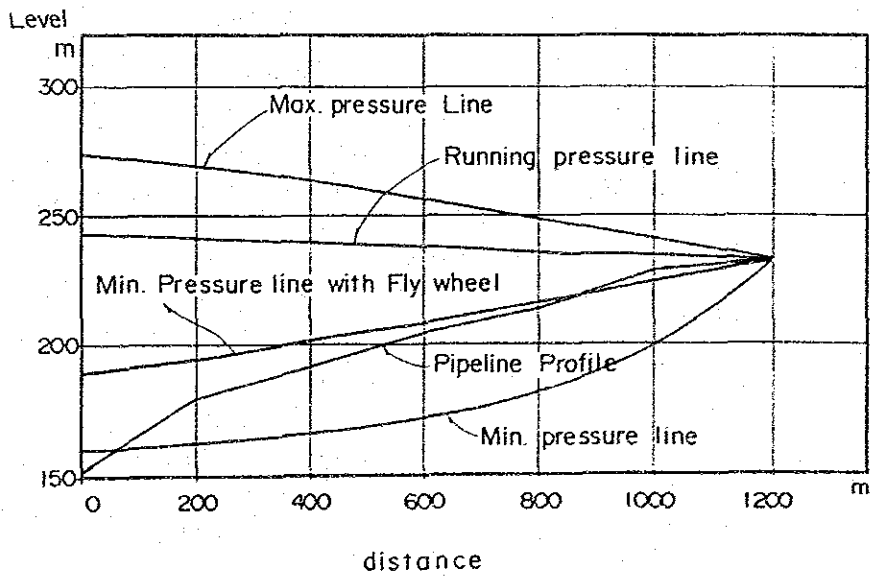- Tranquera pump
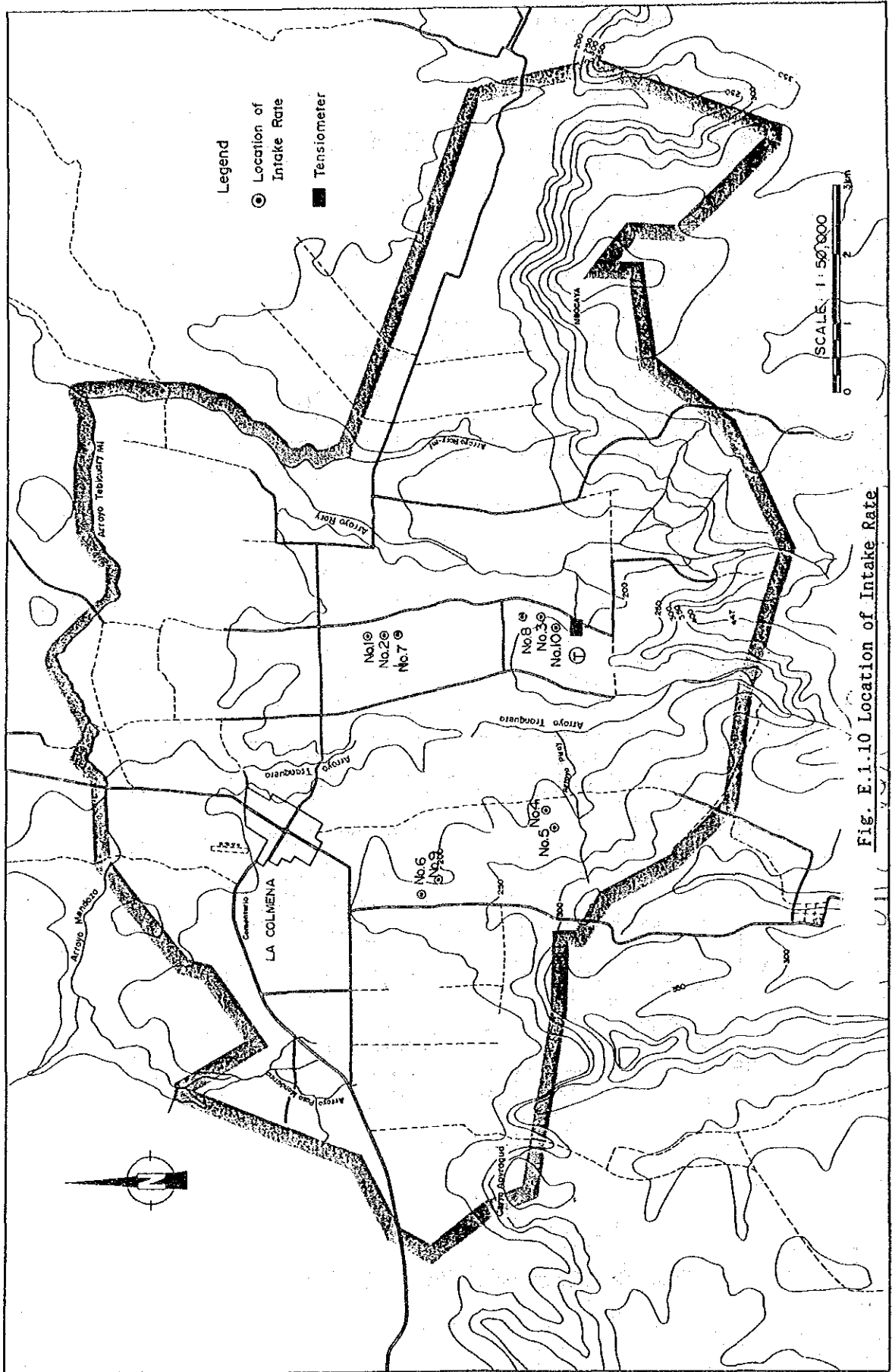

- Rory pump

Fig. E.1.9 Water Hammer Analysis

Fig. E.1.10 Location of Intake Rate
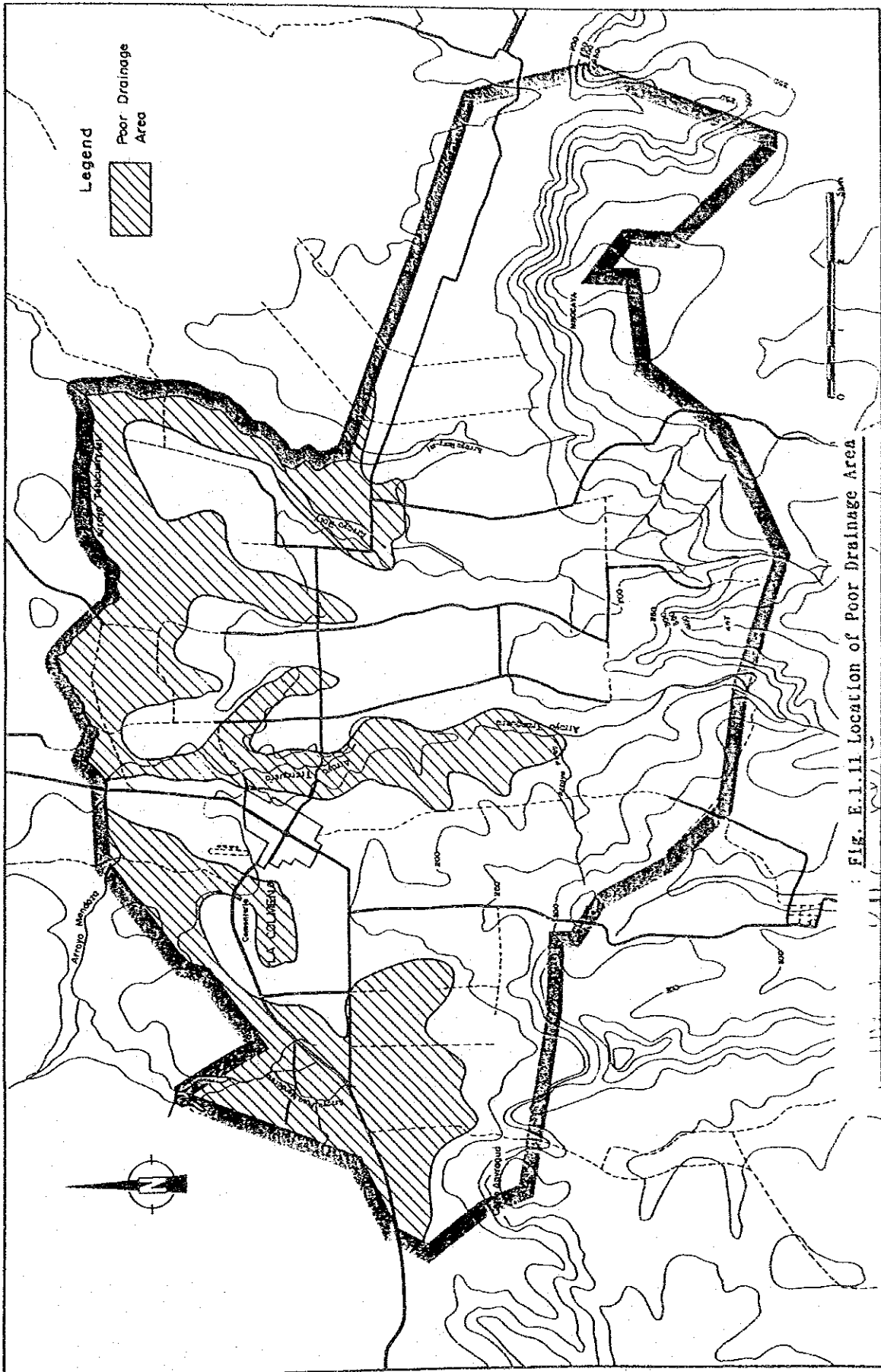
Fig. E.1.11 Location of Poor Drainage Area

ANNEX F — RURAL PLANNING

ANNEX F RURAL PLANNING

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ANNEX F RURAL PLANNING

F.1 Current Situation

1.1 Current Situation

(1) Population

1) Movement of the Population in Paraguay

Based on the national census data, the recent population changes are shown below:

Prefectures	Area (km2)	1982 Population	1982 Density	1972 Population	1972 Density	1962 Population	1962 Density
ASUNCION	117	454,881	3,887.9	388,958	3,324.4	288,882	2,469.1
CONCEPCION	18,051	133,977	7.4	108,130	6.0	85,690	4.7
SAN PEDRO	20,002	191,002	9.5	138,018	6.9	91,804	4.6
CORDILLERA	4,948	194,011	39.2	192,218	39.3	188,313	38.1
GUAIRA	3,846	143510	37.3	124,799	41.3	114,949	38.0
CAAGUAZU	11,474	299,437	26.1	210,858	17.1	125,138	5.8
CAAZAPA	9,496	109,452	11.5	103,139	10.9	92,401	9.7
ITAPUA	16,525	262,680	15.9	201,411	12.2	149,821	9.1
MISIONES	9,556	77,475	8.1	69,246	7.2	59,411	7,6
PARAGUARI	8,705	204,399	23.5	211,977	24.4	203,012	23.3
ALTO PARANA	14,895	199,644	13.4	88,607	5.9	24,067	1.2
CENTRAL	2,465	497,388	201.8	310,390	125.9	229,073	92.9
NEEMBUCU	12,147	70,388	5.8	73,098	6.0	57,878	4.2
AMAMBAY	12,933	68,395	5.3	65,111	5.0	34,505	2.7
CANINDEYU	14,667	66,409	4.5	-	1.9	-	-
PTE. HAYES	72,907	33,021	0.5	38,439	0.5	29,870	0.5
ALTO PARAGUAY	45,982	8,734	0.2	5,366	0.1	3,854	0.1
CHACO	36,367	287	0.0	-	-	-	-
NUE. ASUNCION	44,961	234	0.0	-	-	-	-
BOQUERON	46,708	14,556	0.3	26,190	0.6	40,405	0.2
TOTAL	406,752	3,029,830	7.4	2,357,955	5.8	1,819,103	4.5

2) Population Distribution in Paraguari Prefecture

The population distribution within Paraguari is illustrated in Fig.1.1.

3) Population Index

Based on the census, major population indexes are classified into four divisions as shown below:

Index		Paraguari		La Colmena	
		Total	Rural	Total	Rural
a.Juvenile Rate	(A/B)	0.81	0.86	0.76	0.82
b.Aged People Rate	(C/B)	0.11	0.11	0.10	0.10
c.Subordinate Rate	([A+C]/B)	0.92	0.97	0.86	0.92
d.Aged Rate	(C/A)	0.14	0.13	0.13	0.12

(note)　A= 14 years old or younger
　　　　B= 15 - 64 years old
　　　　C= 65 years old or older

(2) Residence Distribution

The study area is composed of the urban area called URBANO and the rural area. The urban area is crowded with most of the major facilities being located there. The area shows a grid-like city structure with ten blocks spreading east-west and 12 blocks north-south. A part PLAZA is located in the center surrounded by other public facilities.

Distribution map of the facilities in the urban area is shown in Fig. F.1.2.

Houses in the rural area, which are found clustered along the roads, are divided into 10 administrative districts called COMPANIA.

According to the 1985 survey at the time of polio vaccination in CENTRO DE SALUD, population and the number of houses at each administrative section is as follows:

Area	Household	Population
Urban	460	2,309
Rural	405	2,600
Total	865	4,909
Compania	Household	Population
1.YBAROTY	53	340
2.YAJHAPETY	27	175
3.PINDOTY	52	360
4.RORY	30	190
5.CAATY-MI	46	295
6.MBOCAYATY	56	335
7.FATIMA	34	215
8.BARRERO AZUL	40	260
9.POTRERO ALTO	33	210
10.SOL NACIENTE	34	220

The divisions are arranged in the following manner:

```
                ┌──────────┐        ┌────────┐
                │ SOL      │        │ RORY   │      []:HOUSEHOLD
                │ NACIENTE │        │ [ 30]  │      ():POPULATION
                │ [ 34]    │ PINDOTY│ (190)  │
        ┌───────│ (220)    │ [ 52]  │        │
        │       │──────────│ (360)  └────────┤
        │       │ ZONA     │        ┌────────┤
        │       │ URBANA   │        │        │
   ┌────┤       │ [ 460]   │        │ CAATY-MI│
   │YBAROTY│    │ (2309)   │        │ [ 46]  │
   │[ 53]  │    │──────────│        │ (295)  │
   │(340)  │    │ TAJHAPETY│        │        │
   └───────┤    │ [ 27]    │ BARRERO│        │
           │    │ (175)    │ AZULL  │        │
           │────┴──────────│ [ 40]  ├────────┴──────┐
           │ POTRERO ALTO  │ (260)  │ FATIMA│NBOCAYATY│
           │ [ 34]         │        │ [ 34] │ [ 56]  │
           │ (210)         │        │ (215) │ (335)  │
           └───────────────┴────────┴───────┴────────┘
```

(3) Health and Medical Care

1) Facility Situation
    a.National Health Center (CENTRO DE SALUD) : 1 place
    b.Private Clinics   : 3 places
      (Pediatrics, Gynecology and Internal medicine)
    c.Dental Clinics   : 2 places
    d.Licensed Midwife   : 2 persons

2) National Health Center
    a.Composition: Chief (Pediatrics) : 1person
                  Nurse   : 5
                  Licenses Midwife   : 1
                  Office clerk   : 1
                  Ambulance driver   : 1
    b.Service hours: AM 7:00 - AM 11:00 (Monday - Saturday)
                  (The nurses take turns to be on 24-hour
                  service.)
    c.Diagnosis items: The center chief makes a round of all the
                  treatment items, but the dentist is also put
                  in the service twice a week (Thursday and
                  Friday). The medical activities at the center
                  are mainly designed for prevention and early
                  treatment of diseases. Patients who need
                  operation and who are seriously ill will be
                  sent by ambulance to large hospitals in
                  Paraguari or Asuncion.

Treatment records in August 1988 are as shown below:

Children	:	220 people
Adults	:	81
Pregnant women	:	89
Gynecology	:	34
Child-bearing	:	10
Dental services:		60

d.Disease situation: General Diseases :Stomach/Intestinal
Catarrh
Bronchities (common cold, flu) Parasites
: Adult Diseases :High-blood pressure
Anemia caused by
mainutrition Diabetes

(4) Schooling

1) Education System
   The following education system is adopted for schooling in Paraguay.

   Infant education   (ENSENANZA PRE PRIMARIA)
   Primary education   (ENSENANZA PRIMARIA)
   Mid-level education (ENSENANZA ETAPA BASICA Y BACHILLER)
   High-level education(SUPERIOR UNIVERSITARIO)

(a)Primary Education
   The constitution stipulates that education is mandatory for every school age children and therefore is free of charge. However, the parents bear the costs of school uniforms and other expenses such as notebooks,pencils,etc. Ministry of Education (MINISTERIO DE EDUCACION Y CULTO) is responsible for this schooling. The class is being conducted under the unified curriculum.

   The primary education is six years long and is divided into two periods; the first half (1-3 years) and the last half (4-6 years).

Escalation (CONCENTRICO Y LENEAL) for students is adopted as education idea.

(b)Mid-level Education

The six-year-long mid-level education is divided into two periods: the first half called Etapa Basica is from one to three years and the last half called Bachiller is from four to six years. This Bachiller is further divided into the general course (Bachiller Humanistico Cientifico) and the technical course (Bachiller Tecnico). There are three categories available in Bachiller Tecnico; industrial, commercial and agricultural and pasturing.

2)Situation of Education Facilities

(a)Primary Education Facilities

Two primary schools, "Paraguay-Japon" and "San. Francisco Javier", are located in the urban area of La Colmena, with each having three branch schools (Asociado) in the rural area.

Schooling distance is set at 5 km as a rule, but it is up to the students which school to attend. The class is taught with two time sets, morning and afternoon, at each of the main and branch schools. Each class is 40 minutes long and five classes a day are taught.

The school starts on Feb. 26 and ends on Nov. 30, with a 15 day-long winter break in August and a 80-day-long summer vacation starting in December.

Major schooling indexes in the area are as shown below:
.Schooling Rate : 95 %
.Rate of students taking upper education: 80 %

The table below gives some basic information about each school (as of September 1988).

School Names	Prin-cipal	Vice prin.	Teacher	Classes 1st.	Classes 2nd.	Student	Note (garades)
(Main school)							
Paraguay-Japon(La Colmena)	1	1	10	8	8	382	1 - 6
(Branch school)							
Dr. M,S Bertoni(Isla Alta)	-	-	2	2	2	63	1 - 6
Potrero Alto	-	-	1	1	1	31	1 - 3
Fatima	-	-	1	1	1	27	1 - 2
(Main school)							
San Francisco Javier	1	1	6	5	5	240	1 - 6
(Branch school)							
Caaty-mi	-	-	3	3	3	93	1 - 6
Mbocayaty	-	-	3	3	3	111	1 - 6
Pindoty	-	-	2	2	2	50	1 - 6

Changes in the number of students in the past ten years are shown below:

School Name	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88
.Paraguay-Japon	460	456	434	443	412	371	380	370	380	382
.Isla Alta	100	90	90	88	85	92	80	70	68	63
.Potrero Alto	40	40	41	40	42	36	29	25	32	31
.Fatima	50	48	45	40	36	40	38	35	32	27
Sub-total	650	634	610	611	575	539	527	500	512	503
.San Fra. Javier	230	220	228	228	238	204	220	236	237	240
.Caaty-mi	129	121	134	156	112	101	82	76	79	93
.Mbocayaty	134	109	124	158	117	134	130	122	118	111
.Pindoty	77	66	62	76	74	77	62	64	60	50
Sub-tota	570	516	548	618	541	516	494	498	494	494
TOTAL	1220	1150	1158	1229	1116	1055	1021	998	1006	997

Fatima branch school is under improvement work now but Caaty-mi and Potrero Alto branch school are in bad condition due to old age.

Playing ground is about the only auxiliary facility for both main and branch schools.

Fig. F.1.6 shows distribution of the school facilities in La Colmena.

(b)Situation of Mid-level Education Facilities

As a mid-level education school, "Agustina Miranda Gonzalez" Institute is located in the urban area. Founded in 1957, it first started as a night school and become a day school as is

seen today when a main school building was constructed in 1972.

On average, about 80 students are enrolled each year, with 70 % of them finish all the required courses. And about 70 % of the graduates move on to the higher schools.

The class is taught with two time sects, in the morning and in the afternoon. At the moment, there are 17 teachers (including principal and vice principal) who teach 6 classes a day . One class has 40-minutes.

The table below shows the number of students classified by grade.

School Year	1	2	3	4	5	6	
Morning	45	47	27	26	26	-	
Afternoon	48	50	33	32	28	49	(students)

(c)Other Education Facilities

- Vocational school:A vocational training school designed for graduates of the primary schools and those of the 1st-half of the mid-level education is established within "Agustina Miranda Gonzalez". There are three classes available - wooden work, art and electricity - for the period of one year.

- Japanese language school:
    .Name   : La Colmena Japanese Language School
    .Foundation: Nov. 16. 1936
    .Founder   : La Colmena Japanese Culture Association
    .Number of teachers: 2 (and one principal)
    .Number of classes: 2
    .Number of students: 64 (as of May 1988)
    .Teaching level: 9 steps

(5) Traffic System

The wide area road network within Paraguay is illustrated in Fig. F.1.3.

1) Current Road Condition

The area has four main roads, three provincial roads and 34 farm roads.

According to the survey, roads in the area are divided into the following four pattern:

Pattern A: Wide Area Arterial Road

B: Connection Road -I (Join Arterial Road)

C: Connection Road -II (Linking Outside Area)

D: Connection Road -III(Linking the Area)

E: Simple Farm Road

Current road condition within the area is shown in Table F.1.1, Fig. 1.4 and Fig.1.5.

2) Result of Traffic Density Survey

Traffic density for 12 hours at some of major points is as follows:

Vehicle Type	818 (M)		819		251		818 (U)		805	
	Into	out	Into	out	Into	out	Into	out	Into	out
COCHE	39	33	7	9	10	16	11	22	3	1
JEEP	27	36	7	9	27	16	9	17	2	5
CAMION	28	27	5	5	32	29	20	33	6	8
TRCTOR	12	12	3	4	-	-	4	3	1	2
ACOPCADO	6	5	-	-	-	-	-	-	1	2
OMNIBUS	11	9	2	1	13	15	8	8	-	-
SUB TOTAL 1	123	122	24	28	82	76	52	83	13	18
CARRETA(VA.)	6	5	4	1	2	2	13	14	13	7
CARRETA(CA.)	-	-	-	-	-	2	2	-	-	-
CABALLO	9	7	11	4	5	4	15	16	15	14
SUB TOTAL 2	15	12	15	5	7	6	30	32	28	21
BICICLETA	33	22	11	11	9	13	9	7	17	15
MOTOCICLETA	48	45	27	33	15	22	18	14	3	5
SUB TOTAL 3	81	67	38	44	24	35	27	21	20	20
1-3 TOTAL	219	201	77	77	113	117	109	136	61	59
HOMBRE	480	465	207	194	507	530	307	359	219	193
TOTAL	699	665	284	271	620	647	416	495	280	252
Hourly Traffic	16.8	15.5	5.9	5.9	8.7	9.0	8.4	10.5	4.7	4.5
Total Hourly	53.8	51.2	21.8	20.8	47.7	49.8	32.0	38.1	21.5	19.4

All in all, those above can be summarized as follows:
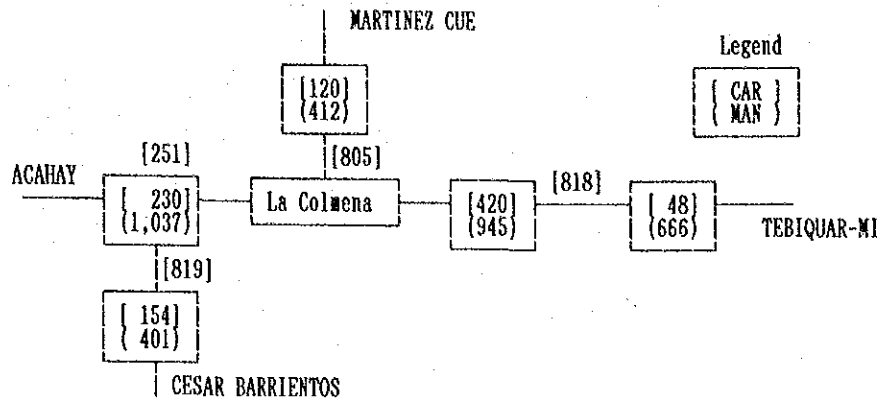
3) Public Transportation System

Only the bus service is available as a means of public transportation in the study area. As is seen from the diagram below, La Colmena serves as the core of the bus route which extends to the surrounding places.
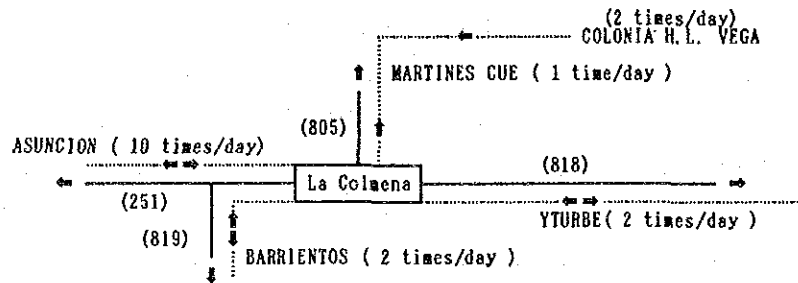
(6) Communication and Postal System

1) Communication

(a)Communication System in Paraguay

Wide area communication network is as follows:

  -Connected to Asuncion via Carapegua.

  -Connecting station from La Colmena located in Carapegua.

  -Long distance calls to Chauria and Barrientos are connected to other prefectures via La Colmena.

The diagrams below show the wide area communication networks.
(Current situation, as of September 1988)
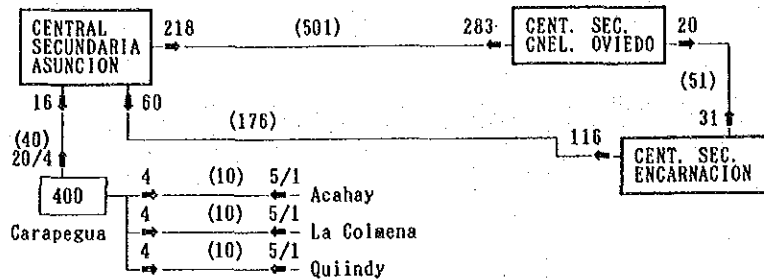
(Scheduled for 1991)
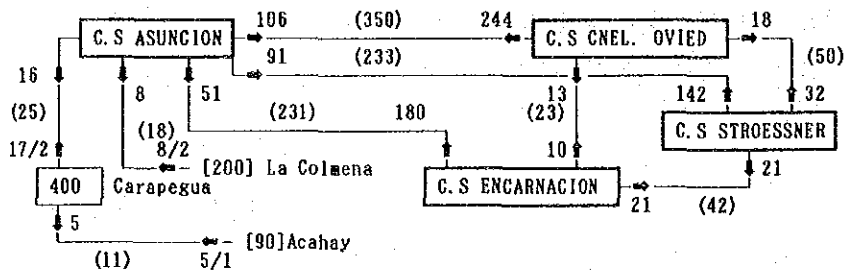
(b)Telephone Facility Situation of the Area

One telephone station of ANTELCO is located in the urban area.
Switchboard is manually operated. Dialing system is used for the
ordinary calls. Long distance and overseas calls can be made
through the operator. One pay-phone booth is installed within
the telephone station. It can be used to make such calls as
ordinary calls, long distance calls and overseas calls. The
station is open from Monday to Saturday, 6:30 - 22:00.

The number of employees: Chief   : 1 person
                         Operator   : 3 (works in three shifts)
                         Service   : 1

(c)Telephone Users

At the moment, a total of 99 families make use of the service. The availability of the telephone service is limited by the small capacity of the switchboard. According to the ANTELCO long-term plan, the machine will be made completely automatic in three years and the number of line will be extended to 200.

Existing telephone users are as follows:

Urban area : 99

Rural area : 1 (Pindoty)

(d)Telex and Facsimile

No telex or fax service is available now. They will be made available when the number of telephone users have sufficiently increased in the future.

(e) Telephone Charge

General charge   :Ordinary family 3,300 G/month
                         Commerce   6,500

Long distance charge   :204 G for 3 minutes, 44 G for each
                         extra minute (to Asuncion)

(f) Radio Communication

In general, this form of communication is not in use in La Colmena. ANTELCOs' permission is necessary to use it.

(g) Other Communication Facilities

Radio set diffusion rate   : nearly 100 %

Television set diffusion rate: 50 % (in the urban)
                               30 % (in the rural)

Broadcast station   : two TV stations in Asuncion
                                Radio stations in Asuncion,
                                Paraguari

2) Postal Service

La Colmena post office was founded in 1979. The post office is responsible for receiving and sending mails, but does not conduct home delivery. Mails are received or sent to Asuncion main office by public bus once a day. Office hours are AM 7:00 - 11:30 and 14:00 - 17:00.

Average mail volume per month is as follows:

Receiving : 200 letters

Sending   : 150 letters

(7) Electricity

1) Network

Power is generated at two power station in ITAIPU and ACARAY, from where it will be distributed nationwide. To this area, power is first reduced from 220 kv to 66 kv at San Lorenzo and arrives here through Itaguai, Paraguari, Carapegua (where it is further reduced to 23 kv), Acahay and La Colmena in this order.

The power distribution route around the study area is shown below:
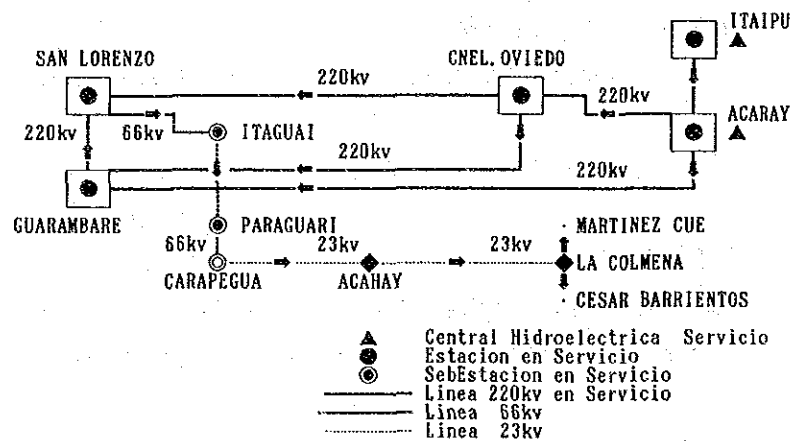
2) Electricity User Breakdown

A total of 437 households are receiving electricity in La Colmena. Classification according to administrative sections is as follows:

Administrative	Receiver	Transformer
Urban area	370	7
Sol Naciente	23	1
Ybaroty	7	1
Yajhapety	8	2
Pindoty	17	2
Rory	6	2
Caaty-mi	0	0
Mbocayaty	0	0
Fatima	8	1
Brrero Azul	21	3
Potrero Alto	0	0

The net work of electicity in La Colmena is shown in Fig F.1.6.

3) Electric Charge Billing System

The billing system is well established according to the use.   The table below shows a typical example (as of August 1988). The bill is charge according to the reading of the electricity meter. Reading of the meter is done by those who are in electricity business commissioned by ANDE.

For Residences (C-41)	< 20 kw	:	17.67 G/kw
	21 - 50	:	26.47
Home use (C-42)	< 85 kw	:	27.70 G/kw
	85 - 150	:	28.89
	150 - 250	:	30.10
	> 250	:	32.01
Commercial use (C-45)	< 85 kw	:	36.00 G/kw
	85 - 150	:	37.50
	150 - 250	:	39.12
	> 250	:	41.61
Industrial use (C-43)	> 100 kw	:	28.89 G/kw
	100 - 200	:	28.13
	200 - 500	:	27.05
	500 - 750	:	26.14
Public use (C-46)	> 85 kw	:	27.70 G/kw
	85 - 100	:	28.89
	100 - 250	:	30.10
	> 250	:	31.01

(8) Drinking Water Supply System

   1)Situation in the Urban Area

     a) Water Supply in La Colmena

.Water source	:Two wells are used to obtain water.
	No.1:H= 76 m Q=3,000-3,500 lit./hr.
	No2.:H= 96 m Q=3,000-3,500 lit./hr.
	(However, the combined water volume is
	Q=2,500 lit./hr. during the summer
	dry season.)
.Water distribution	:Water tower(V=120,000 lit/hr, H=16 m)
	Conducting pipe L=1,220 m
	Distribution pipe L=6,500 m Ø40 - 85 m/m
.Maintenance and	:La Colmena sanitation committee
Management	(La Junta de Saneamiento)
.Recipient	:240 household
	(40 % of the total in urban area)

b) Water Charge

    .1,400 G/month   (202 households)

    .1,700 G/month   (38 households)

    .Charge for new subscribers

        .40,000 G (When the pipe is in the front)

        .45,000 G (When the pipe is in the back.)

c) Water Cut-off Situation

    .Periodic water cut-off :Twice a month to for facility maintenance.

    .Water is supplied during certain time of the day in summer (from September to March) as shown below:

        High land in the urban : 6:00- 15:00

        Low land in the urban   : 6:00- 11:00, 15:00-20:00

2) Situation of the Rural Area

Right now, no drinking water supply facilities are available in the rural area where private wells and streams are the predominant source of water. Most farm families have private wells about 10 m deep with the water depth of 0.3-3.0 m, but some of them run dry in summer. Although some of the farmers store well water in a tank for home use, most of them get water from their wells as needs arise.

Some farmers scattered in the mountainous regions get water directly from springs and streams, but they are small in number. Refer to Annex B for the survey results concerning private wells.

(9) Waste and Sewage Treatment

Neither the urban area nor the rural area have sewer or drainage facilities. In most cases, human waste is buried in the ground by each farming family. Most of the households in the urban area are equipped with toilets, but their number is very small or none at all in the rural area.

As to the miscellaneous water, each farm family has a simple drainage channel within the premises to let the ground naturally absorb the water. On the other hand, some urban families discard it directly into the river or onto the road.

(10) Agricultural Facilities

Some of the major agriculture-related facilities within the study area are: agricultural extension office (MAG-SEAG), public market (ABAST), juice factory (under construction) and other public facilities managed by agricultural cooperative in La Colmena (rice mill, cotton factory and winery).

(refer to Annex D for the details)

F.2 Master Plan of Rural Infrastructure

(1) Potentiality for Improvement

To formulate the improvement plan of rural infrastructure in the Study Area, potentiality of the Area is summarized below to set up the standard of improvement:

a) Furnished the primary social infrastructures,
b) High intention to improve the rural infrastructure,
c) High levels of human resources on both quantity and quality, and
d) Easy land acquisition for proposed facilities.

(2) Constraint for Improvement

Primary social infrastructures has been furnished, however, constraints to more advanced improvement in the area are as follows:

a) Complex land shapes with undulation
b) Scattered houses in the rural area
c) Dwindling water resources with sub-division

(3) Strategy for Improvement

With the conditions given above, the following strategies for improvement can be set up. Targets based on the long-term views which will be carried out with stage-wise should be established *for improvement of the Study Area.*

a) Improvement will be proceeded with the administrative division as a unit,
b) Improvement of road should be made as a core project, then, basic social infrastructure such as electrification, drinking water supply and etc. will be established,
c) Moreover, upgrade will be attempt with full use of existing facilities, then
d) Improvement the quality where basic infrastructure has been set up.

(4) Target of Improvement

Based on the situation of the existing facilities, targets for improvement of the Study Area will be set up as follows. The

target year is scheduled after 10 years. The target year is divided into three stages, then, urgent one will designate as the First Stage and long-term ones as the Future Stage.

With these, target of improvement with the administrative division-wise is shown below:

Administrative Section \ Items	Main Road	Provincial Road	Farm Road	Electricity	Water Supply	Telecommunication	Medical Facility	Education	Garbage Teatment	Sewage Treatment	Rural Park	Meeting Center	Notes
1. YBAROTY	—	—	●	◎	●	◎	—	—	△	△	◎	◎	● : First
2. YAJHAPETY	—	●	△	—	●	△	—	—	△	△	△	△	◎ : Second
3. PINDOTY	●	●	●	◎	●	△	—	—	△	△	△	△	△ : Future
4. RORY	—	—	●	◎	●	△	—	△	△	△	△	△	
5. CAATY-MI	●	—	●	◎	●	◎	—	●	△	△	◎	◎	
6. MBOCAYATY	●	—	◎	◎	●	◎	—	△	△	△	◎	◎	
7. FATIMA	—	●	●	◎	●	△	—	◎	△	△	△	△	
8. BARRERO AZUL	—	●	◎	◎	●	△	—	—	△	△	△	△	
9. POTRERO ALTO	—	●	●	◎	△	◎	—	●	△	△	◎	◎	
10. SOL NACIENTE	●	—	◎	—	●	△	—	—	△	△	△	△	
11. URBAN AREA	●	●	—	—	●	◎	●	△	◎	△	◎	—	

Target and its scale are explained following chapters in detail on the basis of above figures.

2.1 Road

The road is the basic infrastructure for both living of habitants and productive activities, and thus plays an important role for the Study Area. For this reason, the priority should be given to road improvement over the other infrastructures. The following shows basic attitude for improvement and its required quantity.

(1) Target

Priorities of road improvement will be determined based on the number of benefited households and the amount of daily traffic. The priority should be given to connecting the farm road to the main road, to allow car traffic in case of emergency. With these items being considered, the following targets for road improvement are set out.

Item	First	Second	Future
1.Main Road			
a.Road Bed	----- 80%-	----- 90%-	-----100%-
b.Peripheral Facility	-----100%-		
c.Pavement	----------	----- 70%-	----- 90%-
2.Provincial Road			
a.Road Bed	----- 50%-	-----100%-	
b.Peripheral Facility	----- 50%-	-----100%-	
c.Pavement			----- 50%-
3.Farm Road			
a.Connection to Main	----- 80%-	-----100%-	
b.Connection Farm Road	----- 30%-	----- 50%-	----- 70%-
c.Simple Farm Road	----- 10%-	----- 30%-	----- 60%-
d.Peripheral Facility	----- 20%-	----- 40%-	----- 60%-

(2) Selection of Road for Improvement

The sellection of roads for improvement was decided on by taking three important points into account; their relation to agriculture, the formation of their road networks and executionability.

Items for assessment are set up as follows:

Item	Category	Score		Rank
A.Execution-ability	1.Geographical features	5		1 2 3 4 5
	2.Situation of subgrade course	8		1 2 3 4 5
	3.Situation of drainage	5	30	1 2 3 4 5
	4.Bridge and conduit	6		1 2 3 4 5
	5.Proportion of rehabilitation	6		1 2 3 4 5
B.Formation of road network	6.Household (direct)	10		1 2 3 4 5
	7.Household (indirect)	8		1 2 3 4 5
	8.Connectionability	7	40	1 2 3 4 5
	9.Approaches to public facilities	4		1 2 3 4 5
	10.Approaches to urban area	4		1 2 3 4 5
	11.Demand of local-inhabitants	7		1 2 3 4 5
C.Relation to agriculture	12.Approach to upland fields	10		1 2 3 4 5
	13.Collection and shipping	10	30	1 2 3 4 5
	14.Relation to water supply	10		1 2 3 4 5

The results of assessment are shown in Table F.2.1 to 2.

(3) Extent of Improvement

As a standard of road structure, the main and provincial roads will be two lanes plus on path for pedestrian while the farm road will have one lane. The extent of improvement is as follows:

Item	First Stage	Second Stage	Future Stage
1.Main Road			
a.Road Bed	2 routes L=11.5km	-	1 route L= 2.8km
b.Pavement	1 route L= 3.1km	1 route L= 2.4km	1 route L=11.9km
c.Preripheral Facility	Bridge:6 Culv.:3	-	Culvert:3
2.Provincial Road			
a.Road Bed	3 routes L=14.2km	3 routes L=14.2km	-
b.Preripheral Facility	Bridge:1 Culv.:10	-	-
c.Pavement	-	-	3 routes L=14.2km
3.Farm Road			
a.Connection to Main	6 routes L=17.6km	-	1 route L= 3.7km
b.Connection Farm Road	3 routes L= 6.4km	4 routes L= 6.3km	6 routes L=11.1km
c.Simple Farm Road	-	2 routes L= 3.8km	2 routes L= 3.7km
d.Peripheral Facility	Bridge:4 Culv.:12	Bridge:1 culv.:10	Bridge:5 Culv.:13

2.2 Electrification

Availability of electricity has an influence not only on the improvement of living environment but on the modernization of agricultural management. It is, therefore, put emphasis on early establishment of power distribution line in the Area as the priority improvement. Some power distribution line has already been set up even in the rural areas, and the extension of existing facilities suffice to install full electricity supply to the whole area. For the time being, therefore, efforts will be placed on expansion of the existing power distribution line to the whole rural areas to realize the full supply rate. However, the cost to install a service wire into each household will be borne by the recipient. Extent of the plan is as follows:

Item	First Stage	Second Stage	Future Stage
Power Distribution	-	L= 46.8km	-
New Receiver	-	128 houses	-
Power Supply Rate	-	100 %	-

2.3 Rural Water Supply

(1) Target

Item	First	Second	Future
1.Urban Area			
a.Development new water source	-----100%-		
b.Measures for water demand	----- 50%-	----- 80%-	-----------
2.Rural Area			
a.Development water source	-----100%-		
b.Water supply facility	----- 70%-	----- 70%-	-----100%-
c.Service pipes & hydrant	----- 50%-	----- 70%-	-----100%-

(2) Extent of Improvement

a) Required water amount

By taking into account the increasing demand for water, the maximum daily water consumption in the urban areas will be set at 200 1/day per person while the rural areas will supply 200 1/day, which will be used for shower, washing, cooking, farming and etc. other than for drinking. From this, the maximum daily water requirement is as follows:

Urban area: 200 1/day/person x 2,300 = 460 t/day (5.4 1/sec)

Rural area: 200 1/day/person x 2,600 = 520 t/day (6.1 1/sec)

At the urban area, differentials between current water supply amount and projected as above will be compensated.

b) Facility planning

1) Water supply method

It is possible to supply water both for drinking and farming using one supply method, however, the ratio of water use between drinking and farming comes 3 = 100, tilting heavily toward farming. It is, therefore, not economical to purity the water to the level suitable for drinking. For this reason, separate water supply methods will be used.

[CASE- 1]

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                                          ┌─────────────┐
                                          │ YBAROTY- Ⅲ  │
                                          └─────────────┘
                                          ┌─────────────┐        ┌─────────────┐
                                          │ YBAROTY- Ⅰ  │────────│ YBAROTY- Ⅱ  │
                                          └─────────────┘        └─────────────┘
  .Ao PIROY ──────────┌─────────────┐
                      │  YAJHAPETY  │
                      └─────────────┘     ┌─────────────┐        ┌─────────────┐
                                          │   URBANO    │────────│ SOL NACIENTE│
                                          └─────────────┘        └─────────────┘
  .Ao TRANQUERA ──┬──┌──────────────┐                            ┌─────────────┐
                  │   │ BARRERO AZUL- Ⅰ│                          │ PINDOTY - Ⅲ │
                  P   └──────────────┘                           └─────────────┘
                  ├──┌──────────────┐
                  │   │ BARRERO AZUL- Ⅱ│
                  │   └──────────────┘
                  └──┌──────────────┐
                      │ POTRERO ALTO │
                      └──────────────┘


                      ┌─────────────┐     ┌─────────────┐        ┌─────────────┐
                      │  FATIMA- Ⅰ  │     │  PINDOTY- Ⅰ │────────│  PINDOTY- Ⅱ │
  .Ao RORY ───────┬──└─────────────┘     └─────────────┘        └─────────────┘
                  P                       ┌─────────────┐        ┌─────────────┐
                  └──┌─────────────┐      │  CAATYMI- Ⅰ │────────│    RORY     │
                      │  FATIMA - Ⅱ │     └─────────────┘        └─────────────┘
                      └─────────────┘

  .Ao RORY-MI ────┬──┌─────────────┐      ┌─────────────┐
                  │   │  CAATYMI- Ⅱ │─────│ MBOCAYATY- Ⅰ │
                  P   └─────────────┘      └─────────────┘
                  └──┌─────────────┐
                      │ MBOCAYATY - Ⅱ│
                      └─────────────┘
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[CASE - 2]

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              ┌─────────────────┐
              │ BARRERO AZUL- Ⅱ │
              └─────────────────┘
              ┌─────────────────┐       ┌─────────────┐
              │  POTRERO ALTO   │───────│ YBAROTY - Ⅲ │
              └─────────────────┘       └─────────────┘
                                        ┌─────────────┐        ┌─────────────┐
        (P)                             │ YBAROTY- Ⅰ  │────────│ YABROTY- Ⅱ  │
                                        └─────────────┘        └─────────────┘
                      ┌─────────────┐
                      │  YAJHAPETY  │
                      └─────────────┘   ┌─────────────┐        ┌─────────────┐
  Ao TRANQUERA ─┐                       │   URBANO    │────────│ SOL NACIENTE│
                │                       └─────────────┘        └─────────────┘
                │     ┌──────────────┐                         ┌─────────────┐
                │     │ BARRERO AZUL- Ⅰ│                        │ PINDOTY - Ⅲ │
  Ao RORY ──────┘     └──────────────┘                         └─────────────┘

                      ┌─────────────┐   ┌─────────────┐        ┌─────────────┐
                      │  FATIMA- Ⅰ  │──│  PINDOTY- Ⅰ │────────│ PINDOTY - Ⅱ │
                      └─────────────┘   └─────────────┘        └─────────────┘
        (P)──┌─────────────┐
              │  FATIMA - Ⅱ │
              └─────────────┘

                      ┌─────────────┐        ┌─────────────┐
                      │  CAATYMI- Ⅰ │────────│    RORY     │
  Ao RORY-MI ─────┬──└─────────────┘        └─────────────┘
                  │   ┌─────────────┐        ┌─────────────┐
                  │   │  CAATYMI- Ⅱ │────────│ MBOCAYATY - Ⅰ│
                  │   └─────────────┘        └─────────────┘
        (P)───────┌─────────────┐
                  │ MBOCAYATY - Ⅱ│
                  └─────────────┘
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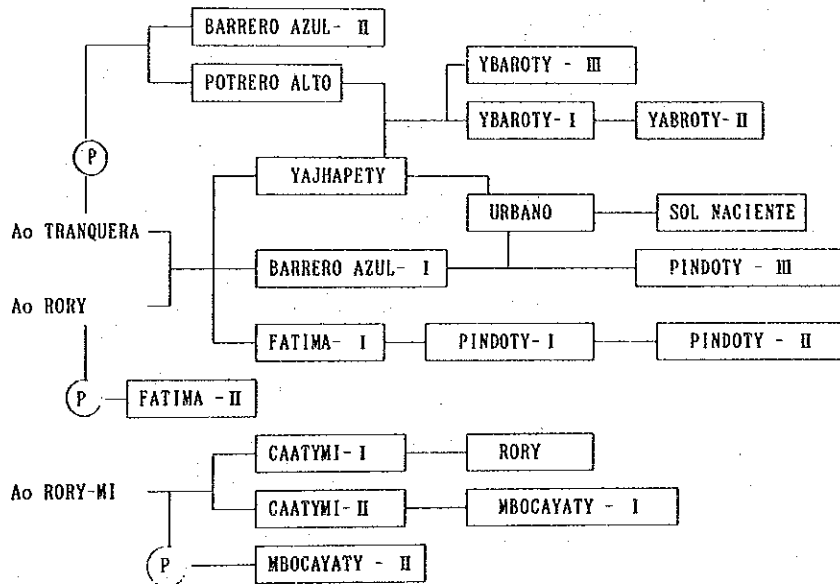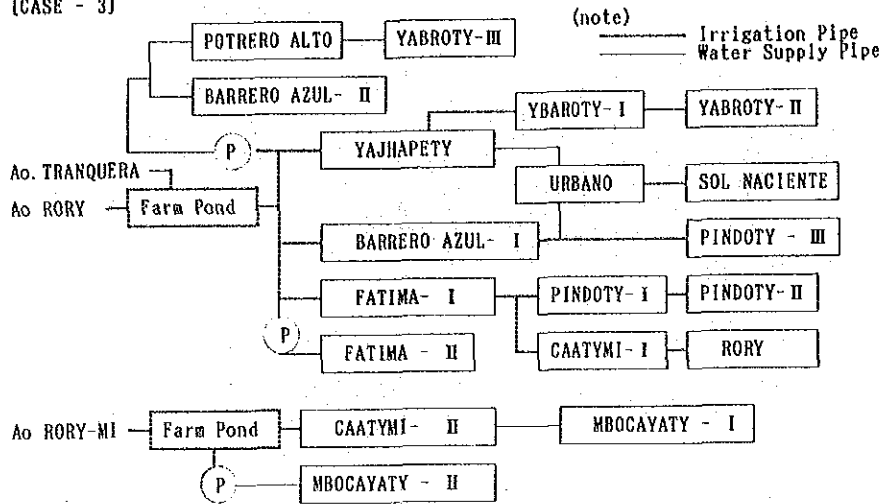
F-21

[CASE - 3]

POTRERO ALTO — YABROTY-Ⅲ

(note)
———— Irrigation Pipe
———— Water Supply Pipe

BARRERO AZUL- Ⅱ

YBAROTY- I — YABROTY- Ⅱ

Ao. TRANQUERA — P — YAJHAPETY

URBANO — SOL NACIENTE

Ao RORY — Farm Pond — BARRERO AZUL- I — PINDOTY - Ⅲ

FATIMA- I — PINDOTY- I — PINDOTY- Ⅱ

P — FATIMA - Ⅱ — CAATYMI- I — RORY

Ao RORY-MI — Farm Pond — CAATYMI- Ⅱ — MBOCAYATY - I

P — MBOCAYATY - Ⅱ

[CASE - 4]

POTRERO ALTO — YABROTY-Ⅲ

BARRERO AZUL- Ⅱ

YBAROTY- I — YABROTY- Ⅱ

P — YAJHAPETY

URBANO — SOL NACIENTE

Ao RORY — BARRERO AZUL- I — PINDOTY - Ⅲ

FATIMA- I — PINDOTY- I — PINDOTY- Ⅱ

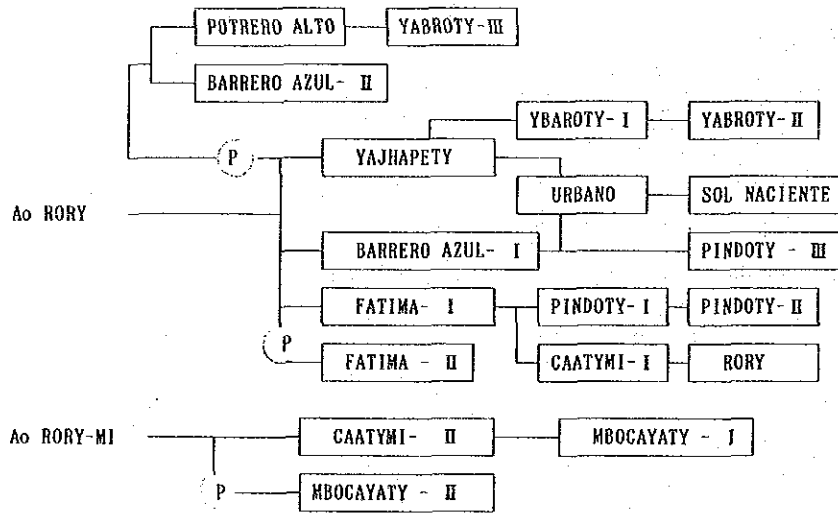P — FATIMA - Ⅱ — CAATYMI- I — RORY

Ao RORY-MI — CAATYMI- Ⅱ — MBOCAYATY - I

P — MBOCAYATY - Ⅱ

2) Intake facilities

Underground water and water from streams can be used as a source for potable water. However, taking the small amount of water available and O & M of equipment on the ground water into account, it has been decided to use water from the stream by gravity system.

Intake structure designed for irrigation purpose will be used for potable water supply. For Mbocayaty district, its own intake facility will be constructed to get water from the streams flowing in its area. For Sol Naciente district, the existing facility in the urban area will be expanded to cover the water requirement of the district.

Covering area and population of each stream is as follows:

Source	Area	Population	Houses	Remarks
Ao.Rory-mi	Caaty-mi	115	16	Share the intake
	Mbocayaty	335	56	facility with
Ao.Rory	Fatima	215	34	irrigation water
	Pindoty	360	52	
	Barrero Azul	260	40	
	Yajhapety	175	27	
	Potorero Alto	210	33	
	Ybaroty	340	41	
	Urban Area	800	160	
Expansion	Sol Naciente	220	34	
Total		3,400	565	

Item	Ao. Rory	Ao. Rory-mi
Household	493	72
Population	2,950	450
Maximum daily water consumption/person	200 lit./day-person	200 lit./day-person
Maximum daily water Supply	590　t/day 6.8 lit./sec	80　t/day 1.0 lit./day

3) Extent of improvement

Source	User	Intake (unit)	Purify Facility (unit)	Distri- bution (unit)	Pomp (unit)	Conduct- ing Pipe (km)	Distri- bution Pipe (km)
Ao.Rory-mi	450	–	1	2	1	L= 2.1	L= 13.2
Ao.Rory	2,950	–	1	5	2	L= 1.8	L= 56.9
Total	3,400	–	2	7	3	L= 3.9	L= 69.1

Facility	Ao.RORY	Ao.RORY-MI
1.Intake	(refer to Irrigation)	(refer to Irrigation)
2.Conveyance	(refer to Irrigation)	D75　L=800m
3.Regulating Pond	V = 3.0 m3	V = 1.5 m3
4.Sedimentation	V = 113 m3 x 2	V = 35m3 x 2
5.Sand Filter	V = 150 m3 x 4	V = 40m3 x 3
6.Disinfection	Disinfection by chlorine	Disinfection by chlorine
7.Distributing Reservoir	Main　　　 : V = 220 m3 Yahapety : V = 80 m3 Fatima-I : V = 25 m3 Fatima-II: V = 6 m3 Potrero　 : V = 25 m3	Main　　　　 : V = 35m3 Mbocayaty-II: V = 7m3
8.Pumping Station	Fatima-II: Q=11 l/min 　　　　　 H=150m 　　　　　 D50 L= 800m Potrero　 : Q=45 l/min 　　　　　 H=160m 　　　　　 D50 L=1,000m	Mbocayaty-II: Q=13 l/min 　　　　　　 H=240m 　　　　　　 D50 L=1,300m
9.Distribution Pipe	Main　　　 : D 50 L=13,200m 　　　　　 D 70 L=17,600m 　　　　　 D100 L= 9,600m 　　　　　 D125 L= 3,600m 　　　　　 D150 L= 1,300m 　　　　　 D200 L= 1,400m Fatima-II: D 50 L= 2,500m Potrero　 : D 50 L= 3,400m 　　　　　 D 75 L= 2,800m 　　　　　 D100 L= 1,500m Total　　　　 L=56,900m	Main　　　 : D 50 L=　700m 　　　　　 D 70 L= 5,000m 　　　　　 D100 L= 4,150m 　　　　　 D125 L=　100m Mbocayaty : D 50 L= 1,700m 　　　　　 D 70 L= 1,500m Total　　　　 L=13,150m

2.4 Telecommunication System

According to the ANTELCO's improvement plan, the present manually operated telephone switchboard will be replaced with automatic ones and the number of lines will be increased to 200. From these, telephones will be set up for each administrative district for emergency and public use after completion of ANTELCO's scheme. The public telephones will be installed at the sub-center which will be mentioned later. Extent of improvement is as follows:

Item	First Stage	Second Stage	Future Stage
a.Pay-phon	-	8 units	12 units
b.Telephon Wire	-	14 km	11 km

2.5 Medical Facilities

It is desirable to set up medical facilities covering the area such as Tebiquari-Mi, Martinez Cue, Cesar Barrientos and Chauria. It is also essential to strengthen emergency medical care to dissolve habitants anxiety about them. For these improvement, the items shown below will have to be provided:

Item	First Stage	Second Stage	Future Stage
a.Enrichment of medical facility	-	Oxgent tent Dental equip. Analytical equip.	Enrichment of available freatment items
b.Improvement of emergency care	-	New Ambulance Car	-

2.6 Education Facilities

On a short-term basis, the following improvements should be made: repair of superamuated school houses, elimination of long-distance walking to attend classes and upgrading of exercise facilities. The items below should be given due consideration.

Item	First Stage	Second Stage	Future Stage
a.Repair work on old school	-	Potrero Alto Caaty-mi	-
b.Elimination of long-distance schooling	-	-	Enforcement of full-grade schooling at Potrero Alto & Fatima
c.Upgrading of exercise facility	-	-	Construction of exercise ground at each branch

2.7 Other Facilities

To rise the function of rural community and to further rural development, the following facilities will have to be set up: Administrative Center, Sub-center, Research Center, rural park, garbage treatment facility and sewage treatment facilities.

The sub-center, a necessary facility which offers guidance for smooth operation of other facilities, will be set up in Fatima, Potrero Alto, Mbocayty and Ybaroty, all of which are located far from the urban center. In addition, a management center, which is to serve as the key facilities of rural development, will be set up in the urban area to integrate these sub-centers.

The rural park will be constructed adjacent to the sub-center and will be introduced in the four districts mentioned above.

For the time being, garbage will be disposed of on an individual family basis in the rural areas; however, the amount of non-flammable garbage is expected to increase in the future and a central treatment facility will have to be constructed. The situation is rather serious in the urban area where unlawful disposal of garbage is being practiced, seriously polluting the living spaces. It is, therefore, strongly desired to construct a treatment facility as soon as possible.

Treatment of sewage will be left, at least for the time being, to individual families. The matter will be reviewed after the

completion of facilities for electricity and drinking water. For the urban area, sewage will be handled by centralized sewers; for the rural areas, treatment plans should be conceived as independent items.

Further, a farm research center should be set up to facilitate development of the rural areas and their modernization. The center will also serve as a branch facility, maintaining close contact with other existing agricultural research centers throughout the nation. It will be constructed adjacent to the Administrative center.

(1) Target

Item	First Stage	Second Stage	Future Stage
1.Extension & O/M center	---------100%-		
2.Sub-Center		--------- 40%-	--------- 60%-
3.Rural Park		--------- 40%-	--------- 60%-
4.Garbage Treatment			
.Urban Area		---------100%-	
.Rural Area			
5.Sewage/Waste Treatment			
.Urban Area			---------100%-
.Rural Area			-----

(2) Extent of improvement

Item	First Stage	Second Stage	Future Stage
1.Extension & O/M center	1 pleace	-	-
2.Sub-Center	-	4 pleaces	-
3.Rural Park	-	-	6 pleaces
4.Garbage Treatment			
.Urban Area	-	1 pleace	-
.Rural Area	-	-	6 pleaces
5.Sewage/Waste Treatment			
.Urban Area	-	-	1 pleace
.Rural Area	-	-	-

F.3 Rural Infrastructure Improvement Plan

3.1 General

Based on the situation of the existing facilities, targets for
improvement of the area are set up as follows.

    a.Improvement of roads

    b.Rural water supply system

    c.Extencion of electricity

    d.Extencion of telecommunication

    e.Supply of emergency medical care facilities

    f.Improvement of education facilities

    g.Installation of agricultural extencion and O/M center facilities

    h.Installation of sub-center

    i.Improvement of rural park

    j.Improvement of garbage treatment facilitiy

3.2 Road Improvement Plan

To contribute the betterment of the rural living environment and
improvement of agricultural management with the establishment of the
well-functioned road network in the Area, following 20 routes with
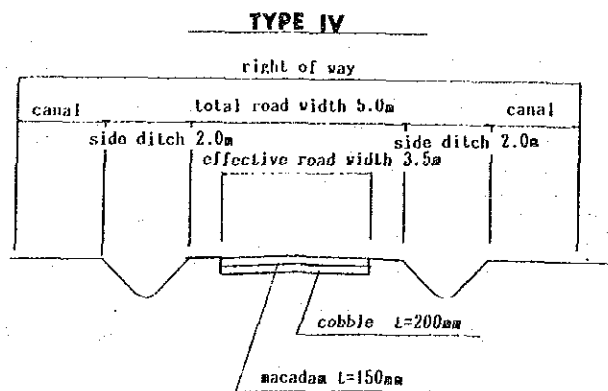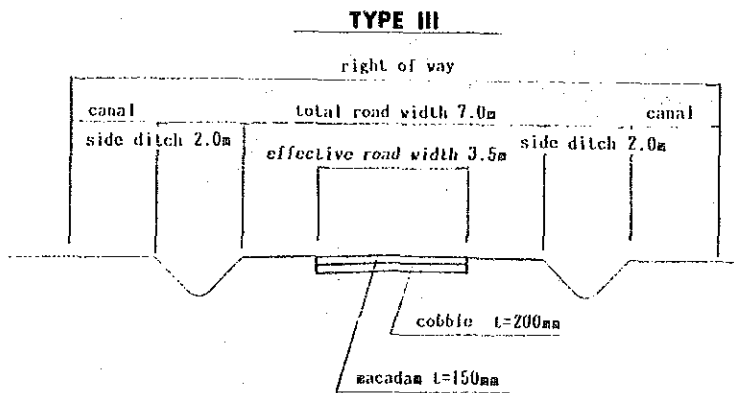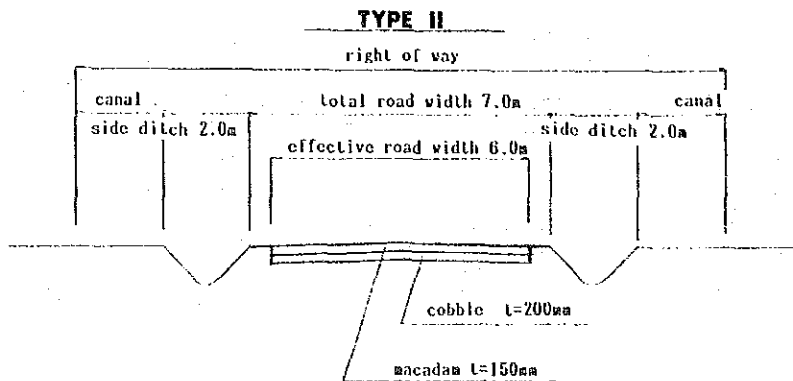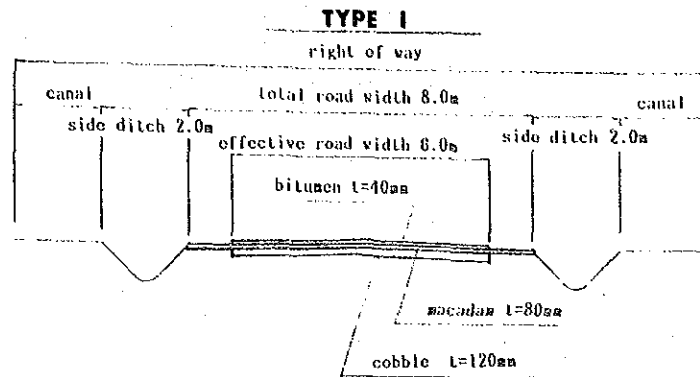total length of 64.3 km should be improved.

Furthermore, the wide-area transportation system will be established
with the adequate road pavement, from the urban areas to Ao.Rory-mi,
at the national road of route 818 where there is much traffic in the
Area.

(1) Typical Road Cross Section and Dimensions
    Typical road cross sections are classified into five divisions as
    shown below:

Type	Total Road Width (m)	Effective Road Width (m)	Shoulder (m)	Pavement Width (m)	Side Dith Width (m)	Pipe Lot (m)	Right of Way (m)
I	8.0	6.0	1.0 *2	6.0	2.0*2	2.0	14.0
II-A	8.0	6.0	1.0 *2	6.0	2.0*2	2.0	14.0
II-B	8.0	6.0	1.0 *2	3.5	2.0*2	2.0	14.0
III	7.0	6.0	0.5 *2	3.5	2.0*2	2.0	13.0
IV	5.0	3.5	0.75*2	3.5	2.0*2	2.0	11.0

Typical road cross sections are as follows:

TYPE I

right of way

canal | total road width 8.0m | canal
side ditch 2.0m | effective road width 6.0m | side ditch 2.0m

bitumen t=40mm

macadam t=80mm

cobble t=120mm

TYPE II

right of way

canal | total road width 7.0m | canal
side ditch 2.0m | effective road width 6.0m | side ditch 2.0m

cobble t=200mm

macadam t=150mm

TYPE III

right of way

canal | total road width 7.0m | canal
side ditch 2.0m | effective road width 3.5m | side ditch 2.0m

cobble t=200mm

macadam t=150mm

TYPE IV

right of way

canal | total road width 5.0m | canal
side ditch 2.0m | effective road width 3.5m | side ditch 2.0m

cobble t=200mm

macadam t=150mm

Required facilities for each route are as follows:

No.	Route	Length (km)	Wt (m)	We (m)	I (km)	II-A (km)	II-B (km)	III (km)	IV (km)	Bridge (number)	Conduit (number)
1	818	11.8	8.0	6.0	5.5	6.3	-	-	-	6	3
2	818-06	5.6	7.0	6.0	-	-	-	5.6	-	-	2
3	818-01	5.2	7.0	6.0	-	-	-	5.2	-	1	2
4	805	2.8	7.0	6.0	-	-	2.8	-	-	-	-
5	818-04	3.6	7.0	6.0	-	-	-	3.6	-	-	2
6	818-05	3.7	7.0	6.0	-	-	-	3.7	-	-	-
7	818-02	3.2	7.0	6.0	-	-	-	3.2	-	-	1
8	818-03-3	2.4	5.0	3.5	-	-	-	-	2.4	1	2
9	818-03	4.6	7.0	6.0	-	-	-	4.6	-	-	3
10	251-22	5.8	7.0	6.0	-	-	-	5.8	-	-	6
11	251-17-3	2.0	7.0	6.0	-	-	-	2.0	-	1	-
12	818-05-2	1.0	7.0	6.0	-	-	-	1.0	-	-	2
13	818-05-1	0.5	7.0	6.0	-	-	-	0.5	-	-	-
14	819-02	2.0	5.0	3.5	-	-	-	-	2.0	-	2
15	818-01-3	1.4	5.0	3.5	-	-	-	-	1.4	-	3
16	818-01-2	1.7	5.0	3.5	-	-	-	-	1.7	-	3
17	251-16	2.4	7.0	6.0	-	-	-	2.4	-	-	2
18	818-01-1	1.1	5.0	3.5	-	-	-	-	1.1	-	-
19	251-20	1.4	7.0	6.0	-	-	-	1.4	-	-	1
20	818-07	2.1	5.0	3.5	-	-	-	-	2.1	1	1
Total		64.3			5.5	6.3	2.8	39.0	10.7	10	35

[note] Wt:Total Road Width   We:Effective Road Width

(2) Incidental facilities

Incidental facilities for each route are bridges and conduits.
Typical bridge and conduit cross sections are as follows:

TYPE I

abutment
reversal T type

TYPE II

TYPE III

abutment
gravity type
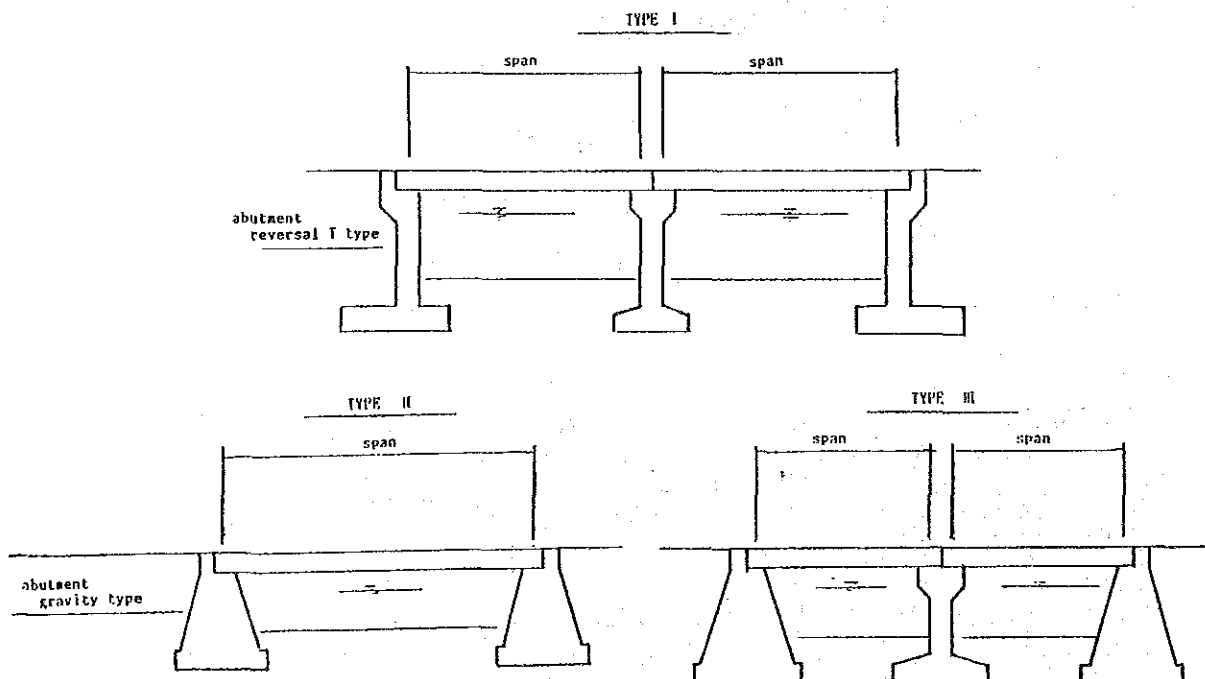
Required facilities for each route are as follows:

No.	Route	Length (km)	Design Discharge (t/sec)	Bridge Type (m)	Width (m)	Length (m)	Down Part	Dai-meter	Conduit Number	Length (m)
1	818	11.8	100.9	1	6.0	16.0	RT	-	-	-
			8.2	-	-	-	-	1,200	2	10.0
			96.7	1	6.0	16.0	RT	-	-	-
			0.8	-	-	-	-	700	1	10.0
			45.3	2	6.0	10.0	W	-	-	-
			4.7	-	-	-	-	1,000	2	10.0
			11.5	2	6.0	6.0	W	-	-	-
			12.2	2	6.0	6.0	W	-	-	-
			59.0	2	6.0	10.0	W	-	-	-
2	818-06	5.6	2.5	-	-	-	-	1,000	1	9.0
			0.2	-	-	-	-	500	1	9.0
3	818-01	5.2	0.5	-	-	-	-	600	1	9.0
			0.7	-	-	-	-	600	1	9.0
			23.9	2	6.0	6.0	W	-	-	-
4	805	2.8	-	-	-	-	-	-	-	-
5	818-04	3.6	13.9	-	-	-	-	1,200	2	9.0
			20.2	-	-	-	-	1,200	2	9.0
6	818-05	3.7	-	-	-	-	-	-	-	-
7	818-02	3.2	-	-	-	-	-	1,200	2	9.0
8	818-03-3	2.4	8.1	-	-	-	-	1,200	2	7.0
			38.8	2	3.5	10.0	W	-	-	-
			4.1	-	-	-	-	1,200	1	7.0
9	818-03	4.6	0.5	-	-	-	-	600	1	9.0
			5.0	-	-	-	-	1,000	2	9.0
			4.1	-	-	-	-	900	1	9.0
10	251-22	5.8	7.7	-	-	-	-	1,200	2	9.0
			3.4	-	-	-	-	1,200	1	9.0
			4.1	-	-	-	-	1,200	1	9.0
			0.1	-	-	-	-	500	1	9.0
			7.7	-	-	-	-	1,200	2	9.0
			2.2	-	-	-	-	1,000	1	9.0
11	251-17-3	2.0	80.0	3	6.0	20.0	W	-	-	-
12	818-05-2	1.0	4.0	-	-	-	-	1,200	1	9.0
			186.3	-	-	-	-	1,200	3	9.0
13	818-05-1	0.5	-	-	-	-	-	-	-	-
14	819-02	2.0	0.4	-	-	-	-	500	1	7.0
			0.4	-	-	-	-	500	1	7.0
15	818-01-3	1.4	0.04	-	-	-	-	500	1	7.0
			0.04	-	-	-	-	500	1	7.0
			9.6	-	-	-	-	1,200	3	7.0
16	818-01-2	1.7	1.1	-	-	-	-	800	1	7.0
			1.3	-	-	-	-	800	1	7.0
			1.3	-	-	-	-	800	1	7.0
17	251-16	2.4	2.5	-	-	-	-	1,000	1	9.0
			0.6	-	-	-	-	600	1	9.0
18	818-01-1	1.1	-	-	-	-	-	-	-	-
19	251-20	1.4	2.5	-	-	-	-	1,000	1	7.0
20	818-07	2.1	27.2	2	3.5	8.0	W	-	-	-
			0.6	-	-	-	-	600	1	7.0
Total		64.3		10					38	

[Note] RT: Reversal T type   W: Gravity type

3.3 Rural Water Supply Improvement Plan

(1) Setting of Water Supply Area
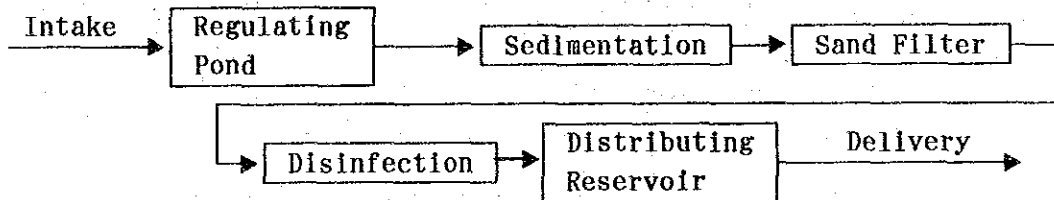
Using the natural force, water will be supplied to the following area. The numer of recipients and that of households are follows.

```
┌─────────────┬──────────┐                    ┌────────┐
│ Sol         │Pindoty-I │                    │ Rory   │   [ ]:HOUSEHOLD
│ Naciente    │[ 52]     │ ┌─────────┐        │[ 30]   │   ( ):POPULATION
│ [ 34]       │(360)     │ │Pindoty-II        │(190)   │
│ (220)       │          │ │[ 24]    │        │        │
├─────────────┼──────────┤ │(165)    │        │        │
│Ybaroty-I    │ ZONA     │ │         ├────────┼────────┬────────┐
│[ 29]        │ URBANA   │ └┬────────┤Caaty-mi│Caaty-mi│Mbocayaty
│(185)        │[ 160]    │  │Pindoty-III│ -I   │ -II    │ -I     │
│             │( 800)    │  │[ 12]    │[ 30]   │[ 16]   │[ 48]   │
├─────────────┼──────────┼──┤[ 85]    │(180)   │(115)   │(285)   │
│ Ybaroty-II  │Yajhapety │Barrero│     │        │        │        │
│ [ 12]       │[ 27]     │Azull  │     │        │        │        │
│ ( 80)       │(175)     │[ 27]  ├─────┴────────┴────────┴────────┘
└─────────────┴──────────┤(180)  │
                         │   ┌───┴────┐
                         │   │Fatima  │
                         │   │[ 34]   │
                         └───┤(215)   │
                             └────────┘
```

```
Rural area  :  333 households ( 2,150 people)
Urban area  :  160 households (   800 people)
    Total   :  493 households ( 2,950 people)
```

(2) Water Purification Facility Flow Diagram

As water is drawn from the stream, its purification is carried out in the following manner.

```
Intake ──▶ ┌───────────┐      ┌───────────────┐     ┌─────────────┐
           │Regulating │ ───▶ │ Sedimentation │ ──▶ │ Sand Filter ├─┐
           │Pond       │      └───────────────┘     └─────────────┘ │
           └───────────┘                                            │
     ┌──────────────────────────────────────────────────────────────┘
     │   ┌──────────────┐    ┌──────────────┐     Delivery
     └─▶ │ Disinfection ├──▶ │ Distributing ├───────────────▶
         └──────────────┘    │ Reservoir    │
                             └──────────────┘
```

(3) Facility Construction Plan

1) Purification Facility

The table below shows capacity of each facility, Which has been determined by taking into account the possibility of future expansion. The areas excluded in this study are also included to calculate the capacity.

Item	Ao.RORY SYSTEM	Ao.RORY-MI SYSTEM
Household	429 (493)	64 (72)
Population	2,550 (2,950)	400 (450)
Maximum daily water consumption/person	200 l/day.person	200 l/day.person
Maximum daily water supply (Qm)	510 t/day (590 t/day) (6.8 l/sec)	80 t/day (90 t/day) (1.0 l/sec)
1.Intake	(refer to Irrigation)	(refer to Irrigation)
2.Conveyance	(refer to Irrigation)	ϕ75 L=800m
3.Regulating Pond	Stay Time: 1.5 min. V = Qm * 1.5min /(24hr * 60min)	
	$V = 3.0m^3$	$V = 1.5 m^3$
4.Sedimentation	The capacity is equivalent to 8-hour volume of Qm.	
	V = Qm * 8hr / 24hr	
	$V = 113 m^3$ x 4	$V = 35 m^3$ x 2
5.Sand Filter	Filtering speed is 4m/day.	
	The area of filtering pond is A = Qm / 4m/day	
	$V = 150 m^3$ x 4	$V = 40 m^3$ x 3
6.Disinfection	Disinfection by chlorine	Disinfection by chlorine
7.Distributing Reservoir	The capacity is equivalent to 8-hour volume of Qm.	
	V = Qm * 8hr/24hr	
	Main : $V = 220 m^3$	Main : $V = 35m^3$
	Yahapety : $V = 80 m^3$	
	Fatima-I : $V = 25 m^3$	

2) Water Distribution Pipes

The pipe bore has been determined according to the maximum water flow volume per hour. The minimum water head at the terminal is set at 10m. Hazen-Williams formula was used in the hydraulic calculation, the result of which is shown in Table F. The table below shows the bore and length of the pipes to be used in the project.

Facility	Ao.RORY SYSTEM	Ao.RORY-MI SYSTEM
Distribution Pipe	ϕ 50 L=13,200m	ϕ 50 L= 700m
	ϕ 70 L=17,600m	ϕ 70 L= 5,000m
	ϕ 100 L= 9,600m	ϕ 100 L= 4,150m
	ϕ 125 L= 3,600m	ϕ 125 L= 100m
	ϕ 150 L= 1,300m	
	ϕ 200 L= 1,400m	
Total	L=46,700m	Total L= 9,950m

Fig. F.3.2 shows overall facility plan.

3.4 Electricity Improvement

As a rural, the existing facilities will be expanded to realize well-developed electricity supply networks for the farmers. As shown below, a total of 24 routes (total length L=48.8 km, 244recipients) will be improved.

The main electric power line carries the voltage of 23 kv with transformers to be set up every 3 km to reduce it to 220 v before the electricity is delivered to each family.

Route	Length	Recipient	Trans	Pole	Related administrative area	
EC- 1	2.4 km	3	1	13	YBAROTY	
EC- 2	3.1	6	2	16	YBAROTY	
EC- 3	1.1	2	1	6	YBAROTY	
EC- 4	1.0	7	1	6	YBAROTY	
EC- 5	0.5	2	-	3	YBAROTY	
EC- 6	3.0	13	2	16	PINDOTY	
EC- 7	2.1	14	1	12	PINDOTY	
EC- 8	0.6	5	-	3	PINDOTY	
EC- 9	2.1	13	1	11	RORY	
EC-10	0.4	3	-	2	RORY	
EC-11	0.6	4	-	3	RORY	
EC-12	2.0	12	1	11	POTRERO ALTO	
EC-13	1.3	5	1	7	POTRERO ALTO	
EC-14	1.7	8	1	9	POTRERO ALTO	
EC-15	2.8	15	2	15	POTRERO ALTO	BARRERO Azul
EC-16	2.7	6	2	15	FATIMA	
EC-17	0.8	7	-	4	FATIMA	
EC-18	0.6	7	-	3	FATIMA	
EC-19	0.4	7	-	2	FATIMA	
EC-20	8.5	59	5	45	RORY CAATI-MI	MBOCAYATY
EC-21	5.1	19	2	26	CAATI-MI	MBOCAYATY
EC-22	2.2	14	1	12	CAATI-MI	
EC-23	2.2	2	1	12	MBOCAYATY	
EC-24	0.7	6	-	4	MBOCAYATY	
EC-25	0.9	5	-	5	MBOCAYATY	
Total	48.8	244	25	261		

Fig. F.3.3 shows service system diagram.

3.5 Communication Improvement

As shown below, a total of three routes will be improved.

Route	Length	Recipient	Pay-phone	Pole	Area
(Use existing line)		53	2	-	YBAROTY
TEL-1	6.0 km	68	2	31	YAJHAPETY,POTRERO
TEL-2	2.5	125	2	13	RORY,CAATI-MI,FATIMA
TEL-3	5.5	56	2	28	MBOCAYATY
Total	14.0	302	8	72	

3.6 Medical Facilities Improvement

The improvement plan include renewal of the ambulance and installation of an oxygen tent. Details of the facility improvement are shown below.

    a.Ambulance

      .Car type : Long body, high roof, 4doors 1car

      .Equipment: Main Stretcher 1set

              Sub-Stretcher 1set

              Multi Reflective Beacon Lamp 1set

              Medical Instrument Box 1set

              (oxygen tank,aspirator,mouth gang,oxygen mask

               decompresion valve,connectionhose & airway)

              First-Aid Box 1set

              (rescue sheet,bandage,triangle bandage ,paper

               cloth net bandage,small scissors,tweezers

               sticking plaster)

              Portable Artificial Resuscitator 1set

              (oxygen cylinder,automatic respiratory,etc.)

              Sink with water tank 1set

              Medicine Cabinet 1set

              Dust pot 1set

    b.Oxygen Tent

      .Equipment: Oxygen Tent 1set

              Oxygen Cylinder 4set

              Control Box 1set

3.7 Education Facility Improvement

Age-damaged buildings of Caaty-mi and Potorero Alto primary school will be improved. The following facilities will be improved for each school.

        .School building : Brick structure

        .Classroom   : $50m^2$ * 2 classrooms

        .Teacher's room : $30m^2$ * 1 room

        .Toilet   : $10m^2$ * 1 room

3.8 Agricultural Extension and Facility Management Center

An agricultural technique extension center and a facility management center will be established for dissemination of modern agricultural techniques and facility management. The centers will be located in the urban area so that their functions can be most effectively put into use.

The following gives the general information about the centers.

Classification	Facilities	Area(m^2)
a.Agricultural Extension Office (233.3 m^2)	:Specialist office	38.9
	Chief's office	29.2
	General office	19.4
	Document room	38.9
	Storage	19.4
	Toilet	29.2
	Corridor	58.3
b.Facility Management Office (233.3 m^2)	:Chief's office	19.4
	Cooperative head's office	19.4
	Cooperative office	38.9
	Reception room	19.4
	General office	19.4
	Night watchman's room	29.3
	Toilet	29.2
	Corridor	58.3
c.Common Use Section (272.2 m^2)	:Training room	97.2
	Meeting room	29.2
	Document preservation room	29.2
	Connecting corridor	58.3
d.Machine Room for Maintenance	:Machine storage	158.8
	(Bulldozer 11t 1 car)	
	(Grader 180ps 1 car)	
	(Road Roller 8t 1 car)	
	(Back Hoe 0.5m^3 1 car)	
	(Pickup truck 4WD 2 cars)	
Total		897.6m^2
Facility plottage		5,400.0m^2

Facility composition and building arrangement are shown in the following charts.

Floor Plan (dimensions in mm)

Top dimension: 32400 (7200, 5400, 3600, 5400, 7200, 3600)

Left dimension: 36000 (7200 [5400, 1800], 3600, 14400 [5400, 3600, 5400], 3600, 7200 [1800, 5400])

Right dimension: 36000 (5400, 7200, 10800, 7200, 5400)

Top row rooms:
- OFFICE (PROFESSIONAL)
- MANAGER ROOM
- OFFICE
- TOILET
- LIBRARY ROOM
- LUMBER ROOM

Center rooms:
- MEETING ROOM
- HALL
- OFFICE
- TRAINING ROOM

Bottom row rooms:
- OFFICE COOPERETION
- HEAD COOPERETION
- DRAWING ROOM
- CHIEF ROOM
- OFFICE
- NIGHT WATCHMANS ROOM
- TOILET

Center dimensions: 5400, 1800, 9000

Bottom dimension: 32400 (7200, 3600, 3600, 5400, 5400)

Section markers: ⒷⒷ, ⒶⒶ, ⒸⒸ

SECTION Ⓐ-Ⓐ

SECTION Ⓑ-Ⓑ

F —37

3.9 Sub-Center

The sub-center is aimed at facilitating communication among the residents of the area while serving as a branch for the agricultural extension office and the facility management center.

The sub-center will be installed for each compania, but priorities will be given to remote area far away from the main center. For now, sub-center will be established in Ybaroty, Potrero Alto, Caaty-mi and Mbocayaty. Facilities to be installed are as follows.

Classification	Facilities	Area(m^2)
a.Sub-Center Office	: Office	38.9
(207.4 m^2)	Meeting room	29.2
	Document room	38.9
	Storage	19.4
	Toilet	29.2
	Corridor	51.8
b.Facility Plottage		800.0

An arrangement chart of the facilities is given below.
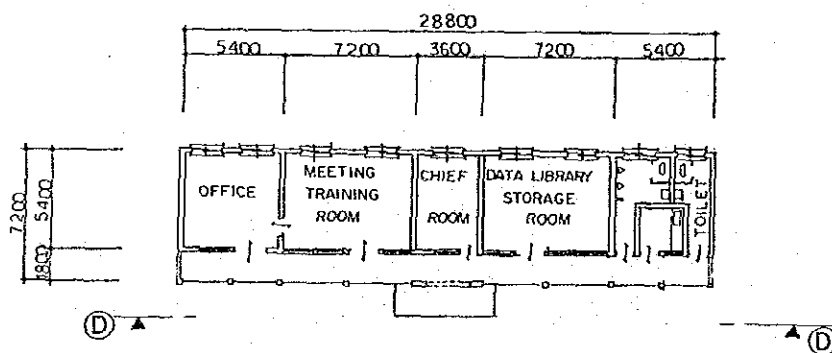
SUB - SENTER

SECTION ⒟ - ⒟

3.10 Rural Park

To be constructed adjacent to the sub-center, a rural park will be serve as a place to promote farmers' healthy life and facilitate communication among them. This 5,000 m^2 facility will include play ground each for soccer, volleyball, basketball and gateball and play things for small children.

Places of installation: Ybaroty, Potrero Alto Caaty-mi and Mbocayaty		
Facilities: Soccer court	2,000 m^2	1 court
Volleyball court	1,000	1
Basketball court	500	1
Gateball court	300	1
Play lot	1,000	1

Fig. F.3.3 shows the position of these facilities.

3.11 Garbage Treatment Center

A garbage treatment center will be constructed adjacent to the graveyard about 2 km west of the urban area as part of the city's garbage treatment policy. After completion, the center will be have a furnace incinerate flammable garbage, a raw garbage burying pit and a nonflammable large burying pit. The plottage of the center is 2,000 m^2.

General information about the facility is as follows.

.Plottage   : 2,000 m^2

.Treatment facilities : Flammable garbage furnace   1 set

                             : Raw garbage burying pit   500 m^2

                             : Nonflammable large garbage

                             : burying pit   1,000 m^2

Fig. F.3.3 shows the position of the facilities.

Table F.1.1   Existing Road Condition

Name	Type	Length (km)	Right of way (m)	Effective width (m)	Pavement (km)	Sediment (km)	Bare (km)	Impassable (km)	Bridge (no.)	Conduit (no.)	Household Direct (no.)	Household Indirect (no.)	Farm Land Rate (%)
(Main Road)													
251	A	5.5	15.9	6.2	5.5	-	-	-	3	-	7	4,500	45
805	A	2.8	29.1	8.0	-	1.0	1.8	-	-	-	32	380	90
818	A	12.3	16.3	3.7	-	-	12.3	-	4	5	60	1,560	95
819	A	2.8	15.8	3.9	-	-	2.8	-	-	3	15	2,150	90
Sub-total		23.4			5.5	1.0	16.9	-	7	8	114	8,590	
(Provincial Road)													
818-01	B	5.2	9.0	3.0	-	-	5.2	1.0	1	2	33	68	100
818-03	B	4.6	7.5	3.0	-	-	4.6	1.0	1	2	20	58	100
251-22	C	5.8	12.0	6.2	-	-	5.8	2.5	2	4	51	580	100
Sub-total		15.6			-	-	15.6	4.5	5	8	104	706	
(Farm Road)													
251-17	B	3.7	25.8	4.4	-	-	3.7	-	-	-	10	350	5
818-02	B	3.2	5.1	3.5	-	-	3.2	1.2	-	1	10	10	95
818-04	B	3.6	10.2	3.4	-	-	3.6	1.5	1	3	17	470	70
818-05	B	3.7	10.9	3.2	-	-	3.7	0.7	-	-	21	590	100
818-06	B	5.6	10.5	3.0	-	0.5	5.1	0.5	1	2	22	760	55
251-16	C	2.4	6.7	2.3	-	-	2.4	0.3	1	-	3	350	10
251-17-1	C	1.3	13.8	3.8	-	-	1.3	1.3	-	-	-	120	-
251-17-3	C	1.7	21.9	4.6	-	-	1.7	0.7	-	4	-	240	-
818-08	C	0.4	6.9	3.9	-	-	0.4	-	-	-	-	510	100
818-11	C	0.4	9.1	2.9	-	-	0.4	-	-	-	-	170	100
251-20	D	1.4	7.1	3.2	-	-	1.4	-	-	1	9	8	75
805-01	D	1.3	3.2	1.8	-	-	1.3	0.9	1	-	1	35	30
805-02	D	2.5	13.4	2.5	-	-	2.5	2.0	1	2	5	130	25
818-01-1	D	1.1	7.9	3.5	-	-	1.1	-	-	-	-	95	100
818-01-2	D	1.4	4.0	2.3	-	-	1.4	1.4	2	4	-	11	20
818-01-3	D	1.3	5.2	2.7	-	-	1.3	0.5	-	3	10	15	80
818-03-1	D	1.2	2.8	1.3	-	-	1.2	1.2	1	3	-	35	75
818-03-3	D	2.4	14.7	3.3	-	-	2.4	1.0	2	3	14	80	65
818-04-1	D	2.4	12.4	5.3	-	-	2.4	1.3	1	2	8	25	35
819-01	D	3.6	10.0	1.0	-	-	3.6	3.6	1	9	4	35	100
819-02	D	2.0	10.2	3.2	-	-	2.0	1.2	-	4	5	65	85
251-15	E	1.2	20.5	2.9	-	-	1.2	1.1	1	-	-	-	10
251-18	E	2.2	17.5	3.7	-	-	2.2	1.3	1	-	2	6	-
251-19	E	2.2	10.5	3.0	-	-	2.2	2.0	1	1	-	5	5
251-21	E	1.0	6.4	2.8	-	-	1.0	0.3	-	-	3	-	40
818-03-2	E	1.7	6.0	2.7	-	-	1.7	0.6	-	3	8	6	60
818-05-1	E	0.5	13.7	2.0	-	-	0.5	-	-	-	2	-	100
818-05-2	E	1.0	6.2	1.0	-	-	1.0	0.4	1	2	4	-	100
818-06-10	E	1.8	6.5	3.0	-	-	1.8	1.5	-	-	5	-	100
818-07	E	2.1	7.7	2.4	-	-	2.1	0.6	1	-	14	-	70
818-09	E	2.7	6.0	2.7	-	-	2.7	1.5	1	4	3	-	70
818-10	E	1.9	8.0	2.5	-	-	1.9	0.9	1	-	3	-	70
818-12	E	1.2	6.0	2.7	-	-	1.2	0.3	-	3	4	-	50
Sub-total		66.5			-	0.5	65.6	29.8	19	43	187	4,011	
TOTAL		105.5			5.5	1.5	98.5	34.3	26	51	405	13,307	

(note) Road Type: A=Trunk Road (Join Wide Area)   D=ConnectionRoad III(Join Inside)
               B=Connection Road I (Join Trunk Road)   E=Simple Farm Road
               C=Connection Road II(Join Outarea)

Table F.2.1 Assessment of Existing Road

Name	Executionability 1	2	3	4	5	Formation of Network 6	7	8	9	10	11	Agriculture 12	13	14
805	3	4	3	4	4	3	4	5	4	5	3	3	4	4
818	4	4	3	3	4	5	5	5	5	5	5	5	5	5
819	2	2	2	2	2	3	4	5	4	5	2	3	4	4
251-22	1	2	2	2	3	5	4	4	4	4	4	4	4	4
818-01	4	3	3	4	3	3	4	5	4	4	4	4	4	4
818-03	4	3	3	3	3	3	3	4	4	3	4	4	4	4
251-15	4	1	1	3	1	1	1	2	3	2	1	2	3	3
251-16	4	1	3	3	3	2	5	5	5	5	3	3	4	3
251-17	4	4	4	4	4	1	3	3	3	3	2	2	3	3
251-17-1	3	2	2	3	2	2	2	4	3	3	3	3	3	3
251-17-3	4	2	3	3	2	2	2	5	5	5	4	4	5	4
251-18	4	1	1	2	1	1	1	2	3	2	2	2	2	2
251-19	4	1	1	1	1	1	1	1	1	1	1	1	1	1
251-20	3	3	4	3	3	3	2	3	3	3	2	4	4	4
251-21	4	3	2	3	3	1	1	2	3	3	1	3	3	3
805-01	4	3	2	2	3	2	3	3	4	4	2	3	4	4
805-02	4	3	2	2	2	2	4	3	4	4	2	3	4	4
818-01-1	5	4	4	4	4	1	3	4	4	4	2	2	4	4
818-01-2	3	3	3	3	3	3	1	4	4	4	4	4	4	4
818-01-2	2	2	2	2	1	1	3	3	2	2	1	1	1	1
818-01-3	3	3	3	2	2	3	4	5	4	3	4	3	4	4
818-01-3	3	3	2	2	3	3	4	5	4	4	4	3	5	4
818-02	4	3	3	3	3	4	3	3	3	4	4	4	4	5
818-03-1	3	1	1	2	1	1	3	4	3	3	3	2	3	3
818-04	4	3	3	3	3	4	4	4	3	4	4	4	4	4
818-04-1	4	3	2	2	2	3	2	4	5	3	2	3	4	4
818-05	4	3	3	4	3	3	4	4	3	4	4	4	4	4
818-05-1	4	3	3	4	3	3	4	4	3	3	4	3	4	3
818-05-2	4	3	3	3	3	3	4	4	4	4	4	3	4	3
818-06	3	3	3	3	3	4	5	5	4	4	5	4	5	4
818-06-10	3	3	3	3	2	3	1	3	4	4	4	3	4	4
818-07	3	3	4	3	3	3	1	3	3	3	3	4	4	4
818-08	4	3	4	4	4	1	5	3	2	2	1	1	1	1
818-09	3	3	3	3	3	1	1	2	2	3	1	2	3	3
818-10	2	3	3	3	3	1	1	2	3	3	3	3	3	3
818-11	4	3	4	4	4	1	4	3	3	4	1	1	1	1
818-12	3	3	3	4	3	1	1	2	2	3	1	1	1	1
819-01	4	1	1	2	1	2	2	4	4	4	2	3	3	3
819-02	4	3	3	3	3	3	3	4	3	3	3	4	4	4

Item	Category	Score		Rank
Executionability	1. Geographical features	5		1 2 3 4 5
	2. Situation of subgrade course	8		1 2 3 4 5
	3. Situation of drainage	5	30	1 2 3 4 5
	4. Bridge and conduit	6		1 2 3 4 5
	5. Proportion of rehabilitation	6		1 2 3 4 5
Formation of road network	6. Household (direct)	10		1 2 3 4 5
	7. Household (indirect)	8		1 2 3 4 5
	8. Connectionability	7	40	1 2 3 4 5
	9. Approaches to public facilities	4		1 2 3 4 5
	10. Approaches to urban area	4		1 2 3 4 5
	11. Demand of local-inhabitants	7		1 2 3 4 5
Relation to agriculture	12. Approach to upland fields	10		1 2 3 4 5
	13. Collection and shipping	10	30	1 2 3 4 5
	14. Relation to water supply	10		1 2 3 4 5

Table F.2.2 The Results of Assessment

name	Executionability						Formation of Network							Agriculture				total	Rank
	1	2	3	4	5	(A)	6	7	8	9	10	11	(B)	12	13	14	(C)		
818	20	32	15	18	24	109	50	40	35	20	20	35	200	50	50	50	150	459	1
818-06	15	24	15	18	18	90	40	40	35	16	16	35	182	40	50	40	130	402	2
818-01	20	24	15	24	18	101	30	32	35	16	16	28	157	40	40	40	120	378	3
805	15	32	15	24	24	110	30	32	35	16	20	21	154	30	40	40	110	374	4
818-04	20	24	15	18	18	95	40	32	28	12	16	28	156	40	40	40	120	371	5
818-05	20	24	15	24	18	101	30	32	28	12	16	28	146	40	40	40	120	367	6
818-02	20	24	15	18	18	95	40	24	21	12	16	28	141	40	40	50	130	366	7
818-03-3	15	24	10	12	18	79	30	32	35	16	16	28	157	30	50	40	120	356	8
818-03	20	24	15	18	18	95	30	24	28	16	12	28	138	40	40	40	120	353	9
251-22	5	16	10	12	18	61	50	32	28	16	16	28	170	40	40	40	120	351	10
251-17-3	20	16	15	18	12	81	20	16	35	20	20	28	139	40	50	40	130	350	11
818-05-2	20	24	15	18	18	95	30	32	28	16	16	28	150	30	40	30	100	345	12
818-05-1	20	24	15	24	18	101	30	32	28	12	12	28	142	30	40	30	100	343	13
819-02	20	24	15	18	18	95	30	24	28	12	12	21	127	40	40	40	120	342	14
818-01-3	15	24	15	12	12	78	30	32	35	16	12	28	153	30	40	40	110	341	15
818-03-2	15	24	15	18	18	90	30	8	28	16	16	28	126	40	40	40	120	336	16
251-16	20	8	15	18	18	79	20	40	35	20	20	21	156	30	40	30	100	335	17
818-01-1	25	32	20	24	24	125	10	24	28	16	16	14	108	20	40	40	100	333	18
251-20	15	24	20	18	18	95	30	16	21	12	12	14	105	40	40	40	120	320	19
818-07	15	24	20	18	18	95	30	8	21	12	12	21	104	40	40	40	120	319	20
819	10	16	10	12	12	60	30	32	35	16	20	14	147	30	40	40	110	317	21
818-06-10	15	24	15	18	12	84	30	8	21	16	16	28	119	30	40	40	110	313	22
818-04-1	20	24	10	12	12	78	30	16	28	20	12	14	120	30	40	40	110	308	23
805-02	20	24	10	12	12	78	20	32	21	16	16	14	119	30	40	40	110	307	24
805-01	20	24	10	12	18	84	20	24	21	16	16	14	111	30	40	40	110	305	25
251-17	20	32	20	24	24	120	10	24	21	12	12	14	93	20	30	30	80	293	26
251-17-1	15	16	10	18	12	71	20	16	28	12	12	21	109	30	30	30	90	270	27
819-01	10	16	15	12	6	59	10	24	28	16	16	14	108	30	30	30	90	257	28
818-06	10	24	15	18	18	85	10	8	14	12	12	21	77	30	30	30	90	252	29
251-21	20	24	10	18	18	90	10	8	14	12	12	7	63	30	30	30	90	243	30
818-11	20	24	20	24	24	112	10	32	21	12	16	7	98	10	10	10	30	240	31
818-08	20	24	20	24	24	112	10	40	21	8	8	7	94	10	10	10	30	236	32
818-03-1	15	8	5	12	6	46	10	24	28	12	12	21	107	20	30	30	80	233	33
818-09	15	24	15	18	18	90	10	8	14	8	12	7	59	20	30	30	80	229	34
251-15	20	8	5	18	6	57	10	8	14	12	8	7	59	20	30	30	80	196	35
818-12	15	24	15	24	18	96	10	8	14	8	12	7	59	10	10	10	30	185	36
251-18	20	8	5	12	6	51	10	8	14	12	8	14	66	20	20	20	60	177	37
818-01-2	10	16	10	12	6	54	10	24	21	8	8	7	78	10	10	10	30	162	38
251-19	20	8	5	6	6	45	10	8	7	4	4	7	40	10	10	10	30	115	39

Item	Category	Score		Rank
Executionability	1. Geographical features	5		1 2 3 4 5
	2. Situation of subgrade course	8		1 2 3 4 5
	3. Situation of drainage	5	30	1 2 3 4 5
	4. Bridge and conduit	6		1 2 3 4 5
	5. Proportion of rehabilitation	6		1 2 3 4 5
Formation of road network	6. Household (direct)	10		1 2 3 4 5
	7. Household (indirect)	8		1 2 3 4 5
	8. Connectionability	7	40	1 2 3 4 5
	9. Approaches to public facilities	4		1 2 3 4 5
	10. Approaches to urban area	4		1 2 3 4 5
	11. Demand of local-inhabitants	7		1 2 3 4 5
Relation to agriculture	12. Approach to upland fields	10		1 2 3 4 5
	13. Collection and shipping	10	30	1 2 3 4 5
	14. Relation to water supply	10		1 2 3 4 5

Table F.3.1 Pipe-Flow Calculations in Hazen-Williams Formula (Ao Borv System)

No	P	Qd(t/d)	a	Q(l/s)	D(m)	I(0/00)	L(m)	Hf(m)	H(m)	GL(m)'	Hv(m)	V(m/s)
1	1962	392.4	2.4	10.83	200	0.0008	1400	1.06	230.00	220.00	8.94	0.35
2	1032	206.4	2.9	6.91	150	0.0013	500	0.67	228.94	202.00	26.26	0.39
29	990	198.0	2.9	6.73	125	0.0031	500	1.56	228.26	192.00	34.71	0.55
30	966	193.2	3.0	6.63	125	0.0030	500	1.51	226.71	201.00	24.19	0.54
31	936	187.2	3.0	6.50	125	0.0029	500	1.46	225.19	182.00	41.73	0.53
32	666	133.2	3.5	5.37	100	0.0061	500	3.03	223.73	170.00	50.70	0.69
33	648	129.6	3.5	5.29	100	0.0059	500	2.96	220.70	182.00	35.74	0.67
34	630	126.0	3.6	5.22	100	0.0058	500	2.88	217.74	192.00	22.87	0.67
35	612	122.4	3.6	5.14	75	0.0227	500	11.37	214.87	171.00	32.50	1.17
32	252	50.4	4.9	2.87	125	0.0006	1400	0.90	223.73	203.00	19.83	0.23
38	240	48.0	5.0	2.78	100	0.0018	500	0.92	222.83	203.00	18.94	0.36
39	198	39.6	5.4	2.47	75	0.0047	500	2.37	221.94	195.00	26.84	0.55
40	162	32.4	5.9	2.20	75	0.0044	200	0.88	218.84	186.00	31.96	0.50
42	150	30.0	6.1	2.03	75	0.0042	400	2.03	217.96	186.00	34.67	0.46
43	138	27.6	7.5	1.76	75	0.0031	500	1.25	215.93	181.00	34.93	0.40
46	102	20.4	7.5	1.67	50	0.0205	500	10.27	214.67	176.00	38.67	0.86
47	90	18.0	10.8	1.41	50	0.0149	500	7.45	204.41	178.00	26.41	0.72
48	54	10.8	27.6	1.14	50	0.0101	500	5.06	196.95	185.00	31.95	0.58
49	18	3.6	39.5	1.10	50	0.0094	200	1.88	191.89	167.00	24.89	0.56
50	12	2.4							190.01	158.00	22.01	
28	42	8.4	13.6	1.32	50	0.0132	500	6.61	228.26	205.00	16.66	0.68
38	12	2.4	39.5	1.10	125	0.0001	500	0.05	221.65	215.00	7.78	0.09
37	24	4.8	21.3	1.19	50	0.0109	500	5.43	222.78	182.00	33.79	0.61
40	18	3.6	27.4	1.14	50	0.0101	500	5.06	221.21	169.00	41.87	0.58
44	12	2.4	39.5	1.10	50	0.0094	500	4.70	215.84	161.00	31.25	0.56
45	12	2.4	39.5	1.10	50	0.0094	400	3.76	210.87	162.00	26.49	0.56
2	858	171.6	3.1	6.18	150	0.0011	500	0.55	228.94	212.00	16.39	0.35
6	846	169.2	3.2	6.13	100	0.0077	500	3.87	228.39	192.00	32.57	0.78
7	828	165.6	3.2	6.05	100	0.0076	500	3.79	224.52	179.00	41.73	0.77
8	816	163.2	3.2	5.92	100	0.0075	500	3.73	220.73	176.00	37.36	0.76
9	798	159.6	3.3	5.77	100	0.0073	500	3.64	217.00	179.00	30.89	0.74
10	766	153.2	3.4	5.62	100	0.0069	500	3.47	213.36	179.00	39.59	0.72
12	726	145.2	3.4	5.59	100	0.0066	500	3.30	209.89	176.00	27.31	0.72
13	720	144.0	4.0	5.14	100	0.0056	500	2.28	206.59	167.00	44.51	0.66
20	612	122.4	7.0	5.09	75	0.0223	500	11.16	203.31	156.00	33.35	1.16
21	600	120.0	7.1	5.09	75	0.0223	500	11.16	200.01	158.00	20.19	1.16
22	600	120.0							178.19			
3	72	14.4	8.4	1.64	75	0.0024	500	1.22	228.94	206.00	21.71	0.35
4	60	12.0	10.4	1.45	75	0.0022	500	1.10	227.71	192.00	34.62	0.33
5	48	9.6	12.3	1.36	50	0.0140	500	7.02	226.62	198.00	21.59	0.70
13	102	20.4	7.5	1.76	75	0.0031	500	1.57	201.74	171.00	30.74	0.40
14	84	16.8	8.3	1.63	50	0.0195	500	9.77	201.97	154.00	37.97	0.83
15	48	9.6	12.3	1.36	50	0.0140	500	7.02	191.97	155.00	29.95	0.70
16	24	4.8	21.3	1.19	50	0.0109	500	5.43	184.95	155.00	28.52	0.61
17	12	2.4	39.5	1.10	50	0.0094	500	4.70	179.52	152.00	22.82	0.56
18	6	1.2	75.8	1.05	50	0.0087	400	3.49	174.82	147.00	24.34	0.54
19									171.34			

No	P	Qd(t/d)	a	Q(l/s)	D(m)	I(0/00)	L(m)	Hf(m)	H(m)	GL(m)	Hv(m)	V(m/s)
56	732	146.4	3.3	5.65	150	0.0009	300	0.28	230.00	220.00	9.72	0.32
55	270	54.0	4.8	3.00	125	0.0007	200	0.14	229.72	208.00	21.58	0.25
54	264	52.8	4.8	2.96	100	0.0020	500	1.01	229.58	196.00	32.58	0.38
53	246	49.2	5.1	2.82	75	0.0075	500	3.76	228.58	184.00	40.82	0.64
57	228	45.6	5.2	2.69	75	0.0069	500	3.44	224.82	177.00	44.38	0.61
58	222	44.4	5.4	2.65	75	0.0067	500	3.33	221.38	162.00	56.05	0.60
59	216	43.2	5.5	2.60	75	0.0065	500	3.23	218.05	183.00	31.82	0.59
60	192	38.4	5.6	2.43	75	0.0057	500	2.83	214.82	183.00	28.99	0.55
61	186	37.2	5.6	2.38	75	0.0055	500	2.74	211.99	174.00	35.25	0.55
62	180	36.0	6.5	2.34	75	0.0053	500	2.65	209.25	160.00	46.60	0.53
63	156	31.2	6.5	2.16	75	0.0046	500	2.29	206.60	165.00	39.32	0.49
64	132	26.4	6.8	1.98	75	0.0038	500	1.95	204.32	161.00	41.36	0.45
65	120	24.0	7.0	1.89	75	0.0036	500	1.79	202.36	158.00	42.57	0.43
66	108	21.6	7.5	1.76	50	0.0228	500	11.29	200.57	152.00	37.28	0.79
67	72	14.4	9.3	1.54	50	0.0176	500	8.81	189.28	134.00	44.47	0.65
68	36	7.2	15.3	1.27	50	0.0124	500	6.20	180.47	134.00	40.27	0.54
69	6	1.2	75.8	1.05	50	0.0087	500	4.36	174.27	141.00	28.91	
56	462	92.4	4.1	4.42	100	0.0042	100	0.42	169.91	218.00	11.30	0.57
71	438	87.6	4.2	4.24	100	0.0039	500	1.96	229.72	186.00	41.34	0.54
72	438	87.6	4.3	4.24	100	0.0039	500	1.96	229.30	179.00	46.37	0.54
73	402	80.4	4.3	3.98	100	0.0035	500	1.74	227.34	179.00	44.63	0.51
74	342	68.4	4.5	3.53	100	0.0028	500	1.40	225.37	214.00	8.23	0.45
75	336	67.2	4.5	3.49	75	0.0027	500	1.37	223.63	198.00	22.86	0.77
76	324	64.8	4.6	3.40	75	0.0106	500	5.29	222.23	183.00	39.40	0.76
77	318	63.6	4.6	3.36	75	0.0103	500	5.17	220.86	171.00	30.36	0.75
78	312	62.4	4.6	3.31	75	0.0093	500	5.04	215.57	175.00	32.68	0.71
79	275	55.1	4.8	3.18	75	0.0093	500	4.67	210.40	168.00	44.36	0.69
80	258	51.6	4.9	3.05	75	0.0086	500	4.32	205.36	152.00	45.35	0.66
81	222	44.4	5.0	2.91	75	0.0080	500	3.98	200.68	147.00	35.05	0.60
82	198	39.6	5.2	2.65	75	0.0067	500	3.33	196.36	154.00	23.12	0.56
83	192	38.4	5.5	2.47	75	0.0059	500	2.93	192.33	163.00	22.63	0.55
84	168	33.6	5.6	2.43	75	0.0057	500	2.83	189.25	166.00	17.28	0.51
85	144	28.8	6.2	2.25	75	0.0049	500	2.46	185.12	156.00	24.83	0.47
86	138	27.6	6.3	2.07	75	0.0043	500	2.12	183.29	156.00	22.71	0.46
88	132	26.4	6.5	2.03	75	0.0042	500	2.03	181.83	152.00	24.68	0.46
89	108	21.6	7.2	1.98	75	0.0041	500	1.95	178.71	149.00	25.72	0.45
90	78	15.6	8.8	1.81	50	0.0039	500	1.64	176.68	148.00	25.08	0.41
91	18	3.6	27.4	1.58	50	0.0033	500	9.28	174.72	145.00	18.80	0.58
93	18	3.6	27.4	1.14	50	0.0186	500	5.06	173.08	138.00	20.74	0.58
95				1.14	50	0.0101	200	2.02	163.80	130.00	26.72	
96						0.0101			158.74			
87	12	2.4	39.5	1.10	50	0.0094	400	3.76	156.72	142.00	35.06	0.56
91									180.83			
92	12	2.4	39.5	1.10	50	0.0094	500	4.70	177.06	141.00	27.38	0.56
93									173.08			
94	30	6.0	17.7	1.23	50	0.0116	500	5.81	168.38	138.00	19.99	0.63
67									163.80			
70	36	7.2	15.3	1.27	50	0.0124	500	6.20	157.99	135.00	39.27	0.65
									174.27			

```
D  50 (m/m) = 13,200
D  70 (m/m) = 17,600
D 100 (m/m) =  9,600
D 125 (m/m) =  3,600
D 150 (m/m) =  1,300
D 200 (m/m) =  1,400
              --------
      Total   46,700 m
```

***** Pipe-Flow Calculations in Hazen-Williams Formula *****   (Ao.Rory-mi System)

No	P	Qd(t/d)	a	Q(l/s)	D(m)	I(0/00)	L(m)	Hf(m)	H(m)	GL(m)	Hv(m)	V(m/s)
1									214.00			
2	354	70.8	4.4	3.62	125	0.0013	100	0.13	213.87	207.00	6.87	0.30
3	312	62.4	4.6	3.31	100	0.0034	900	3.05	210.82	159.00	51.82	0.42
4	246	49.2	5.0	2.82	100	0.0025	1150	2.90	207.92	169.00	38.92	0.36
5	234	46.8	5.1	2.74	100	0.0024	1100	2.61	205.30	175.00	30.30	0.35
6	168	33.6	5.8	2.25	75	0.0067	500	3.36	201.95	174.00	27.95	0.51
7	168	33.6	5.8	2.25	75	0.0067	900	6.04	195.91	175.00	20.91	0.51
8	156	31.2	6.0	2.16	75	0.0062	500	3.12	192.79	172.00	20.79	0.49
9	138	27.6	6.3	2.03	75	0.0055	800	4.43	188.36	167.00	21.36	0.46
10	108	21.6	7.2	1.81	75	0.0045	1200	5.37	182.99	175.00	7.99	0.41
11	42	8.4	13.6	1.32	75	0.0025	600	1.50	181.49	152.00	29.49	0.30
12	12	2.4	39.5	1.10	75	0.0018	500	0.89	180.60	157.00	23.60	0.25
2									213.87			
13	42	8.4	13.6	1.32	100	0.0006	1000	0.62	213.25	200.00	13.25	0.17
14	12	2.4	39.5	1.10	50	0.0128	700	8.97	204.28	191.00	13.28	0.56

```
          ----------------------------
          D   50  (m/m) =     700 (m)
          D   75  (m/m) =    5000 (m)
          D  100  (m/m) =    4150 (m)
          D  125  (m/m) =     100 (m)
          ----------------------------
             Total    =    9950 (m)
```
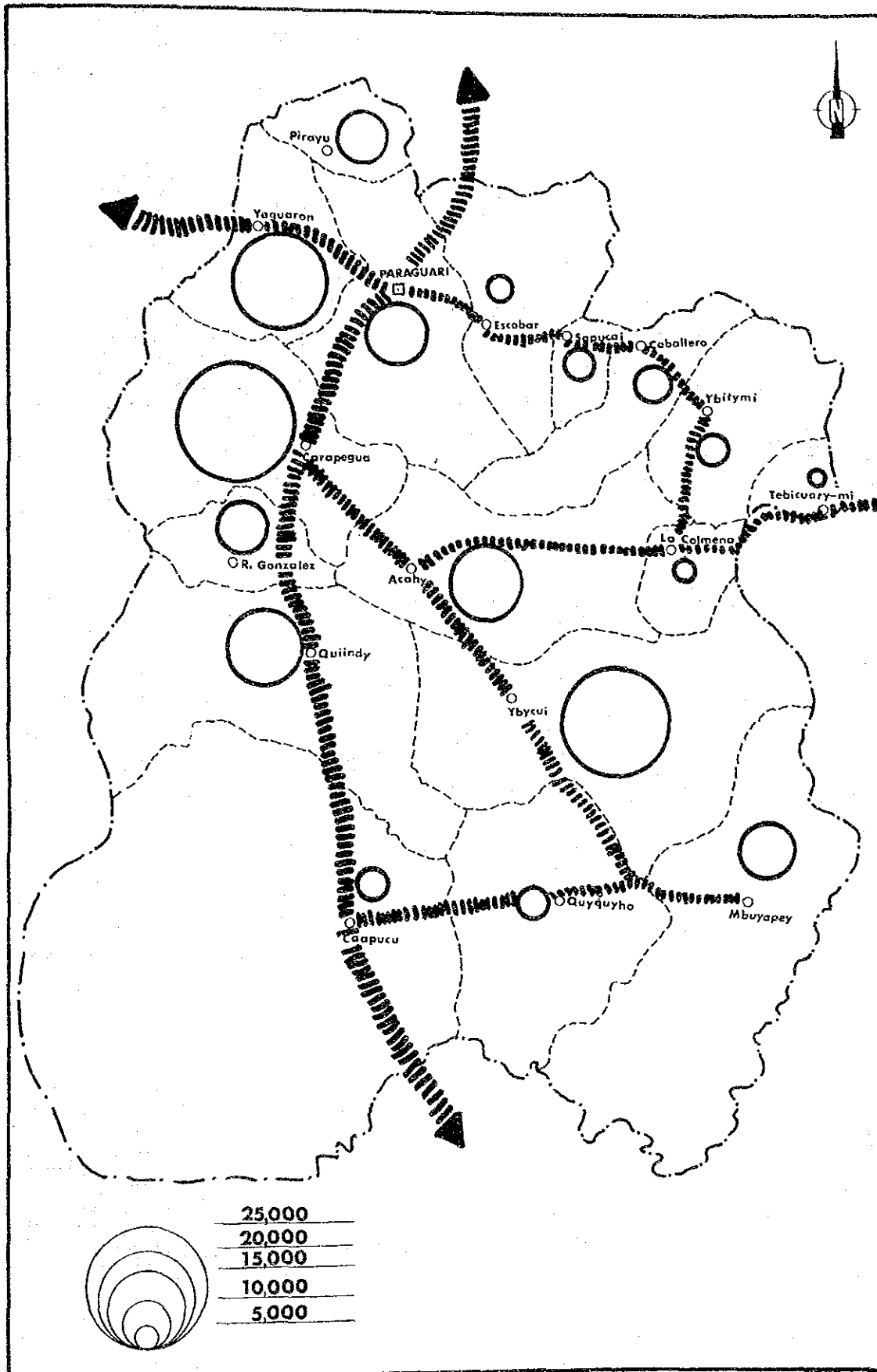
Fig. F.1.1 Distribution Map of Population in Paraguari Pref.

Pirayu
Yaguaron
PARAGUARI
Escobar
Sgaucai
Caballero
Ybitymi
Carapegua
Tebicuary-mi
R. Gonzalez
Acahy
La Colmena
Quiindy
Ybycui
Caapucu
Quyquyho
Mbuyapey

25,000
20,000
15,000
10,000
5,000

Bank of National Fomentation (BNF)
Primary School (Paraguay-Japon)
High School (Agustina Miranda Gonzalez)
Sport Ground (La Colmena)
Medical Center
Extension Service (SEAG)
Processing Factory (Rice mill)
Processing Factory (Cotton)
Winery

Municipality
Taxation Office
Telephone Office (ANTELCO)

La Colmena Agricultural Co-operative
Association Hall (Paraguayo-Japonesa)
Japanese School
Primary School (San Francisco Javier)
Church (San Francisco Javier)
Park (Japonesa)

Water Supply Tank

Post Office
COLORADO Hall
Police Office
Bus Terminal
Public Market (ABASTO)

Legend	
	Public Facility
	Commerce
	Dwelling
	Education
	Recreation
	Religion Sect
	Industry

Fig. F.1.2 Facilities in The Urban Area
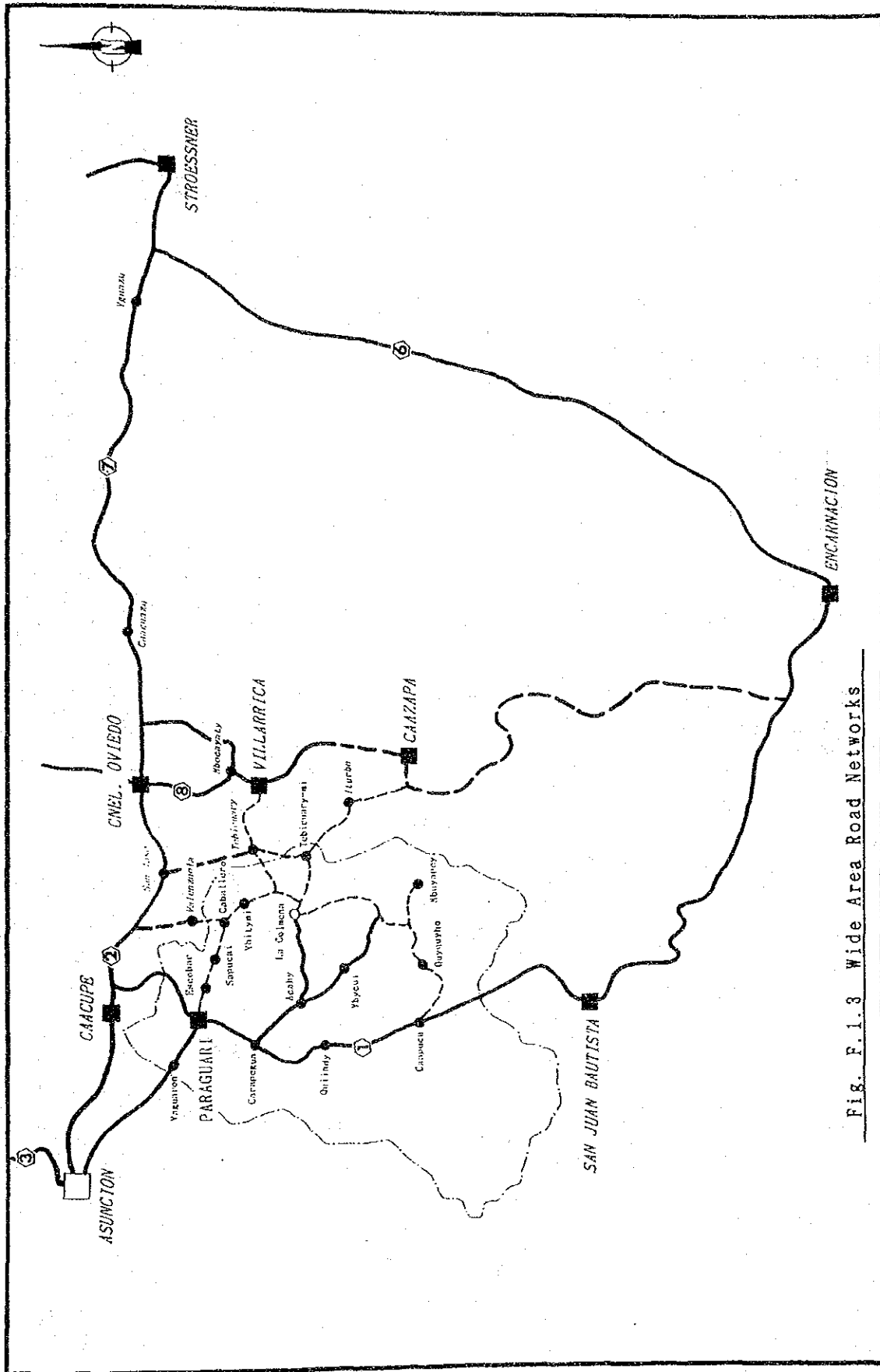
Fig. F.1.3 Wide Area Road Networks
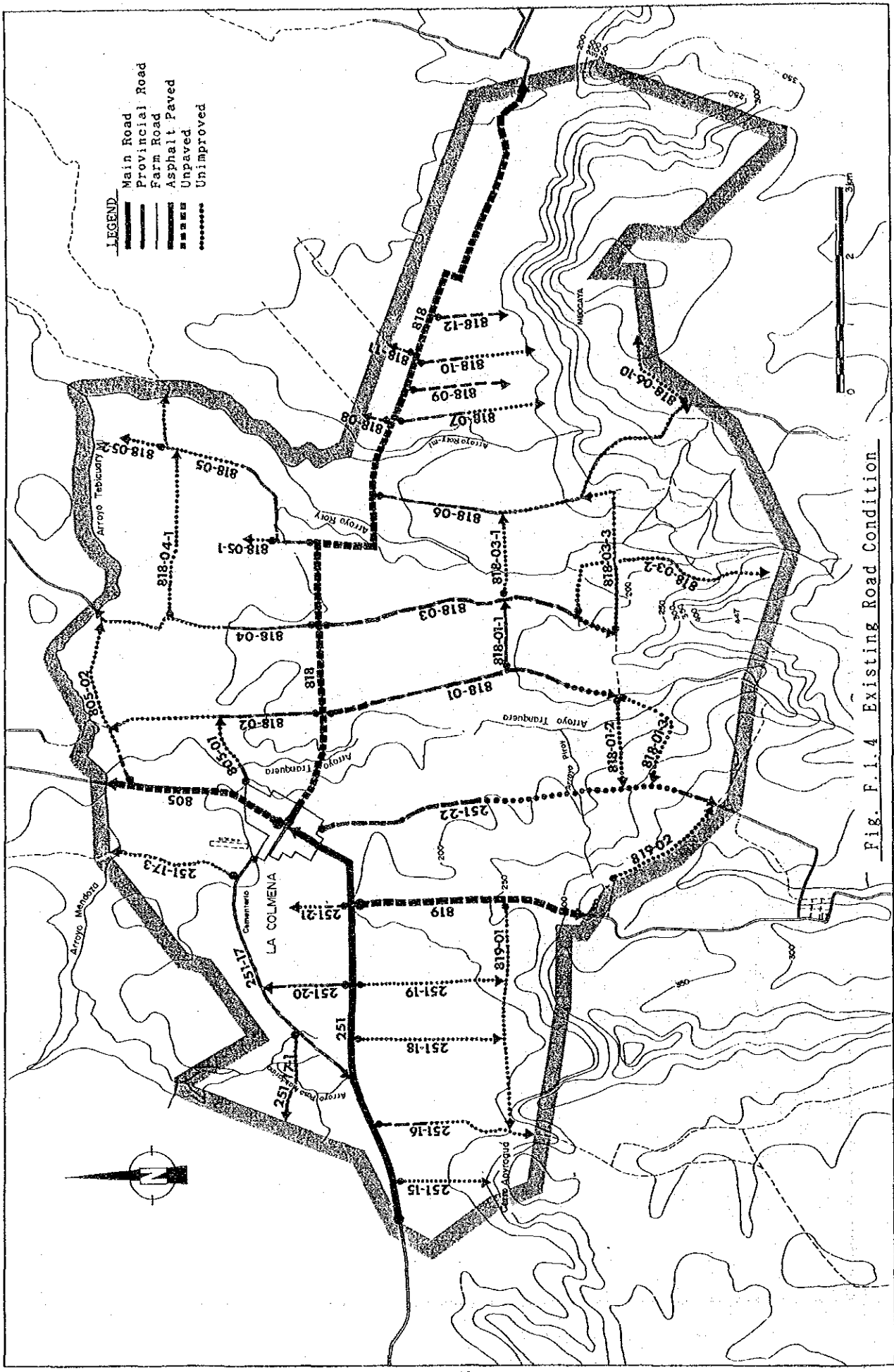
Fig. F.1.4 Existing Road Condition

Fig. F.1.5 Existing Road Classification
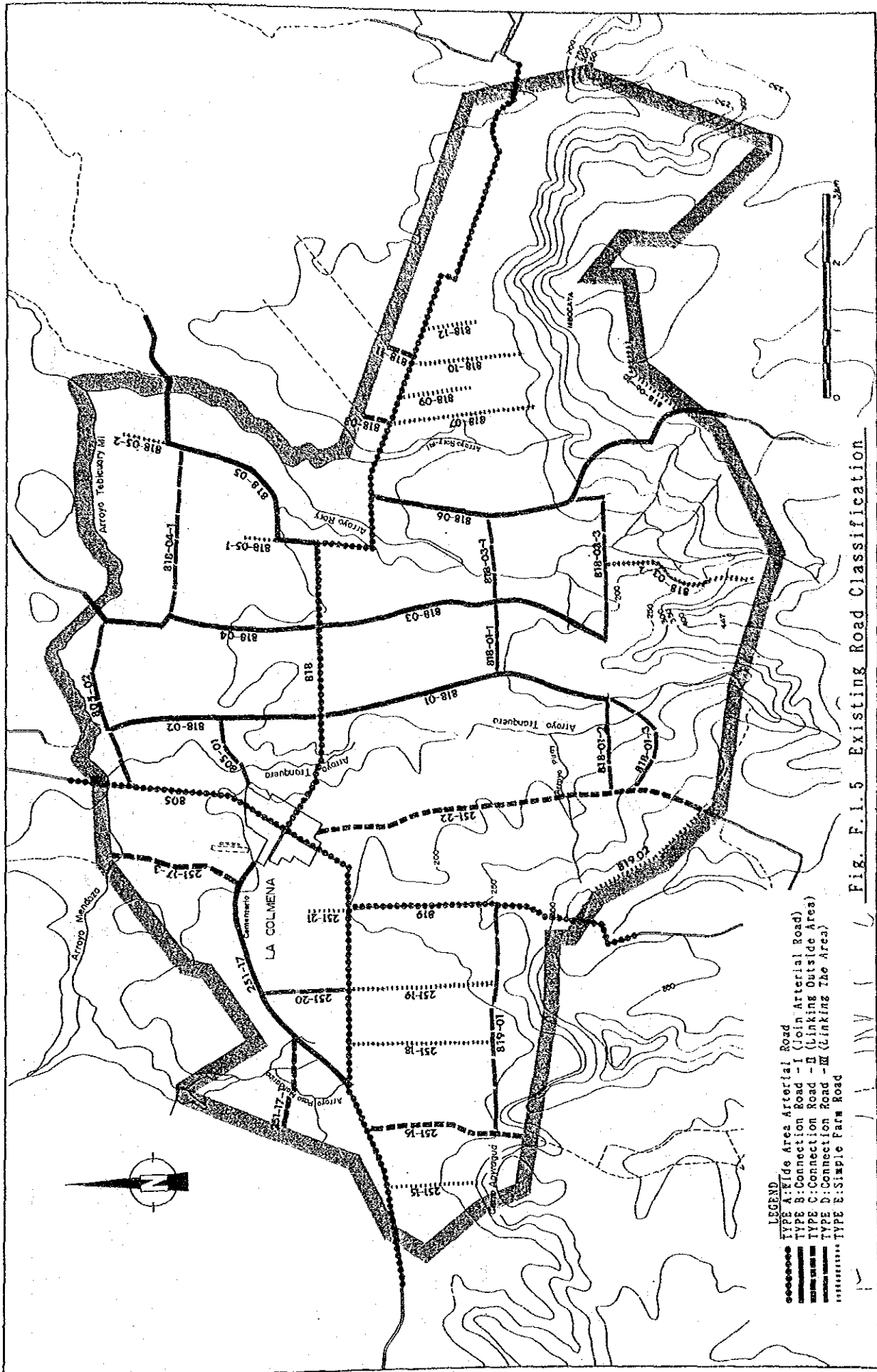
LEGEND
TYPE A : Wide Area Arterial Road
TYPE B : Connection Road - I (Join Arterial Road)
TYPE C : Connection Road - II (Linking Outside Area)
TYPE D : Connection Road - III (Linking The Area)
TYPE E : Simple Farm Road
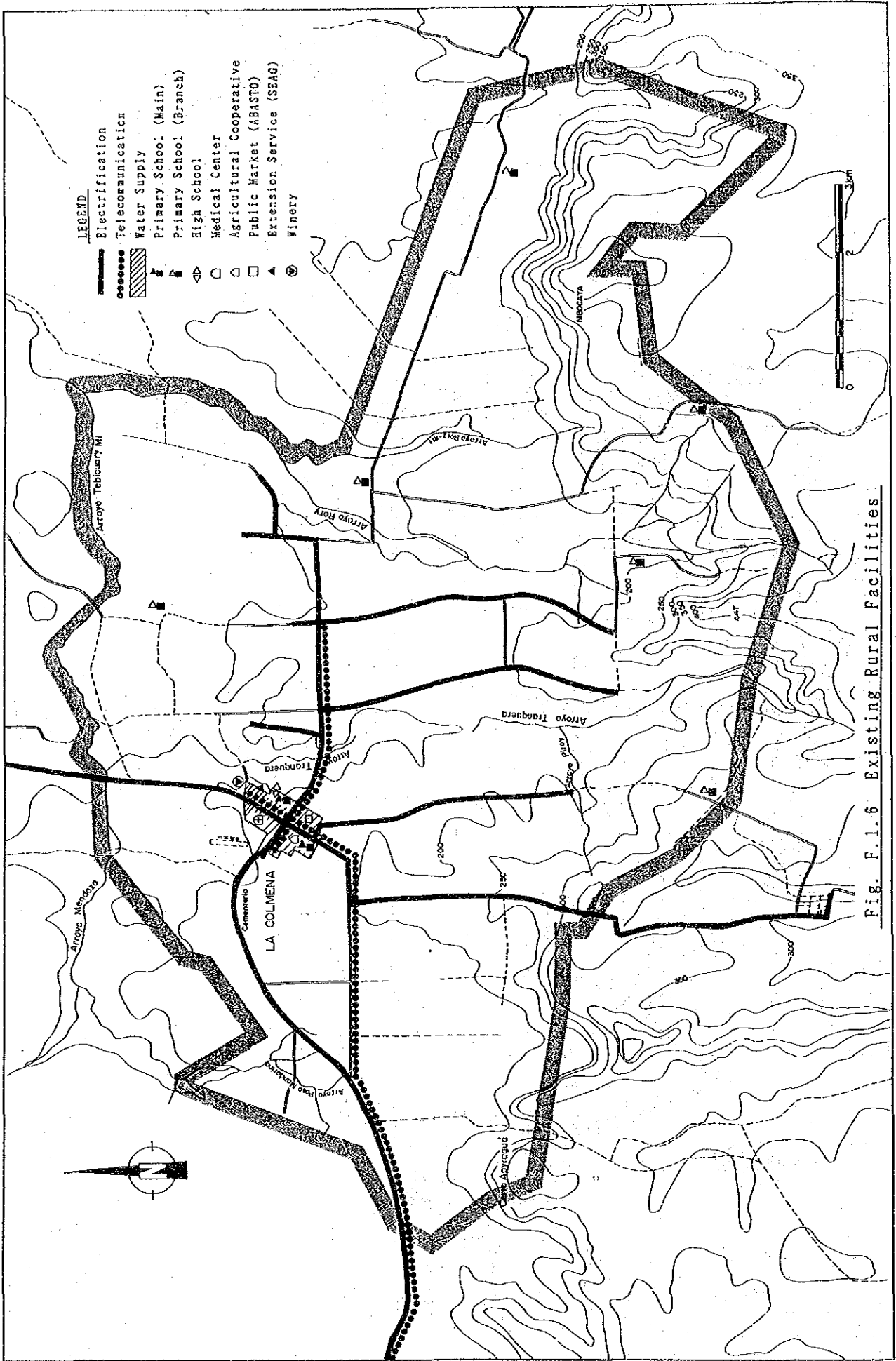
Fig. F.1.6 Existing Rural Facilities

LEGEND

Electrification
Telecommunication
Water Supply
Primary School (Main)
Primary School (Branch)
High School
Medical Center
Agricultural Cooperative
Public Market (ABASTO)
Extension Service (SEAG)
Winery

LA COLMENA

Fig. F.2.1 Master Plan of Road Improvement

LEGEND

MAIN Road
Provincial Road
Farm Road
Farm Road
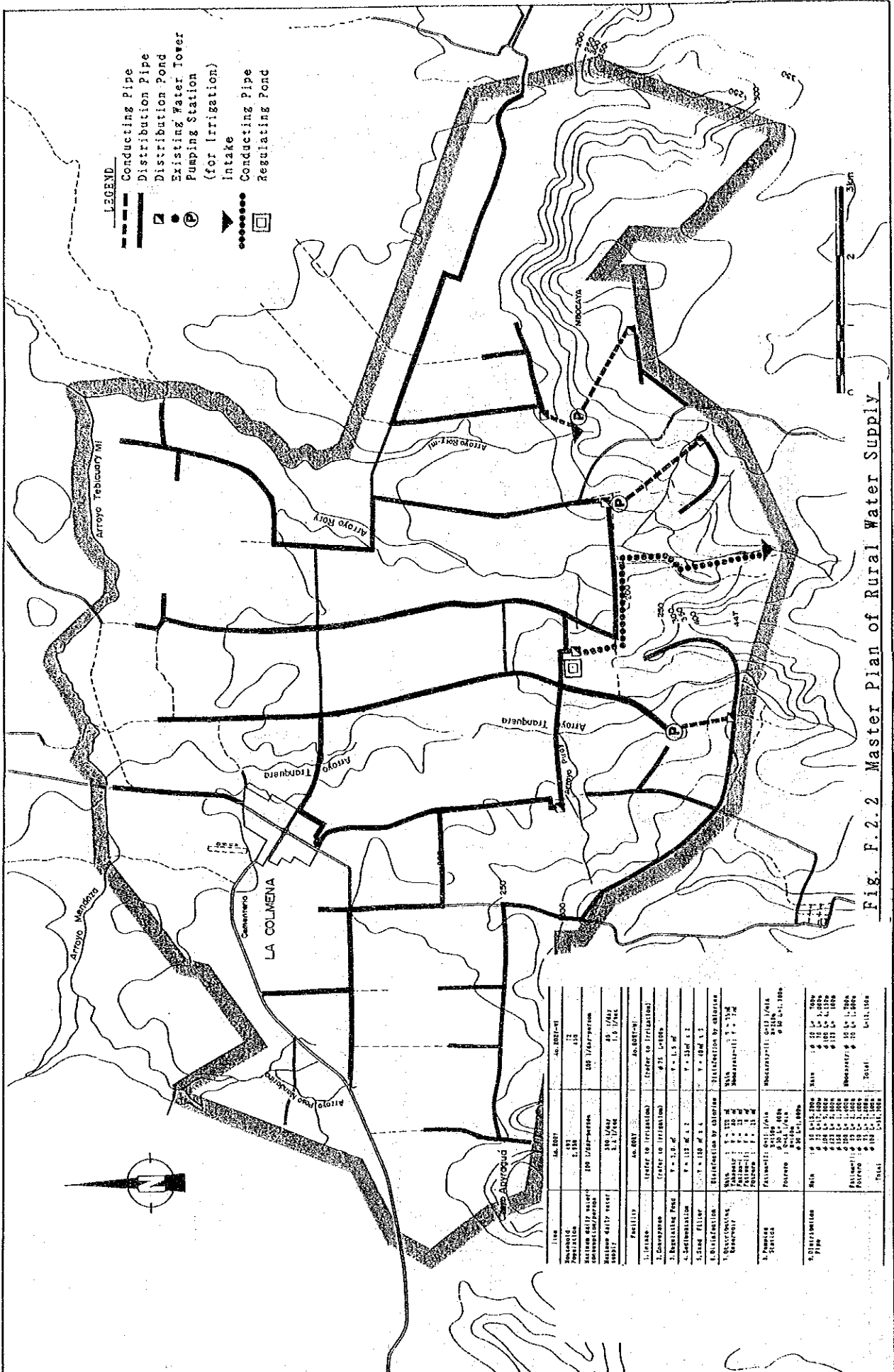
Fig. F.2.2 Master Plan of Rural Water Supply

Fig. F.2.3 Master Plan of Rural Facilities

Fig. F.3.1 Road Improvement Plan

LEGEND

MAIN Road (TYPE I)
MAIN Road (TYPE II)
Provincial Road (TYPE III)
Farm Road (TYPE III)
Farm Road (TYPE IV)
Bridge
Culvert

SCALE 1:50,000
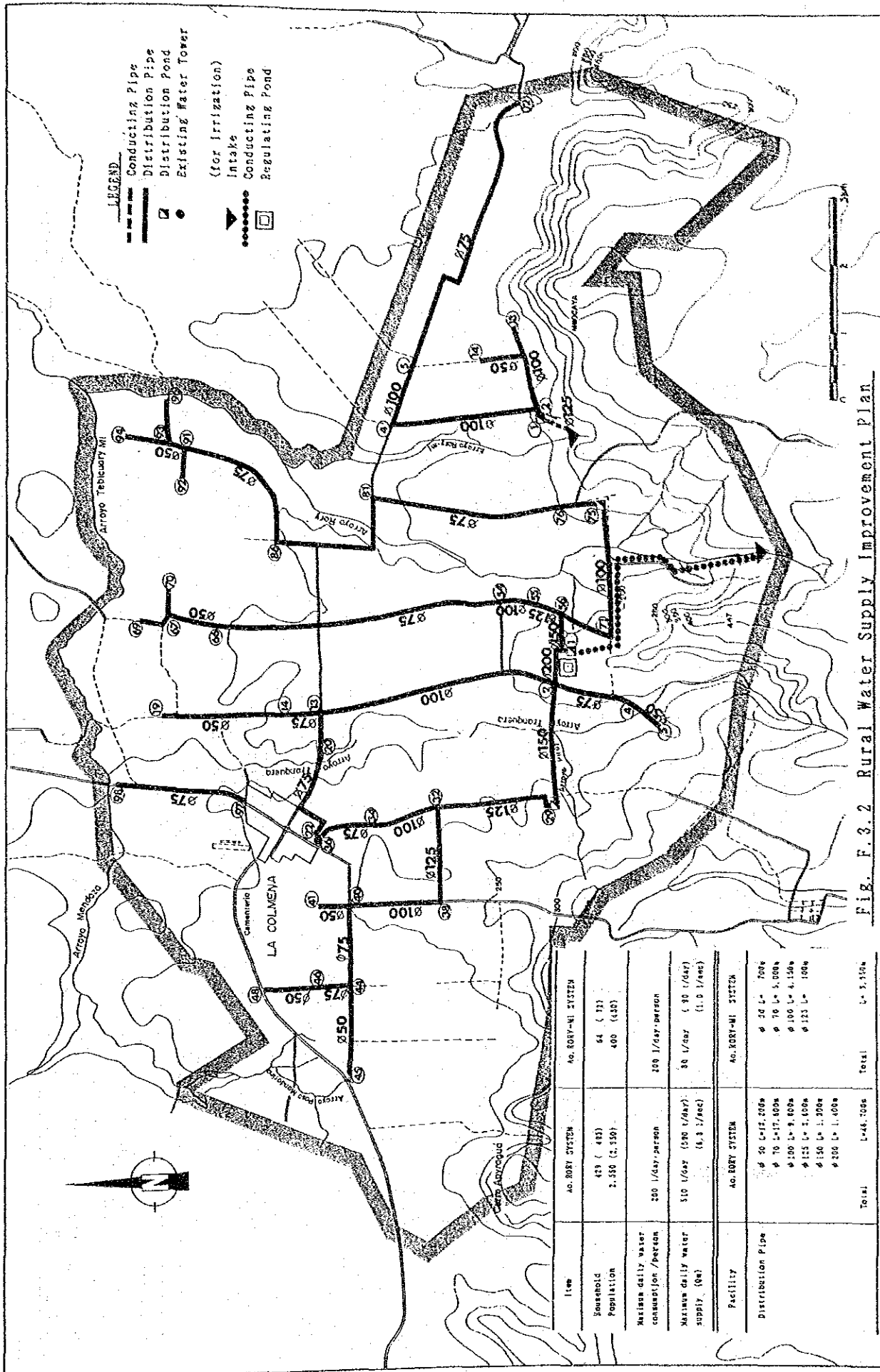
Fig. F.3.2 Rural Water Supply Improvement Plan
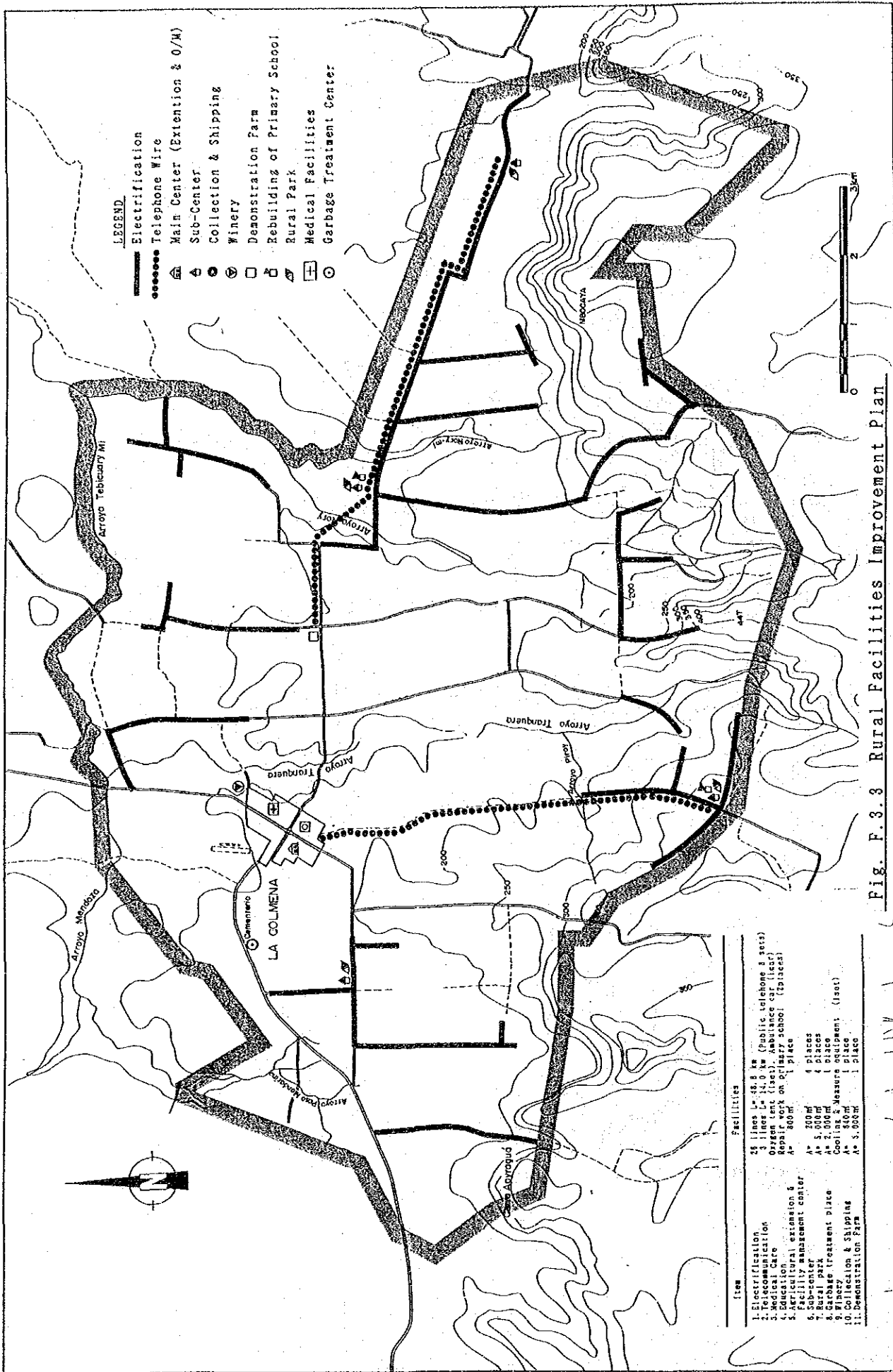
LEGEND

- Electrification
- Telephone Wire
- Main Center (Extention & O/W)
- Sub-Center
- Collection & Shipping
- Winery
- Demonstration Farm
- Rebuilding of Primary School
- Rural Park
- Medical Facilities
- Garbage Treatment Center

LA COLMENA

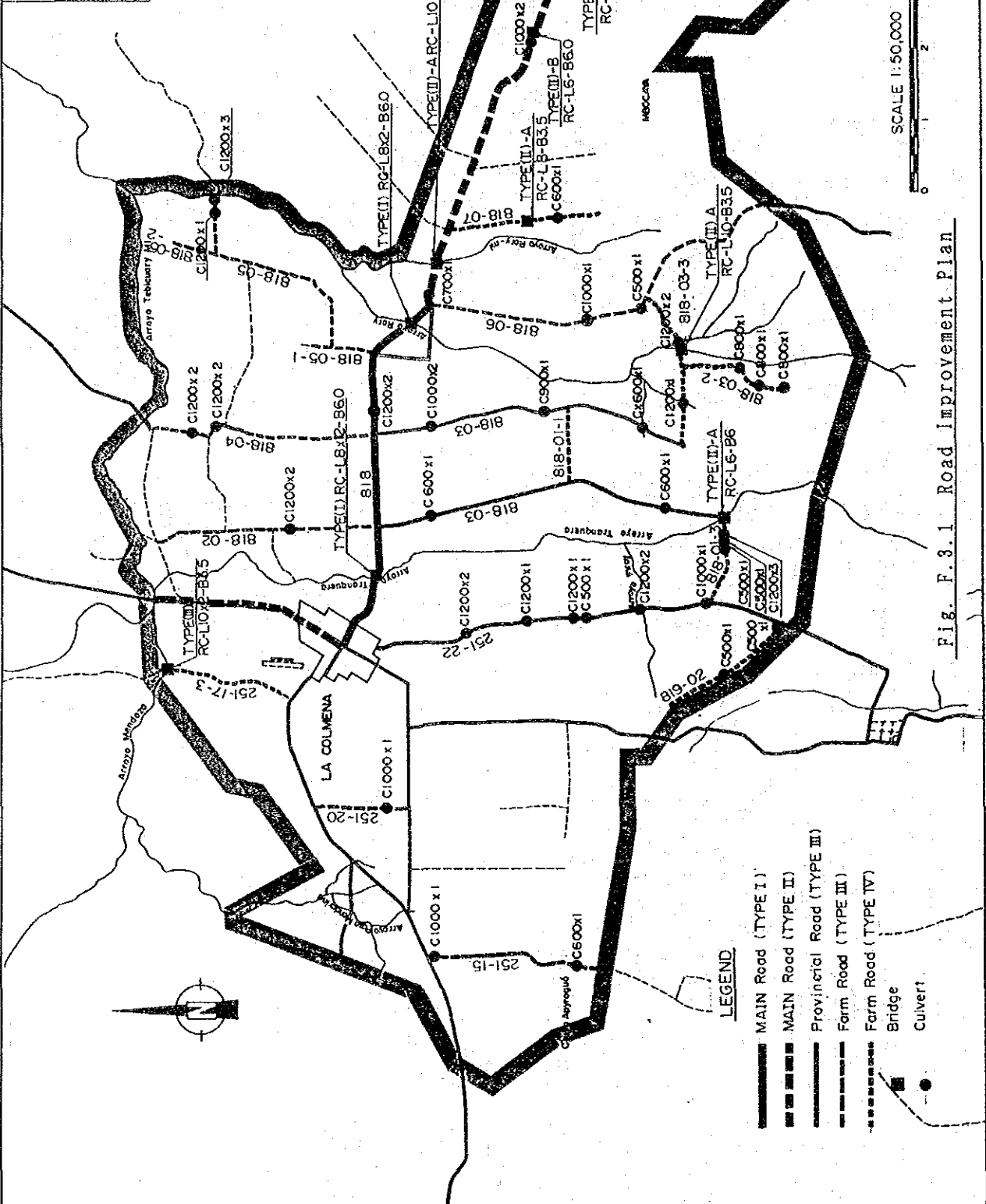| Item	Facilities
1. Electrification	26 lines L= 48.8 km (Public telephone 8 sets)
2. Telecommunication	3 lines L= 14.0 km
3. Medical Care	Oxygen tent (1set), Ambulance car (1set)
4. Education	Repair work on primary school (7places)
5. Agricultural extension & Facility management center	A= 800㎡ 1 place
6. Sub-center	A= 200㎡ 4 places
7. Rural Park	A= 5,000㎡ 4 places
8. Winery	A= 2,000㎡ 1 place
9. Garbage treatment place	Cooling & measure equipment (1set)
10. Collection & Shipping	A= 840㎡ 1 place
11. Demonstration Farm	A= 5,000㎡ 1 place

Fig. F.3.3 Rural Facilities Improvement Plan

Fig. F.3.4 Bird's-Eye View of Extension & O/M Center

Ao.RORY SYSTEM-II

Hydraulic-grade Line
Ground Line
Pipe Line

HWL = 223.73

φ50 φ75 φ100 φ125

Scale 1:1,000 / 1:50,000

DL = 140.0

Hv (m)	22.10	21.69	31.95	36.41	38.67	31.93	31.96	30.84	26.21	18.94	19.83	41.13
EFFECTIVE HEAD (m)	190.05	191.89	196.95	204.49	214.62	215.92	217.98	218.06	221.26	221.96	222.83	223.73
GROUND LEVEL (m)	190	167	165	178	176	181	186	180	195	203	203	182
LENGTH (m)	200	500	600	500	400	500	800	600	600	500	1400	0
STATION No.	50	49	48	47	46	44	43	42	40	39	38	32

Ao.RORY SYSTEM-I

Hydraulic-grade Line
Ground Line
Pipe Line

HWL = 220

φ75 φ100 φ125 φ150 φ200

Scale 1:1,000 / 1:50,000

DL = 150.0

Hv (m)	32.5	22.02	35.74	50.7	41.73	24.19	31.71	26.76	8.9399	0
EFFECTIVE HEAD (m)	203.5	214.02	212.74	220.7	223.73	225.19	226.74	228.76	228.96	230
GROUND LEVEL (m)	171	192	182	170	182	201	192	202	250	230
LENGTH (m)	500	600	500	600	500	500	500	1800	400	0
STATION No.	36	35	34	33	32	31	30	29	2	1

Fig. F.3.5 Profile of Rural Water Supply (1)

Ao.RORY SYSTEM-VI

Hydraulic-grade Line

Ground Line

Pipe Line

HWL=228.94

φ175

φ100i

φ150

DL = 130.0

1 : 1,000
1 : 50,000

HW (m)												
EFFECTIVE HEAD (m)												
GROUND LEVEL (m)												
LENGTH (m)												
STATION NO.												

Ao.RORY SYSTEM-III

Hydraulic-grade Line

Ground Line

Pipe Line

HWL=230

φ50

φ75

φ125

φ150i

DL = 120.0

1 : 1,000
1 : 50,000

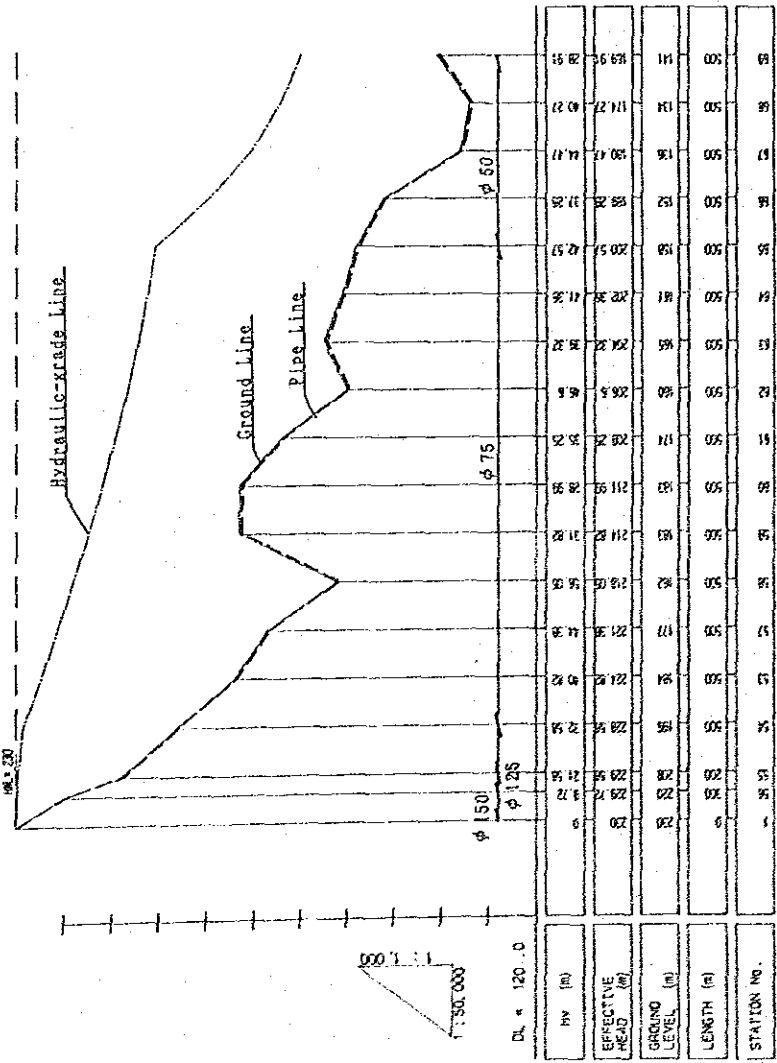																		
HW (m)																		
EFFECTIVE HEAD (m)																		
GROUND LEVEL (m)																		
LENGTH (m)																		
STATION NO.																		

Fig. F.3.5 Profile of Rural Water Supply (2)

Ao. RORY SYSTEM-VI

MWL = 229.72

Hydraulic-grade Line

Ground Line

Pipe Line

φ 50

φ 75

φ 100

DL = 120.0

1:50,000

1:1,000

	Hv (m)	EFFECTIVE HEAD (m)	GROUND LEVEL (m)	LENGTH (m)	STATION No.
	11.9	228.76	202	600	55
	41.34	227.34	186	600	72
	46.37	225.37	170	600	73
	44.63	223.63	179	600	74
	8.2003	222.23	214	600	75
	22.66	220.66	198	600	76
	32.57	215.52	183	600	77
	35.4	210.4	171	600	78
	30.36	205.36	175	600	79
	32.68	200.66	168	600	80
	44.36	196.36	152	600	81
	45.39	192.36	147	600	82
	35.05	189.06	151	600	83
	23.12	186.17	163	600	84
	17.29	183.25	166	600	85
	24.83	180.69	155	600	86
	22.71	178.71	156	600	88
	24.68	175.66	152	600	89
	25.72	174.12	149	600	90
	25.00	173.0	160	600	91
	18.8	163.6	145	600	93
	30.74	158.74	138	500	95
	28.72	155.72	130	600	96

Ao. RORY SYSTEM-V

MWL = 203.31

Hydraulic-grade Line

Ground Line

Pipe Line

φ 50

φ 75

DL = 120.0

1:50,000

1:1,000

	Hv (m)	EFFECTIVE HEAD (m)	GROUND LEVEL (m)	LENGTH (m)	STATION No.
	27.31	203.31	176	0	13
	30.74	201.74	171	500	14
	31.97	181.97	164	500	15
	29.96	184.95	156	500	16
	28.52	179.52	151	500	17
	22.82	174.82	152	500	18
	24.36	171.36	147	400	19

Fig. F.3.5 Profile of Rural Water Supply (3)

Ao.RORY-MI SYSTEM-II

HWL = 213.67

φ 100   φ 50

DL = 150.0

1 : 50,000
1 : 1,000

Hv (m)	6.87	13.26	13.39
EFFECTIVE HEAD (m)	213.67	212.92	204.26
GROUND LEVEL (m)	207	200	191
LENGTH (m)	0	2000	700
STATION NO.	2	13	14

Ao.RORY-MI SYSTEM-I

Hydraulic-grade Line

Ground Line

Pipe Line

HWL = 214

φ 125   φ 100   φ 75

DL = 130.0

1 : 50,000
1 : 1,000

Hv (m)	6.87	28.93	38.82	30.3	21.95	20.51	20.79	21.35	2.90	29.45	21.6
EFFECTIVE HEAD (m)	213.87	210.62	202.82	205.3	201.95	195.95	191.24	188.86	182.93	181.43	180.6
GROUND LEVEL (m)	215	159	169	175	171	175	172	167	175	157	157
LENGTH (m)	600	300	1150	1140	500	500	500	500	1200	800	500
STATION NO.	2	3	4	5	6	7	8	9	10	11	12

Fig. F.3.5 Profile of Rural Water Supply (4)

ANNEX G   PROJECT EVALUATION

Annex G <u>Project Evaluation</u>

<u>CONTENTS</u>

i

List of Table

ANNEX G   Project Evaluation

G.1   Cost estimate

    Cost estimate of the project is made on the basis of proposed implementation schedule, construction plan, unit price and quantities estimated during the study.   The cost estimate is carried out at the price level as of beginning of December in 1988 dividing it into foreign and local currency portions.   The exchange rate used for the cost estimate is US$ 1.00 = G. 1,000 and yen 1.00 = 7.692.   For all works, the cost is estimated first at the price level based on the work quantities estimated for each components of the project.   Duties and taxes on the materials, machinery and equipment to be imported from abroad are deemed to be exempted.   The cost for the civilworks includes the contractor's overhead and profit which are assumed at 25 % of the direct cost.   Estimated results are shown in Table G.1.1 to G.1.6 and the break down of unit price is shown in Table G.1.7.

G.2   Operation and Maintenance Cost

    Based on the guidance of concerned offices, operation and maintenace will be performed by O & M committees at the site.   On the other hand, beneficiaries will be formed management cooperatives to undertake the part of the committees' duties.   The cost for operation and maintenance will include the cost to manage the following facilities:

            - Road and its related facilities
            - Irrigation facilities
            - Drainage facilities
            - Extension and O & M Center
            - Agricultual processing facilities
            - Collecting and shipment facilities
            - Demonstration farm

    The estimated cost for operation and maintenace is shown in Table G.2.1 to G.2.11.

G.3   Benefit

    The anticipated project benefit is broadly divided into two, the direct and the indirect benefits.   Following will be anticipated as the direct benefits of the project:

- Increase of agricultural production and improvement of its qualities.
- Reduction of transportation costs and damaged crops during the transportation.
- Elimination of water famine due to improved rural water supply facilities and reduction of costs involving the work to obtain the water from the water source.
- Supply of quality wine due to betterment of fermentation facilities.
- Improvement of living standards with the installation of electricity and telecommunication systems.
- More efficient land use with the drainage improvement.

As the indirect benefits, following is anticipated:

- Procurement of labor force and materials to be used for the construction works of the project.
- Increase of agricultual employment oppotunities.
- Stable supply of agricultural products
- Favorable repercussion to the distribution industry stimulated by the increased agricultural products, dairy products and production materials.
- Expanded purchasing power of farmers with the increase of agricultural income

Breakdown of these items is shown in Table G.3.1 to G.3.19.

G.4 Evaluation

The economic internal rate of return of the project is calculated on the basis of required costs, proposed disbursement schedule, anticipated benefits and other factors. The sesitivity analysis is also made with the following cases:

(1) Increase of estimated cost by 10 %
(2) One year delay of the construction period
(3) Decrease of agricultual production benefits by 5 %
(4) Combination of (1) and (3)
(5) Exchange rate by US$ 1.00 = G. 550

Tables G.4.1 and G.4.2 show the disbursement schedule of the project and replacement costs required. Calculation results of E.I.R.R. are shown in Tables G.4.3. to G.4.8.

G.5 Financial Analysis

Repayment schedule is examined for two plans, Case I and Case II, which are proposed to reply the total project costs of 14,856 million G with the annual interest of 3.5 % and the five-year grace period over the next 20 years.

Table G.5.1 shows the repayment schedule on the total investment. Repayment schedule on terminal facilities is shown in Tables G.5.2 and G.5.3.

Table 1.1.(1) Summary of Project Cost

(Unit: 1,000 G)

Item	M/P (1)=(2)+(5)			F/S (2)=(3)+(4)			F/S 1st Stage (3)			F/S 2nd Stage (4)			Future Stage (5)		
	Amount	F/C	L/C	Amount	F/C	L/C	Amount	F/C	L/C	Amount	F/C	L/C	Amount	F/C	L/C
Road	8,337,000	2,501,013	5,835,987	4,738,520	1,421,469	3,317,051	3,772,752	1,131,739	2,641,013	965,768	289,730	676,038	3,598,480	1,079,544	2,518,936
Irrigation	11,560,000	7,602,966	3,957,034	4,036,154	2,712,466	1,323,688	4,036,154	2,712,466	1,323,688	-	-	-	7,523,846	4,890,500	2,633,346
Drainage	254,000	-	254,000	103,422	-	103,422	46,540	-	46,540	56,882	-	56,882	150,578	-	15,054
Water Supply	1,877,000	858,507	1,018,493	988,454	444,334	544,120	988,454	444,334	544,120	-	-	-	888,546	414,173	474,373
Electrification	1,308,000	-	1,308,000	1,308,000	-	1,308,000	-	-	-	1,308,000	-	1,308,000	-	-	-
Medical Facilities	231,000	231,000	-	154,000	154,000	-	-	-	-	154,000	154,000	-	77,000	77,000	-
Telecommunication	285,000	-	285,000	162,000	-	162,000	-	-	-	162,000	-	162,000	123,000	-	123,000
Education Facilities	192,000	-	192,000	100,000	-	100,000	-	-	-	100,000	-	100,000	92,000	-	92,000
Extension & Adm. Center	169,000	-		169,000	-	169,000	169,000	-	169,000	-	-	-		-	
Sub-Center	462,000	-	462,000	185,000	-	185,000	185,000	-	185,000	185,000	-	185,000	277,000		277,000
Rural Park	385,000	-	385,000	154,000	-	154,000	-	-	-	154,000	-	154,000	231,000		231,000
Garbage Treatment & Sewage	2,115,000	1,154,000	961,000	192,000	-	192,000	-	-	-	192,000	-	192,000	1,923,000	1,154,000	769,000
Processing Facilities	962,000	811,700	150,300	423,000	380,700	42,300	231,000	207,900	23,100	192,000	172,800	19,200	539,000	431,000	108,000
Collecting & Shipping Facilities	862,000	320,000	542,000	462,000	-	462,000	-	-	-	462,000	-	462,000	400,000	320,000	80,000
Demonstration Farm	23,000	16,100	6,900	23,000	16,100	6,900	23,000	16,100	6,900	-	-	-	-	-	-
O/M Machinery	577,000	577,000	-	577,000	577,000	-	500,000	500,000	-	77,000	77,000	-	-	-	-
Sub-Total	29,599,000	14,072,286	15,526,714	13,775,550	5,706,069	8,069,481	9,766,900	5,012,539	4,754,361	4,008,650	693,530	3,315,120	15,823,450	8,366,217	7,457,233
Engineering Fee	2,241,000	2,241,000	-	1,080,000	1,080,000	-	1,080,000	1,080,000	-	-	-	-	1,161,000	1,161,000	-
Total	31,840,000	16,313,286	15,526,714	14,855,550	6,786,069	8,069,481	10,846,900	6,092,539	4,754,361	4,008,650	693,530	3,315,120	16,984,450	9,527,217	7,457,233

Note: The cost for the terminal facilities listed below are included in the amount of the 1st stage.

(Unit: 1,000 G)

	Amount	F/C	L/C
Irrigation	924,000	572,000	352,000
Water Supply	77,000	77,000	-
Total	1,001,000	649,000	352,000

G-4

Table 1.1.(2)   Summary of Proyect Cost

(Unit:1,000)

Item	F/C	L/C	Total
(1) Road Networks			
Base Cost	12,92,246	3,015,501	4,307,747
Contingency	129,223	301,550	430,773
Total	1,421,469	3,317,051	4,738,520
(2) Irrigation system			
Base Cost	2,465,878	1,203,353	3,669,231
Contingency	246,558	120,335	366,923
Total	2,712,466	1,323,688	4,036,154
(3) Drainage			
Base Cost	--	94,021	94,021
Contingency	-	9,401	9,401
Total	-	103,422	103,422
(4) Rural Water Suplly			
Base Cost	333,940	494,655	828,595
Contingency	33,394	49,465	82,859
Sub-Total	367,334	544,120	911,454
Turn Out	77,000	--	77,000
Total	444,334	544,120	988,454
(5) Electrification			
Base Cost	--	1,189,090	1,189,090
Contingency	-	118,910	118,910
Total	-	1,308,000	1,308,000
(6) Medical Facilities			
Base Cost	140,000	--	140,000
Contingency	14,000	--	14,000
Total	154,000	-	154,000
(7) Telecomunication			
Base Cost	--	147,270	147,270
Contingency	--	14,730	14,730
Total	-	162,000	162,000
(8) Education Facilities			
Base Cost	-	91,000	91,000
Contingency	--,	9,000	9,000
Total	-	100,000	100,000
(9) Extention & Administration Center			
Base Cost	-	153,600	153,600
Contingency	-	15,400	15,400
Total	--	169,000	169,000
(10)Sub - Center			
Base Cost	-	168,180	168,180
Contingency	-	16,820	16,820
Total	-	185,000	185,000
(11)Rural Park			
Base Cost	--	140,000	140,000
Contingency	-	14,000	14,000
Total	--	154,000	154,000
(12)Garbage Treatments & Sewarage			
Base Cost	-	174,600	174,600
Contingency	-	17,400	17,400
Total	-	192,000	192,000
(13)Processing Facilities			
Base Cost	346,100	38,450	384,550
Contingency	34,600	3,850	38,450
Total	380,700	42,300	423,000
(14)Collecting & Shipping Facilities			
Base Cost	-	420,000	420,000
Contingency	-	42,000	42,000
Total	-	462,000	462,000
(15)Demostration Farm			
Base Cost	14,630	6,270	20,900
Contingency	1,470	630	2,100
Total	16,100	6,900	23,000
(16)O/M Machinery			
Base Cost	524,500	--	524,500
Contingency	52,500	--	52,500
Total	577,000	--	577,000
Grand Total	5,706,069	8,069,481	13,775,550

Table G.1.2 (1) Breakdown of the Construction Cost
for Road Improvement (F/S stage)

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Total
1. Road							
- TYPE 1 (Asphalt)	m	5,500	89,103	38,186	490,066,500	210,023,000	700,089,500
- TYPE II (Gravel)	m	6,300	40,803	17,486	257,058,900	110,161,800	357,220,700
- TYPE III (Gravel)	m	41,800	21,525	9,224	899,745,000	385,563,200	1,285,308,200
- TYPE IV (Gravel)	m	10,700	19,699	8,442	210,779,300	90,329,400	301,108,700
Sub-total					1,857,649,700	796,077,400	2,653,727,100
2. Bridge	L.S				330,469,000	141,607,000	472,076,000
Total					2,188,118,700	937,684,400	3,125,803,100
3. Temporary works					109,405,935	46,884,220	156,290,155
4. Miscellaneous					114,876,231	49,228,431	164,104,662
Total					2,412,400,866	1,033,797,051	3,446,197,917
Contractor's overhead					603,100,216	258,449,262	861,549,478
Grand Total					3,015,501,082	1,292,246,313	4,307,747,395

Table G.1.2 (2) Breakdown of the Construction Cost for Bridge

Description		Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Total
1. Bridge								
Road 818	RC L=16 m	place	2	30,876,000	13,232,000	61,752,000	26,464,000	88,216,000
- ditto -	RC L=10 m	place	2	20,750,000	8,892,000	41,500,000	17,784,000	59,284,000
- ditto -	RC L= 6 m	place	3	16,232,000	6,956,000	16,232,000	6,956,000	23,188,000
- ditto -	RC L= 6 m	place	1	13,671,000	5,859,000	13,671,000	5,859,000	19,530,000
Road 818-01	RC L=10 m	place	1	13,671,000	5,859,000	13,671,000	5,859,000	19,530,000
Road 818-01-2	RC L= 8 m	place	1	13,734,000	5,886,000	13,734,000	5,886,000	19,620,000
Road 251-07~1	RC L=20 m	place	1	32,820,000	14,065,000	32,820,000	14,065,000	46,885,000
Road 816-04	RC L= 8 m	place	1	11,136,000	4,772,000	11,136,000	4,772,000	15,908,000
Sub-total						204,516,000	87,645,000	292,161,000
2. Culvert								
φ 500 x 1		place	2	1,377,000	589,000	2,754,000	1,178,000	3,932,000
φ 500 x 2		place	2	2,753,000	1,179,000	5,506,000	2,358,000	7,864,000
φ 600 x 1		place	3	1,638,000	702,000	4,914,000	2,106,000	7,020,000
φ 600 x 2		place	1	3,276,000	1,404,000	3,276,000	1,404,000	4,680,000
φ 700 x 1		place	1	2,161,000	926,000	2,161,000	926,000	3,087,000
φ 800 x 3		place	1	7,239,000	3,102,000	7,239,000	3,102,000	10,341,000
φ 900 x 1		place	1	2,738,000	1,173,000	2,738,000	1,173,000	3,911,000
φ1000 x 1		place	4	3,071,000	1,315,000	12,284,000	5,260,000	17,544,000
φ1000 x 2		place	2	6,141,000	2,631,000	12,282,000	5,262,000	17,544,000
φ1200 x 2		place	2	6,067,000	2,599,000	12,134,000	5,198,000	17,332,000
φ1200 x 3		place	2	9,100,000	3,899,000	18,200,000	7,798,000	25,998,000
φ1200 x 4		place	2	12,133,000	5,199,000	24,266,000	10,398,000	34,664,000
φ1200 x 6		place	1	18,199,000	7,799,000	18,199,000	7,799,000	25,998,000
Sub-total						125,953,000	53,962,000	179,915,000
Toal						330,469,000	141,507,000	472,076,000

Note:

Material and mechanical cost
accounted in direct cost is
shown as below:

Road 60 %
Bridge 70 %

Table G.1.3 (1) Breakdown of the Construction Cost
for Irrigation Facilities

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Total
1. Pipe line	L.S	1			355,642,680	1,076,853,987	1,432,496,667
2. Regulated pond	L.S	1			59,187,428	116,915,000	176,102,428
3. Diversion weir	L.S	1			156,594,237	41,526,000	198,120,237
4. Pump facility	L.S	1			72,711,600	250,179,600	322,891,200
Sub-total					644,135,945	1,485,474,587	2,129,610,532
Temporary work	L.S	1			32,206,797		32,206,797
Miscellaneous	L.S	1			30,339,687	71,228,389	101,568,076
Total					706,682,429	1,556,702,985	2,263,385,414
Contractor's overhead					176,670,607	389,175,746	565,846,353
Total					883,353,036	1,945,878,731	2,829,231,767
Field irrigation equipment	L.S	1			320,000,000	520,000,000	840,000,000
Grand-total					1,203,353,036	2,465,878,731	3,669,231,767

Table G.1.3 (2) Breakdown of the Construction Cost
for Irrigation Facilities

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Total
1. Pipe line							
φ200 DIC	m	2,300	9,920	48,431	22,816,000	111,391,300	134,207,300
φ250 PVC	m	7,200	9,671	32,497	69,631,200	233,978,400	303,609,600
φ200 PVC	m	12,500	8,417	21,616	105,212,500	270,200,000	375,412,500
φ150 PVC	m	7,600	7,737	15,203	58,801,200	115,542,800	174,344,000
φ125 PVC	m	4,800	7,093	8,466	34,046,400	40,636,800	74,683,200
φ100 PVC	m	3,400	7,022	7,728	23,874,800	26,275,200	50,150,000
φ100 VT	m	2,200	7,022	10,819	15,448,400	23,801,800	39,250,200
- Attachment of pipe	L.S				17,412,180	64,964,562	82,376,742
- Hydland valve	No.	110			8,400,000	190,063,125	198,463,125
Sub-total					355,642,680	1,076,853,987	1,432,496,667
2. Regulated pond							
- Common excavation	m3	5,270	1,066		5,617,820		5,617,820
- Trench excavation	m3	2,600	2,335		6,071,000		6,071,000
- Rock excavation	m3	2,680	3,906		10,468,080		10,468,080
- Fill & backfill	m3	1,190	3,675		4,373,250		4,373,250
- Plastic of excavation	m²	4,500	605		2,722,500		2,722,500
- Water proof sheet	m²	4,500		20,000		90,000,000	90,000,000
- Installation of sheet	m²	4,500	1,530		6,885,000	26,915,000	33,800,000
- Plain concrete	m3	92	106,652		9,811,384		9,811,984
- Reinforced concrete	m3	6	186,149		1,116,894		1,116,894
- Drainage canal	m	100	16,209		1,620,900		1,520,900
- Fence	m	700	15,000		10,500,000		10,500,000
Sub-total					59,187,428	116,915,000	176,102,428
Total					414,839,108	1,193,768,987	1,608,599,095

Unit: G

Table G.1.3 (3) Breakdown of the Construction Cost
for Irrigation Facilities

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Amount Total
3. Diversion weir							
- Common excavation	m3	694	1,056		739,804		739,804
- Rock excavation	m3	394	6,133		2,416,402		2,416,402
- Fill & backfill	m3	584	2,614		1,526,576		1,526,576
- Reinforced concrete	m3	163	186,149		30,342,287		30,342,287
- Plain concrete	m3	220	106,652		23,463,440		23,463,440
- Wet mansonry	m²	140	43,620		6,106,800		6,106,800
- Stone pitching	m²	128	15,776		2,019,328		2,019,328
- Sluice gate	m²	6.75		6,152,000		41,526,000	41,526,000
- Temporary road	L.S.				89,979,600		89,979,600
Sub-total					156,594,237	41,526,000	198,120,237
4. Pump facility							
- Pump equipment	piece					114,117,000	114,117,000
- Electric equipment	L.S.					70,132,000	70,132,000
- Power distribution	L.S.				49,608,400	12,100,600	61,709,000
- Cable	L.S.				9,328,800		9,328,800
- Installation					1,940,400	23,070,000	25,010,400
- Transportation					300,000	30,760,000	31,060,000
- Pump house	L				11,534,000		11,534,000
Sub-total					72,711,600	250,179,600	322,891,200
Total					229,305,837	291,705,600	521,011,437

Table G.1.3 (4) Breakdown of the Construction Cost
for Attachment Equipment

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Total
1. Sluice valve φ250	place	6		1,209,560		7,257,360	7,257,360
φ200		11		786,610		8,652,710	8,652,710
φ150		4		520,228		2,080,912	2,080,912
φ125		3		377,579		1,132,737	1,132,737
φ100		3		284,914		854,742	854,742
Installation		27	25,000		675,000		675,000
Concrete		27	9,800		264,600		264,600
Concrete pipe φ600		27	75,000		2,025,000		2,025,000
Sub-total					2,964,500	19,978,461	22,943,061
2. Air valve φ75	place	26		818,985		21,293,610	21,293,610
φ50		20		622,505		12,450,100	12,450,100
φ25		9		331,823		2,986,407	2,986,407
Installation		55	25,000		1,375,000		
Concrete		55	9,800		539,000		
Concrete pipe φ600		55	75,000		4,125,000		
Sub-total					6,039,000	36,730,117	42,769,117
3. Blow off							
Check valve φ50	place	16		154,569		2,473,104	2,473,104
Miscellaneous		16		361,430		5,782,880	5,782,880
Installation		16	25,000		400,000		400,000
Concrete		16	65,000		1,040,000		1,040,000
Drainage canal	m	430	16,206		6,968,580		6,968,580
Sub-total					8,408,580	8,255,984	16,664,564
Total					17,412,180	64,964,562	82,376,742

Table G.1.3 (5) Breakdown of the Construction Cost
for Hydrant Valve

Unit: G

Description	Unit	Quantity	Unit Rate L/C	F/C	Amount L/C	F/C	Total
Sluice valve φ 75	piece	105		190,712		20,024,760	20,024,760
Flow meter φ 75		105		1,138,889		119,583,345	119,583,345
Hydrant valve φ 100		105		169,795		17,828,475	17,828,475
Joint pipe		105		161,490		16,956,450	16,956,450
Miscellenous		105		149,239		15,670,095	15,670,095
Installation		105	35,000		3,675,000		3,675,000
Concrete pipe		105	45,000		4,725,000		4,725,000
Total			80,000	1,810,125	8,400,000	190,063,125	198,463,125

Table G.1.3 (6) Breakdown of the Construction Cost
for Field Irrigation Equipment

Unit: G

Description	Unit	Quantity	Unit Rate L/C	F/C	Amount L/C	F/C	Total
1. Field equipment	ha	400	580	990	232,000,000	396,000,000	628,000,000
2. Temporary work	L.S.				11,600,000		11,600,000
3. Miscellaneous	L.S.				12,180,000	20,050,000	32,230,000
Sub-total					255,780,000	416,050,000	671,830,000
4. Contractor's overhead					64,220,000	103,950,000	168,170,000
Total					320,000,000	520,000,000	840,000,000

Table G.1.4 Breakdown of the Construction Cost
for Drainage Facilities

Unit: G

Description	Unit	Quantity	Unit Rate L/C	F/C	Amount L/C	F/C	Total
F/S Stage							
1. Drainage canal	m	4,000	17,056		68,224,000		68,224,000
2. Temporary work	L.S.				3,411,200		3,411,200
3. Miscellaneous	L.S.				3,581,760		3,581,760
Sub-total					75,216,960		75,216,960
4. Contractor's overhead					18,804,240		18,804,240
Total					94,021,200		94,021,200

Table G.1.5 (1) Breakdown of the Construction Cost
for Rural Water Supply

Unit: G

Description	Unit	Quantity	Unit Rate		Amount		
			L/C	F/C	L/C	F/C	Total
1. Ao. Rory							
(1) Gravity water supply							
– Purification plant	L.S				93,903,497	2,307,000	96,210,497
– Diversion pond (Main, Yahapety, Fatima I)	L.S				15,871,888		15,871,888
– Pipe line (φ250 – φ50)	L.S				139,914,500	204,120,404	344,034,904
Sub-total					249,689,885	206,427,404	456,117,289
2. Ao. Rory-mi							
(1) Gravity water supply							
– Purification plant	L.S				10,935,358	2,307,000	13,242,358
– Diversion pond	L.S				3,967,666		3,967,666
– Pipe line	L.S				94,340,500	45,696,694	140,037,194
Sub-total					109,243,524	48,003,694	157,247,218
Total					358,933,409	254,431,098	613,364,507
Temporary work	L.S				17,946,670	0	17,946,670
Miscellaneous	L.S				18,844,004	12,721,555	31,565,559
Total					395,724,083	267,152,653	662,876,736
Contractor's overhead	L.S				98,931,021	66,788,163	165,719,184
Grand-Total					494,655,104	333,940,816	828,595,920

Table G.1.5 (2) Breakdown of the Construction for
Rural Water Supply : Ao. Rory Gravity

Unit: G

Description	Unit	Quantity	Unit Rate		Amount		
			L/C	F/C	L/C	F/C	Total
1. Purification plant							
- Common excavation	m3	1,395	2,335	0	3,257,325	0	3,257,325
- Rock excavation	m3	800	3,906	0	3,124,800	0	3,124,800
- Fill & backfill	m3	810	3,676	0	2,977,560	0	2,977,560
- Reinforced concrete	m3	467	181,036	0	84,543,812	0	84,543,812
- Equipment	L.S.	1			0	2,307,000	2,307,000
Sub-total					93,903,497	2,307,000	96,210,497
2. Distribution pond							
- Common excavation	m3	328	2,335	0	765,880	0	765,880
- Rock excavation	m3	100	3,906	0	390,600	0	390,600
- Fill & backfill	m3	211	3,676	0	775,636	0	775,636
- Reinforced concrete	m3	77	181,036	0	13,939,772	0	13,939,772
Sub-total					15,871,888	0	15,871,888
3. Pipe line							
- Pipe							
φ200 PVC	m	1,400	886	21,616	1,240,400	30,262,400	31,502,800
φ150 PVC	m	1,300	744	15,203	967,200	19,763,900	20,731,100
φ125 PVC	m	3,600	638	8,466	2,296,800	30,477,600	32,774,400
φ100 PVC	m	9,600	567	7,728	5,443,200	74,188,800	79,632,000
φ 75 PVC	m	17,600	3,889	0	68,446,400	0	68,446,400
φ 50 PVC	m	13,200	2,640	0	34,848,000	0	34,848,000
- Attachment equipment	L.S	1			26,672,500	49,427,704	76,100,204
Sub-total					139,914,500	204,120,404	344,034,904
4. Total					249,689,885	206,427,404	456,117,289

Table G.1.5. (3) Breakdown of the Construction Cost for
Rural Water Supply : Ao. Rory-mi - Gravity

Unit: G

Description	Unit	Quantity	Unit Rate		Amount		
			L/C	F/C	L/C	F/C	Total
1. Purification plant							
- Common excavation	m3	222	2,335	0	518,370	0	518,370
- Rock excavation	m3	110	3,906	0	429,660	0	429,660
- Fill & backfill	m3	156	3,676	0	573,456	0	573,456
- Reinforced concrete	m3	52	181,036	0	9,413,872	0	9,413,872
- Equipment	L.S	1	0	0		2,307,000	2,307,000
Sub-total					10,935,358	2,307,000	13,242,358
2. Distribution pond							
- Common excavation	m3	98	2,335	0	228,830	0	228,830
- Rock excavation	m3	42	3,906	0	164,052	0	164,052
- Fill & backfill	m3	86	3,676	0	316,136	0	316,136
- Reinforced concrete	m3	18	181,036	0	3,258,648	0	3,258,648
Sub-total					3,967,666	0	3,967,666
2. Pipe line							
- Pipe							
φ125 PVC	m	100	7,093	8,466	709,300	846,600	1,555,900
φ100 PVC	m	4,150	7,022	7,728	29,141,300	32,071,200	61,212,500
φ 75 PVC	m	5,000	10,344	0	51,720,000	0	51,720,000
φ 50 PVC	m	700	8,557	0	5,989,900	0	5,989,900
- Attachment equipment	L.S	1	0	0	6,780,000	12,778,894	19,558,894
Sub-total					94,340,500	45,696,694	140,037,194
4. Total					109,243,524	48,003,694	157,247,218

Table G.1.6 Breakdown of the Construction Cost of
Rural Facility

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Total
1. Electrification	km						1,189,090,000
2. Medical facilities	L.S.					140,000,000	140,000,000
3. Telecommunication	L.S.				147,270,000		147,270,000
4. Education facilities	place	800	191,250		91,000,000		91,000,000
5. Extension and Administration Center (A=800 m²)					153,000,000		153,000,000
6. Sub-center (A=800 m²)	place	800	210,225		168,180,000		
7. Rural park (A=2,000 m²)	place	4	35,000,000		140,000,000		
8. Garbage treatment (A=2,000 m²)	L.S.				174,600,000		
9. Processing facilities	L.S.				38,450,000	346,100,000	384,550,000
10. Collection & shipping facilities (A=640 m²)	L.S.				420,000,000		420,000,000
11. O/M machinery, bulldozer, grader, roller	L.S.					524,500,000	524,500,000
* including contractor's overhead							
Total					1,332,500,000	1,010,600,000	3,049,410,000

Table G.1. 7   Breakdown of the Unit Price

Unit: G

Description	Unit	Quantity	Unit Rate	Total
TYPE I				
- Common excavation machine	m3	4.2	1,066	4,477
- Common excavation labor	m3	1.8	3,927	7,068
- Stone material	m3	0.9	10,000	9,000
- Gravel material	m3	0.8	20,000	16,000
- Grading and compaction	m²	6.0	1,624	9,744
- Asphalt pavement t = 4 mm	m²	6.0	13,500	81,000
Total				127,289
TYPE II				
- Common excavation machine	m3	4.2	1,066	4,477
- Common excavation labor	m3	1.8	3,927	7,068
- Stone material	m3	1.5	10,000	15,000
- Gravel material	m3	1.1	20,000	22,000
- Grading and compaction	m²	6.0	1,624	9,744
Total				58,289
TYPE III				
- Common excavation machine	m3	4.5	1,066	4,797
- Common excavation labor	m3	1.8	3,927	7,068
- Stone material	m3	0.9	10,000	9,000
- Gravel material	m3	0.7	6,000	4,200
- Grading and compaction	m²	3.5	1,624	5,684
Total				30,749
TYPE IV				
- Common excavation machine	m3	5.0	1,066	5,330
- Common excavation labor	m3	1.0	3,927	3,927
- Stone material	m3	0.9	10,000	9,000
- Gravel material	m3	0.7	6,000	4,200
- Grading and compaction	m²	3.5	1,624	5,684
Total				28,141

Table G.1.7 (2) Breakdown of the Unit Price

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Total
φ250 PVC							
Trench excavation	m3	1.6	2,344		3,750		3,750
Fill & backfill	m3	1.6	3,036		4,857		4,857
Pipe material	m	1.0		32,497		32,497	32,497
Installation of pipe (labor)	m	1.0	1,064		1,064		1,064
Total					9,671	32,497	42,168
φ200 PVC							
Trench excavation	m3	1.4	2,344		3,281		3,281
Fill & backfill	m3	1.4	3,036		4,250		4,250
Pipe material	m	1.0		21,616		21,616	21,616
Installation of pipe (labor)	m	1.0	885		886		886
Total					8,417	21,616	30,033
φ150 PVC							
Trench excavation	m3	1.3	2,344		3,047		3,047
Fill & backfill	m3	1.3	3,036		3,946		3,946
Pipe material	m	1.0		15,203		15,203	15,203
Installation of pipe (labor)	m	1.0	744		744		744
Total					7,737	15,203	22,940
φ125 PVC							
Trench excavation	m3	1.2	2,344		2,812		2,812
Fill & backfill	m3	1.2	3,036		3,643		3,643
Pipe material	m	1.0		8,466		8,466	8,466
Installation of pipe (labor)	m	1.0	638		638		638
Total					7,093	8,466	15,559
φ100 PVC							
Trench excavation	m3	1.2	2,344		2,812		2,812
Fill & backfill	m3	1.2	3,036		3,643		3,643
Pipe material	m	1.0		7,728		7,728	7,728
Installation of pipe (labor)	m	1.0	567		567		567
Total					7,022	7,728	14,750

Table G.1.7 (3) Breakdown of the Unit Price

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Amount Total
φ 75 PVC							
Trench excavation	m3	1.2	2,344		2,812		2,812
Fill & backfill	m3	1.2	3,036		3,643		3,643
Pipe material	m	1.0	3,428		3,428		3,428
Installation of pipe (labor)	m	1.0	461		461		461
Total					10,344		10,344
φ 50 PVC							
Trench excavation	m3	1.1	2,344		2,578		2,578
Fill & backfill	m3	1.1	3,036		3,339		3,339
Pipe material	m	1.0	2,250		2,250		2,250
Installation of pipe (labor)	m	1.0	390		390		390
Total					8,557		8,557
φ 250 Dictil							
Trench excavation	m3	1.6	2,344		3,750		3,750
Fill & backfill	m3	1.6	3,036		4,857		4,857
Pipe material	m	1.0		60,258		60,258	60,258
Installation of pipe (labor)	m	1.0	2,669		2,669		2,669
Total					11,276	60,258	71,534
φ 200 Dictil							
Trench excavation	m3	1.4	2,344		3,281		3,281
Fill & backfill	m3	1.4	3,036		4,250		4,250
Pipe material	m	1.0		48,431		48,431	48,431
Installation of pipe (labor)	m	1.0	2,389		2,389		2,389
Total					9,920	48,431	58,351
φ 100 VT							
Trench excavation	m3	1.2	2,344		2,812		2,812
Fill & backfill	m3	1.2	3,036		3,643		3,643
Pipe material	m	1.0		10,819		10,819	10,819
Installation of pipe (labor)	m	1.0	567		567		567
Total					7,022	10,819	17,841

Table G.1.7 (4)
Breakdown of the Unit Price

Unit: G

Description	Total cost of depreciation/hr (G)	Working quantity/hr	Unit cost /m3
1. Common excavation by Bulldozer (10 ton)	160,000	150	1,066
Total			1,066
2. Trench excavation			
Back-hoe (10 ton)	94,250	60	1,570
Truck	23,963	30	765
Total			2,335
3. Rock excavation			
Back-hoe (0.7 m3)	94,250	30	3,141
Truck (10 ton)	23,963	30	765
Total			3,906
4. Backfill			
Bulldozer (10 ton)	160,000	70	2,285
Roller	44,512	32	1,391
Total			3,676
5. Excavation labor	11,220/day	0.35 (m3/person)	3,927
Back-hoe (0.35 m3)	50,000/hr	30 (m3/hr)	1,666
1 m3/unit			
Labor	3,927/m3	0.3 (m3)	1,178
Back-hoe	1,666/m3	0.7 (m3)	1,166
Total			2,344
6. Backfill labor (m3/unit)	11,220/day	0.181 (m3/person)	2,030
Back-hoe (0.35 m3)	160,000/hr	150 (m3/hr)	1,066
1 m3/unit			
Labor	2,030/m3	1.0	2,030
Back-hoe	1,066/m3	1.0	1,066
Total			3,096

Table G.1.7 (5) Breakdown of the Unit Price

Unit: G

Description	Unit	Quantity	Unit Rate L/C	Unit Rate F/C	Amount L/C	Amount F/C	Amount Total
1. Reinforced concrete (I)							
- Concrete							
Material	m3	1	53,475		53,475		53,475
Mixing and placing	m3	1	25,674		25,674		25,674
Sub-total					79,149		79,149
- Other							
Reinforcement	kg	70	1,100		77,000		77,000
Form	L.S.				30,000		30,000
Sub-total					107,000		107,000
Total					186,149		186,149
2. Reinforced concrete (II)							
- Concrete							
Material	m3	1	49,362		49,362		49,362
Mixing and placing	m3	1	25,674		25,674		25,674
Sub-total					75,036		75,036
- Other							
Reinforcement	kg	60	1,100		66,000		66,000
Form	L.S.				30,000		30,000
Sub-total					96,000		96,000
Total					171,036		171,036
3. Plain concrete (I)							
- Concrete							
Material	m3	1	50,978		50,978		50,978
Mixing and placing	m3	1	25,674		25,674		25,674
Sub-total					76,652		76,652
- Other							
Form	L.S.				30,000		30,000
Total					106,652		106,652
4. Plain concrete (II)							
- Concrete							
Material	m3	1	47,064		47,064		47,064
Mixing and placing	m3	1	25,674		25,674		25,674
Sub-total					72,738		72,738
- Other							
Form	L.S.				30,000		30,000
Total					102,738		102,738

Table G.1.8 Land and Right of Way

	Item	Q't (ha)	Unit Price (1,000 G)	Total (1,000 G)
1.	Head Works			
	Ao. Rory	0.1	500	50
	Ao. Rory-Mi	0.2	500	10
2.	Pumping Stations & Diversion Weirs			
	Ao. Tranquera	0.1	1,000	100
	Ao. Rory	0.1	1,000	100
3.	Regulation Ponds			
	Tranquera	0.92	1,000	920
	Rory-Mi	0.09	1,000	90
	Yajhapety	0.025	1,000	25
4.	Administration Center	0.7	40,000	28,000
	Total			29,295

Table G.1.9 Administration Cost During Costruction for the 1st Stage Project

Item	M/M	Unit Cost	Total (1,000 G)
Chief Engineer	36	2,730,000	98,280
Officer	36	1,248,000	44,928
Asistance	72	910,000	65,520
Other Cost			62,722
Total			271,500
Per annum			90,500

Table G.1.10 Administation Cost for Agricultural Extension (Increased Cost)

Item	M-Day	Unit Cost	Total (1,000 G)	Note man days
Agronomist	180	4,800	864	6 x 30
Consultant for living	60	4,800	288	1 x 60
Assistant	120	3,500	420	2 x 60
Other Costs			428	
Total			2,000	per annum

Table G.2.1 Summary of Operation and Maintenance Costs

UNIT: 1,000 G

YEAR	ROADS	IRRIGATION	DRAINAGE	VILLAGE WATER SUPPLY	PROCESSING	COLLECTING & SHIPPING	TOTAL
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	3,140	17,440	180	3,010	15,530	2,770	42,070
4	4,770	17,440	390	3,010	15,530	3,360	46,540
5	6,690	19,240	390	4,480	15,780	3,740	52,360
6	6,690	19,240	390	4,480	15,780	4,020	53,340
7	6,690	22,240	390	6,940	16,200	4,020	59,220
8	6,690	22,240	390	6,940	16,200	4,500	60,850

Note: Refer to Table G.2.2, G.2.4, G.2.7, G.2.8, G.2.9, G.2.10 and G.2.11

Table G.2.2　O & M Costs for Roads

Item	Qt. / Expenses	Remarks
Working Days	50 days per annum	
Labor Cost		
Operator	820,000 G	50days X 2men X 8,200 G/day
Fuel Cost	1,000,000 G	50days X 20,000 G
Repair Cost(Machinery)	5,770,000 G	577 million G X 0.01
		1st year: 1,920,000 G 2nd year: 3,850,000 G
Sub-total	7,590,000 G	
	1st year: 3,740,000 G 2nd year: 5,670,000 G	
Reduction of O&M Cost		
After Compleasion of the 1st stage project		(1st year):
	△　600,000 G	Refer to Table G.2.3
After Compleasion of the 2nd stage project		(2nd year):
	△　900,000 G	Refer to Table G.2.3
Total	6,690,000 G	
1st year: 2nd year:	3,140,000 G 4,770,000 G	

Table G.2.3　Reduction of O & M Costs for Roads

Item	Qt. / Expenses	Remarks
Labor Cost	1,230,000 G	15 days X 8,200 G/day
Fuel Cost	300,000 G	15 days X 20,000 G
Charge for Machinery	450,000 G	15 days X 30,000 G
Other Cost	27,000 G	
Total	900,000 G	
After Compeasion of the 1st stage project:		
	600,000 G	900,000 G X 2/3

Table G.2.4 O & M Costs for Irrigation Facilities

Item	Qt. / Expenses	Remarks
Labor Cost		
Operator	2,158,000 G	260 days X 8,300 G/day
Scrubman	1,050,000 G	300 men X 3,500 G/day
Energy Cost	14,500,000 G	Refer to Table G.2. .5
Repair Cost	6,000,000 G	4,000,000 X 0.0015
		1st year, 2nd year:1,200,000G 3rd year, 4th year:3,000,000G
Sub-total	23,800,000 G	
	1st year, 2nd year: 19,000,000 G 3rd year, 4th year: 20,800,000 G	
Reduction of O&M Costs		
	△ 1,560,000 G	Refer to Table G.2.6
Total 1st year, 2nd year: 3rd year, 4th year:	22,240,000 G 17,440,000 G 19,240,000 G	

Table G.2.5 Energy Cost of Pumping for Irrigation

Item	Tranquera Pumping Station	Remarks
Dry Year		
Amount of Discharge	1,447,300 m³	832,450 m³
Opeartion Hours	8,200 hr (2.94m³/min)	7,459 hr (1.86 m³/min)
Energy Cost	10,332,000 G (45kw, 28G/kwh)	6,265,560 G (30kw, 28G/kwh)
Total	16,597,560 G per annum (10,332,000 + 6,265,560)	
Normal Year:		
Amount of Discharge	1,122,480 m³	617,000 m³
Operation Hours	6,363 hr	5,183 hr
Energy Costs	8,017,380 G	4,353,720 G
Total	12,371,100 G per annum (8,017,380 + 4,353,720)	
Average	14,484,330 G per annum(16,597,560+12,371,100)X1/2	

Table G.2.6 Reduction of O & M Costs for Exsisting Irrigation Facilities

Item	Qt. / Expenses	Remarks
Annual Cost	1,560,000 G	1man X 60days X 2,600 G/day
		X 10 Farmers

Table G.2.7 O & M Costs for Drainage Facilities

Item	Qt. / Expenses	Remarks
Labor Cost		
After Completion of the 1st Stage Project		
	175,000 G	50 men-day X 3,500 G/day
After Completion of the 2nd Stage Project		
	385,000 G	110 men-day X 3,500 G/day
Other Cost	5,000 G	
Total 1st stage;	180,000 G	
2nd stage;	390,000 G	

Table G.2.8 O & M Costs for Rural Water Supply

Item	Qt. / Expenses	Remarks
Labor Cost		
Walk-around Ispection	74,700 G	3day X 3times X 8,300 G/day
Washing of Filter	70,000 G	10day X 2times X 3,500 G/day
Cleaning of Setting Basin and Ponds	35,000 G	5men X 2times X 3,500 G/day
Expenses for Articles of Consumtion	1,825,000 G	Chlorine 5 kg X 365 days X 1,000 G
Repair Cost	4,925,000 G	985 million G X 0.005
		1st year,2nd year; 995,000G 3rd year,4th year;2,465,000G
Other Cost	10,300 G	
Total	6,940,000 G	
1st year,2nd year; 3rd year,4th year;	3,010,000 G 4,480,000 G	

(Note) In case the water of the wells (2 wells) is used with the water from the rivers, the following energy cost shall be added to the O/M cost above mentioned.

	490,000 G	1.5kw X 16hr X 365 days X 2 stations x 28 G/kwh
Sum of O/M cost with pump; 1st year,2nd year: 3rd year,4th year:	7,430,000 G 3,500,000 G 4,970,000 G	

Table G.2.9 Operating Expenses in Administration Center

Item	Qt. / Expenses	Remarks
Labor Cost		
Chairman of the board of derectors	1,050,000 G	100 days X 10,500 G/day
Secretary general	2,730,000 G	260 days X 10,500 G/day
Engineer	2,158,000 G	260 days X 8,300 G/day
Office workers	3,744,000 G	260days X 3men X 4,800G/day
Assistants	3,640,000 G	260days X 4men X 3,500G/day
Electric charges	240,000 G	12 months x 20,000 G/month
Traveling Expenses	240,000 G	12 months x 20,000 G/month
Expenses for articles of Consuption	180,000 G	12 months x 15,000 G/month
Repair Cost	845,000 G	169million G X 0.005
		1st year, 2nd year: 175,000 G 3rd year, 4th year: 425,000 G
Other Cost	125,000 G	
Total 1st year, 2nd year: 3rd year, 4th year:	16,200,000 G 15,530,000 G 15,780,000 G	

Table G.2.10 O & M Costs for Processing Facilities (Winery)

Item	Qt. / Expenses	Remarks
Energy Cost for Cooling	2,240,000 G	100 days x 16 hr x 50 kw x 28 G/kwh
Repair Cost	1,155,000 G	231 million G x 0.005
- do - After Comletion of the 2nd stage project	(+ 960,000 G)	192 million G x 0.005 Refer to the Note 1
Other Cost	145,000 G	
Total	3,540,000 G	
After completion of the 2nd stage project	(4,500,000 G)	Refer to the Note 2

Note 1	Repair Cost	1st stage	2nd stage	Note 2. amount of O & M Cost
1st year	385,000 G	775,000 G	-	2,770,000 G
2nd year	975,000 G	755,000 G	200,000 G	3,360,000 G
3rd year	1,355,000 G	1,155,000 G	200,000 G	3,740,000 G
4th year	1,635,000 G	1,155,000 G	480,000 G	4,020,000 G
5th year	1,635,000 G	1,155,000 G	480,000 G	4,020,000 G
6th year	2,115,000 G	1,155,000 G	960,000 G	4,500,000 G

Table G.2.11 O & M Costs for Collecting and Shipping Facilities

Item	Qt. / Expenses	Remarks
Labor Cost		
Office Workers	830,000 G	100 days X 8,300 G/day
Assistants	700,000 G	2men X 100days X 3,500 G/day
Expenses for Articles of Consumption	50,000 G	
Repair Cost	2,310,000 G	462 million G X 0.005
		1st year, 2nd year: 460,000G 3rd year, 4th year:1,160,000G
Total	3,890,000 G	
1st year, 2nd year: 3rd year, 4th year:	2,040,000 G 2,740,000 G	

Table G.3.1 Summary of Anticipated Benefits

UNIT: 1,000 G

YEAR	Production Increase	Road Improvement	Water Supply	Agro. Processing	Collecting Shipping	Drainage	TOTAL
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	350,209	892,727	130,386	103,600	0	0	1,476,922
4	649,865	911,750	130,386	103,600	43,763	8,800	1,848,164
5	873,549	924,636	130,386	103,600	43,763	8,800	2,084,734
6	924,368	924,636	130,386	103,600	43,763	8,800	2,135,553
7	948,913	924,636	130,386	103,600	43,763	8,800	2,160,098
8	973,458	924,636	130,386	103,600	43,763	8,800	2,184,643

Note: Refer to Table G.3.2, G.3.6, G.3.15, G.3.16, G.3.17, G.3.18