REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF HIGHWAYS

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

KABUPATEN REPORT 35

KABUPATEN TANA TORAJA

MARCH 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

This is the Kabupaten Report of the Feasibility Study of the Local Road Development in the Republic of Indonesia for Kabupaten Tana Toraja in Sulawesi Selatan Province. The report has been prepared by the Study Team of the Japan International Cooperation Agency (hereinafter called JICA).

Based upon a request from the Government of Indonesia, the Government of Japan arranged for JICA to conduct the Study and JICA accordingly organized a Study Team. The study was carried out using data which were generally prepared by the Kabupaten, routed through the province, under the instructions of Bina Marga of the Ministry of Public Works and Bangda of the Ministry of Home Affairs.

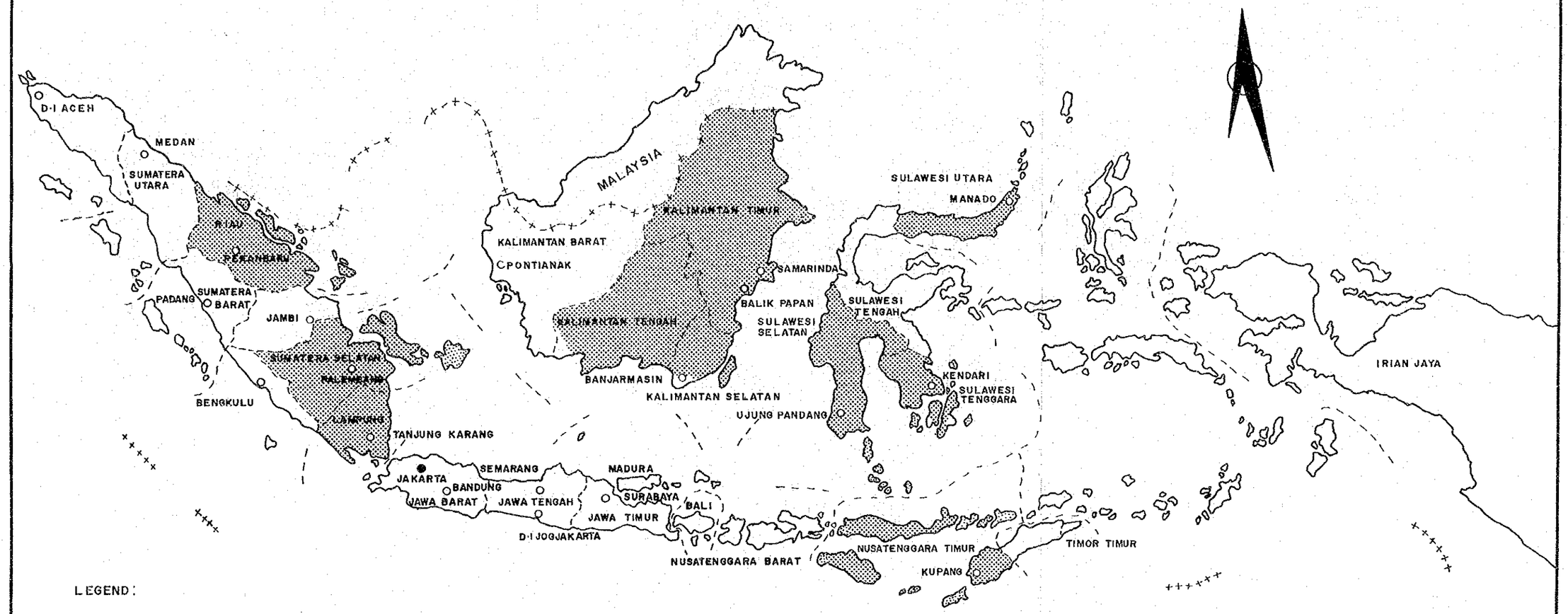
Since the study period was limited, without cooperation of Bina Marga, Bangda and local governments of both province and Kabupaten in collecting the data, the study would not have been completed within the period.

The report consists of the results of the feasibility study and proposed implementation programme of the local road development in the Kabupaten.

The simplified economic feasibility evaluation methodology utilized for the study was established by the Study Team in Phase I Study through a pilot study of seven (7) model Kabupatens, and is described in the Main Report.

The purpose of the study for the Kabupaten is mainly to estimate the total Project Cost for the local road development but only limited data is available for study base. Therefore a detailed survey and design for the improvement of the Kabupaten roads should be carried out before commencing the Project together with a review of this report.

LOCATION MAP OF THE PROJECT AREAS



VIII · PROPINSI SULAWESI UTARA
29 · KAB · MINAHASA

IX · PROPINSI SULAWESI SELATAN
30 · KAB · GOWA
31 · KAB · PANGKAJENE KEPULAUAN
32 · KAB · BARRU
33 · KAB · SOPENG
34 · KAB · WAJO
35 · KAB · TANA TORAJA
36 · KAB · MAMUJU

X · PROPINSI SULAWESI TENGGARA
37 · KAB · MUNA
38 · KAB · KOLAKA

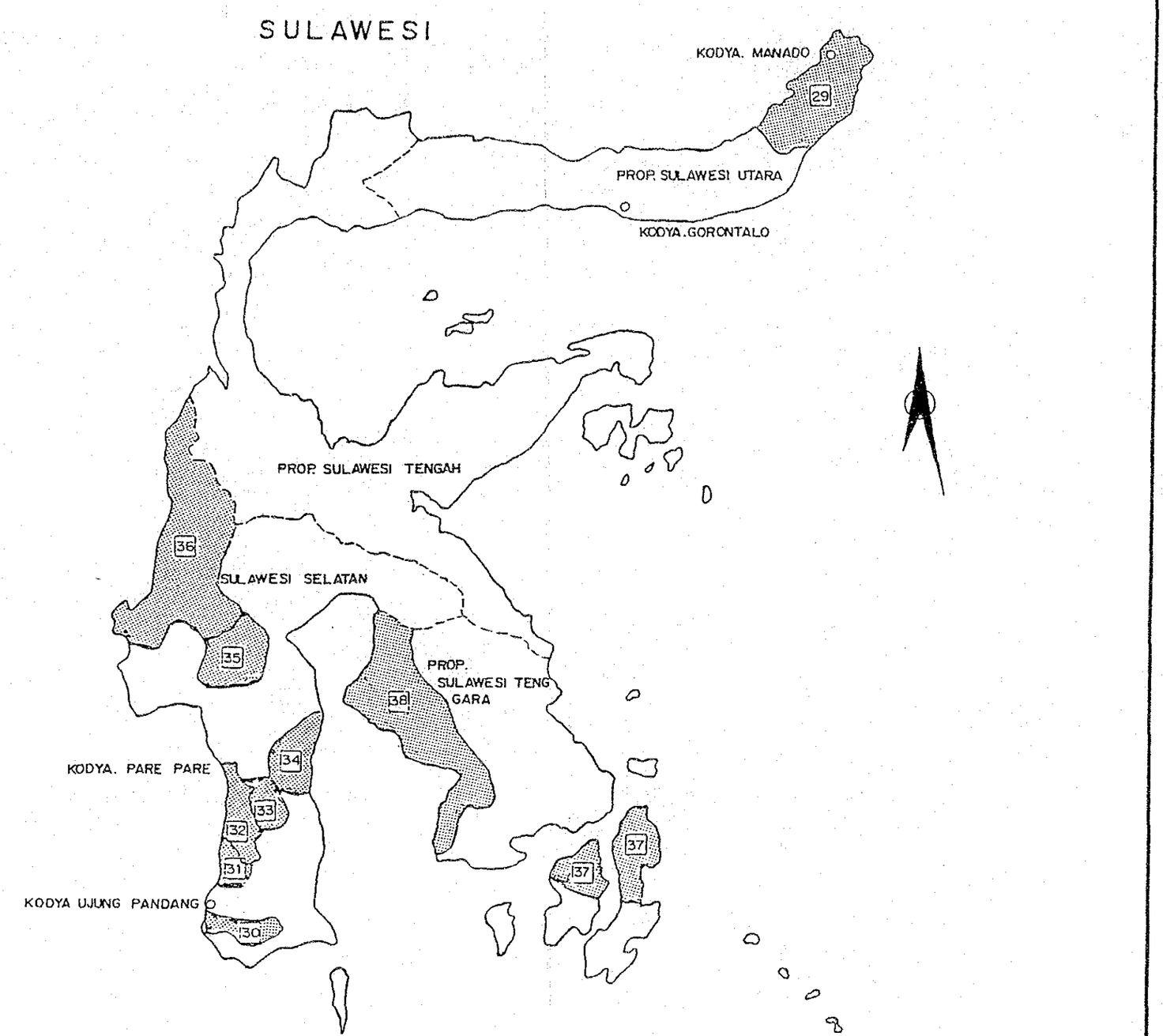
LEGEND :

---- PROVINCIAL BOUDER

LOCATION OF THE PROPOSED AREA

SCALE :

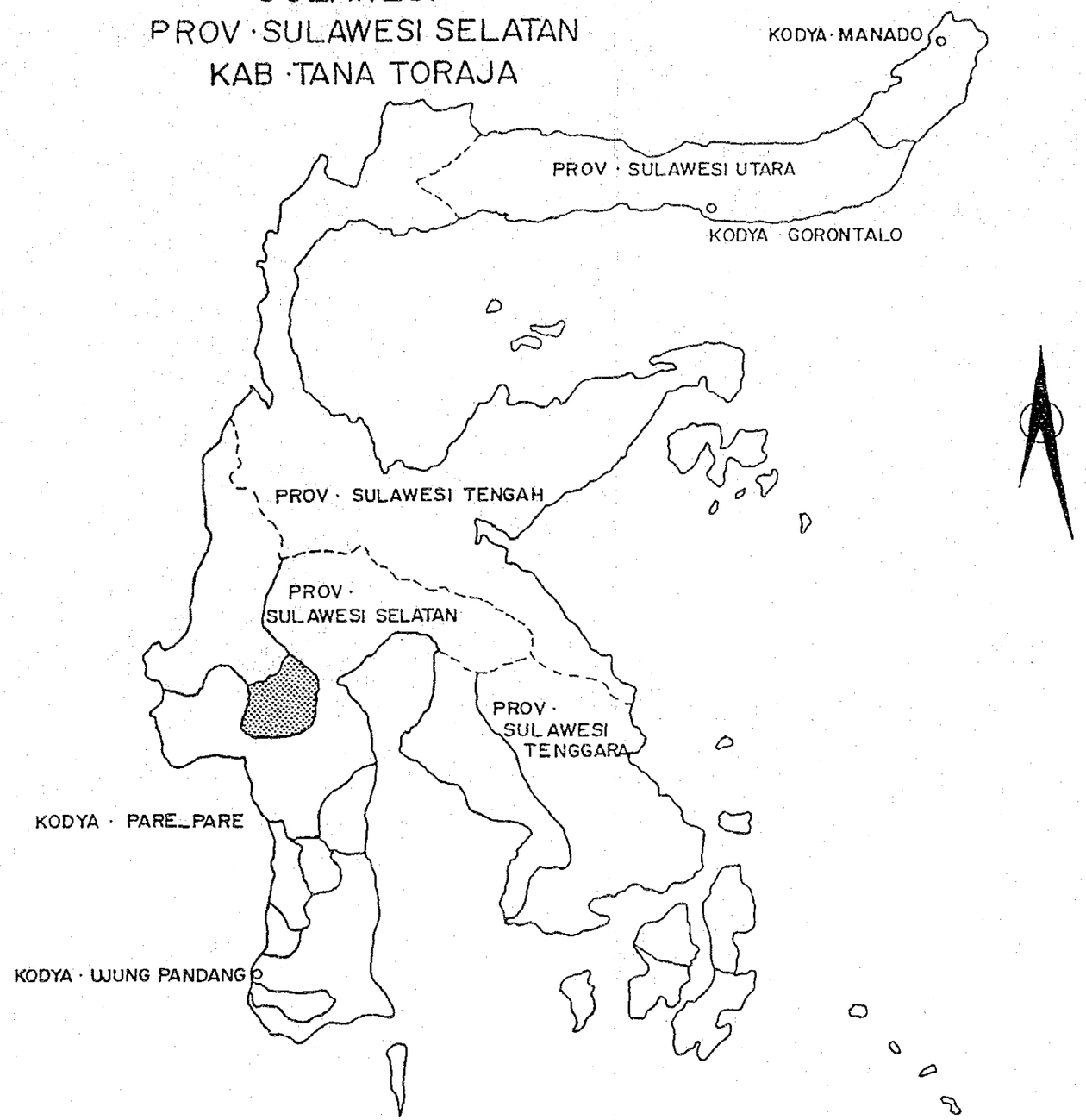
0 92 184 276 460 Km



SULAWESI

PROV · SULAWESI SELATAN

KAB · TANA TORAJA



LEGEND :

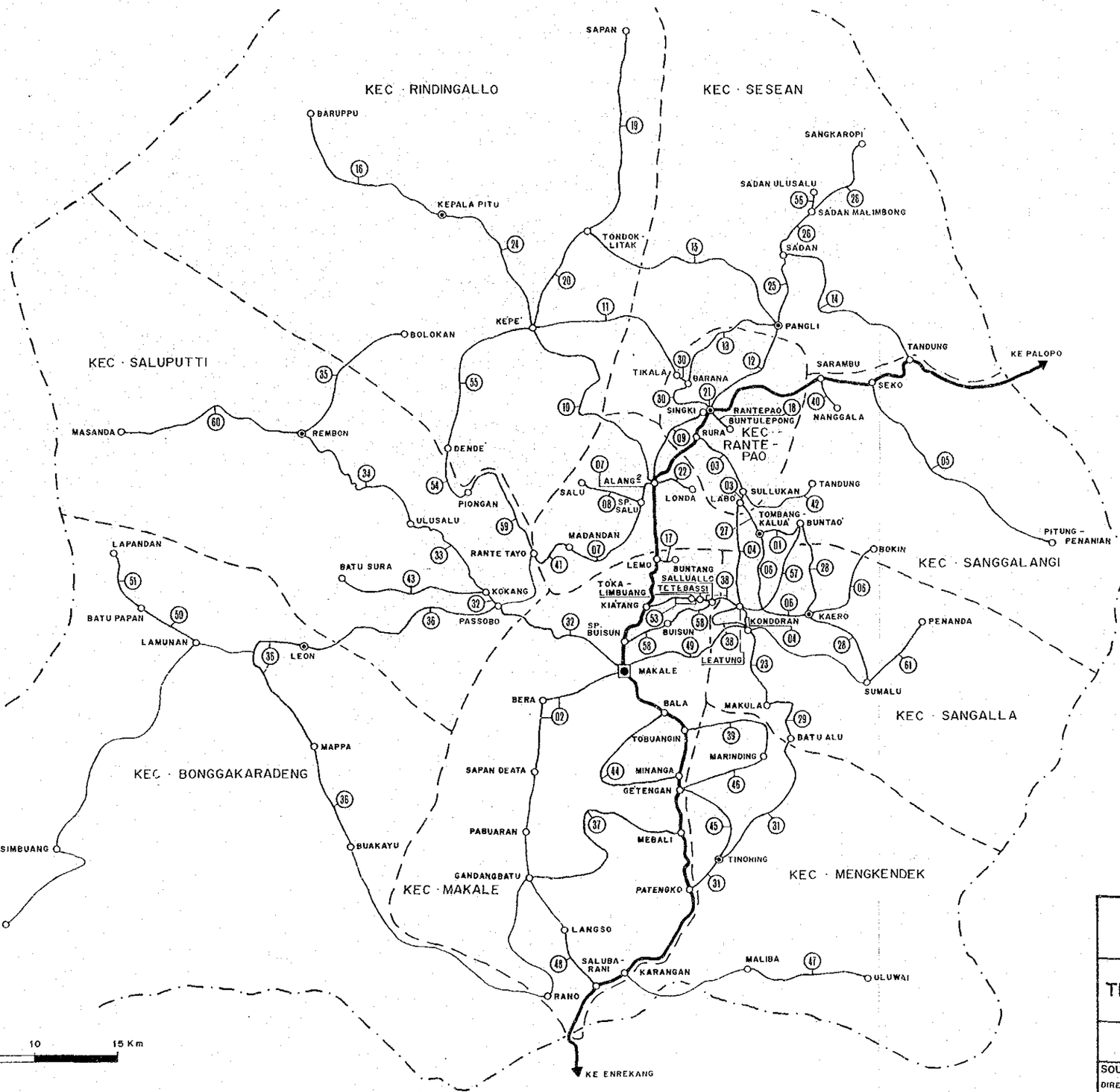
----- PROVINCIAL BOUNDARY

LOCATION OF THE PROJECT AREA

SCALE :

0 92 184 276 460 Km

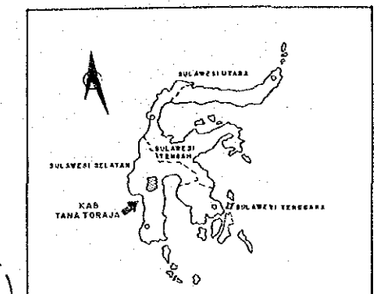
KAB · TANA TORAJA



SCALE :

0 5 10 15 Km

LOCATION MAP



LEGEND :

- KABUPATEN CAPITAL
- KECAMATAN CAPITAL
- OTHER CITY
- (3) LINK NUMBER
- PROVINCIAL BOUNDARY
- KABUPATEN BOUNDARY
- KECAMATAN BOUNDARY
- NATIONAL ROAD
- PROVINCE ROAD
- KABUPATEN ROAD
- VILLAGE ROAD
- RIVER

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

TITLE :

SOURCE :	SCALE :	PROVINCE : SULAWESI SELATAN
DIREKTORAT JENDERAL CIPTA KARYA	AS SHOWN	KABUPATEN : TANA TORAJA

C O N T E N T S

Chapter 1 BACKGROUND OF THE KABUPATEN

1.1 Topographic and Meteorological Conditions

1.1.1 Location and Topography

Kabupaten Tana Toraja is an inland Kabupaten in the middle north of Sulawesi Selatan Province. It is bordered on the north by Kabupaten Mamuju, on the east by Kabupaten Luwu, on the west by Kabupaten Polewali Mamasa, and on the south by Kabupatens Pinrang and Enrekang.

Geographically the Kabupaten is entirely composed of high undulating mountainous districts, and in particular the northwest is surrounded by the Quarles mountains which are not less than 2,500 meter high. The south and east are also surround by 3000 meter or more high mountain ranges standing on the boundary with Kabupatens Enrekang and Luwu. However, the middle of the Kabupaten is formed of tablelands and ravines.

The Kabupaten has an area of 1,950 square kilometers, approximately 3 percent of the province. It consists administratively of 9 Kecamatans.

1.1.2 Meteorological Conditions

The average number of rainy days and the average amount of yearly rainfall in Kabupaten Tana Toraja are 146 days and 1,429 mm respectively.

One year in the Kabupaten consists of a rainy season and a dry season. The dry season is from July through November in general. However this is variable as Table 1-1-1 shows.

The number of working days which is necessary for planning the construction schedule in chapter 6, is estimated at 220 days using the following formula based upon the data shown in the table referred to above.

$$\text{Working Days} = 365 - \text{Holidays} - \text{Rainy Days} + \left(\text{Rainy Days} \times \frac{\text{Holiday}}{365}\right) + (0.10 \times \text{Rainy Days})$$

Where :

- Holidays consist of 52 Sundays and 13 national holidays; and
- 10% of rainy days are assumed to be workable days.

Table 1-1-1

METEOROLOGICAL CONDITIONS

PROVINCE : Sulawesi Selatan
KABUPATEN : Tana Toraja STATION : Makale

MONTH	1980		1981		1982		1983		1984	
	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)
January	11	84	7	72	12	101	18	165	15	229
February	13	130	14	160	15	116	17	93	19	724
March	13	137	25	379	20	233	15	123	23	495
April	25	321	20	493	22	225	8	196	26	264
May	12	131	17	258	17	68	19	159	21	332
June	12	125	15	169	8	67	12	71	14	352
July	7	81	16	137	2	2	13	38	8	72
August	4	15	1	36	2	2	13	68	9	170
September	1	9	16	178	4	25	7	15	11	244
October	7	48	13	119	2	8	12	95	8	70
November	11	149	23	158	2	14	5	54	16	283
December	16	117	7	23	22	117	12	131	9	167
Total	132	1,347	174	2,182	128	978	151	1,208	179	3,402

1.2 Socio-Economic Conditions

1.2.1 Population

The population of Kabupaten Tana Toraja in 1984 was 340,015 which was approximately 5.3% of the 6,475,000 total population of Sulawesi Selatan province as shown in Table 1-2-1.

The population density was 1.73 persons per ha which was higher than the provincial density of 0.88.

The recent annual average growth rate of population of the Kabupaten is 0.6% which is lower than both the provincial rate 1.7% and the national rate of 2.2%. This may be caused by outflow of population to other Kabupatens and cities.

The population of each Kecamatan and its proportion to the Kabupaten population is shown in Table 1-2-2.

Table 1-2-1 POPULATION BY KABUPATEN

DESCRIPTION	POPULATION	AAGR (%)	AREA (ha)	POPULATION DENSITY (persons/ha)	SURVEY YEAR
KABUPATEN:					
GOWA	368,552	0.6	188,332	1.90	1983
PANGKAJENE KEPULAUAN	224,630	0.6	111,229	2.02	1984
BARRU	137,392	0.5	117,472	1.17	1982
SOPPENG	239,335	0.5	135,944	1.76	1984
WAJO	379,948	0.5	250,619	1.52	1984
TANA TORAJA	340,015	0.6	195,000	1.73	1984
MAMUJU	124,315	6.0	1,105,781	0.11	1984
PROVINCE:					
SULAWESI SELATAN	6,278,200		7,278,100		1982
	6,376,100	1.7	7,278,100	0.88	1983
	6,475,000		7,278,100		1984
JAWA IS.(Excluding DKI JAKARTA)	91,126,900	1.7	13,159,700	6.92	-
INDONESIA	161,579,500	2.2	191,944,300	0.84	-

Notes :

1. Sources:
   Kabupaten; Kabupaten concerned with the study
   Province ; Jawa and Indonesia:
   Statistical yearbook of Indonesia 1984, published by the Central statistics Bureau.
2. AAGR ; Average Annual Growth Rate.

Table 1-2-2 POPULATION BY KECAMATAN

Year : 1984

PROVINCE : SULAWESI SELATAN

KABUPATEN : TANA TORAJA

KECAMATAN	POPULATION	PROPORTION (%)
BONGGAKARADENG	22,116	6.5
MENGKENDEK	36,068	10.6
SANGALLA	23,044	6.8
MAKALE	41,374	12.2
SALUPUTTI	46,506	13.7
RINDINGALLO	43,744	12.8
RANTEPAO	27,211	8.0
SANGGALANGI	57,620	16.9
SESEAN	42,359	12.5
TOTAL	340,015	100

1.2.2 Land Use

In Kabupaten Tana Toraja, 58,026 ha of the current available land use area, which is approximately 29.7% of the 195,191 ha total area of the Kabupaten, is used for living purposes and for industrial activity of the inhabitants of the Kabupaten. It is the total value of columns (1) through (6) in Table 1-2-3.

The current available land use area consists of 45,026 ha of agricultural harvest area and 13,000 ha of usable open space which are 77.6% and 22.4% of the current available land use area respectively.

The agricultural harvest area consists of 28,328 ha of paddy field, 11,036 ha of plantation and 5,662 ha of other cultivated area which are 62.9%, 24.5% and 12.6% of the agricultural harvest area respectively.

It can be realized from the land use that the main industrial production in the Kabupaten is food crops, especially paddy.

Table 1-2-3

LAND USE

PROVINCE : SULAWESI SELATAN

(ha)

KABUPATEN	WET PADDY FIELD	UPLAND PADDY FIELD	OTHER CULTIVATED AREA	PLANTATION AREA	RESIDENTIAL AREA	USABLE OPEN SPACE	RIVER & LAKE	FORESTRY AREA	OTHERS	TOTAL AREA	SURVEY YEAR
GOWA	28,800 (15.3)	12,600 (6.7)	-	33,800 (17.9)	9,700 (5.1)	-	-	78,900 (41.9)	24,532 (13.0)	188,332 (100)	1981
PANGKAJENE KEPULAUAN	20,800 (18.7)	554 (0.5)	3,308 (3.0)	10,079 (9.1)	2,538 (2.3)	2,142 (1.9)	5,972 (5.4)	10,754 (9.7)	55,084 (49.5)	111,229 (100)	1983
BARRU	12,653 (11.1)	-	6,262 (5.5)	-	2,870 (2.5)	-	2,362 (2.1)	77,325 (67.5)	13,000 (11.3)	114,472 (100)	1982
SOPPENG	36,098 (28.7)	721 (0.6)	35,968 (28.6)	10,162 (8.1)	750 (0.6)	-	36,607 (29.1)	5,501 (4.4)	-	125,807 (100)	1983
WAJO	56,220 (22.4)	2,154 (0.9)	26,128 (10.4)	14,400 (5.7)	6,422 (2.6)	48,600 (19.4)	39,000 (15.6)	47,753 (19.1)	10,730 (4.3)	250,619 (100)	1984
TANA TORAJA	28,328 (14.5)	-	5,662 (2.9)	11,036 (5.6)	-	13,000 (6.7)	-	137,165 (70.3)	-	195,191 (100)	1983
MAMUJU	5,946 (0.5)	3,979 (0.4)	10,141 (0.9)	-	-	-	-	-	-	1,105,781 (100)	1984

Notes :

1. The value in ( ) denotes the proportion
2. Source : Kabupaten concerned with the study

1.2.3 Agriculture

The cultivated area and food crop production in Kabupaten Tana Toraja in 1984 were 30,137 ha and 123,553 ton respectively as shown in Table 1-2-4. Of food crops, the area and production of paddy, which consists of wet paddy and upland paddy, was 25,222 ha and 91,817 ton respectively which are 84.1% and 74.3% of the total food crops. The yield rate of paddy production is 3.62 ton per ha. The production of cassava amounts to 28,162 ton accounting for 22.8% of all food crops. Thus, paddy is the most predominant agricultural crop of the Kabupaten.

As the table shows, average annual growth rates of area and production of paddy in 1980 through 1984 were 1.5% and 5.3% respectively which indicate favorable development of the paddy production. It is desirable that productivity of paddy increases and this depends upon the future development of irrigation.

The commodity crops, of which clove and coffee are major, are produced in the plantations. The area and production of plantation crops in 1983 were 11,306 ha and 11,400 ton respectively as shown in Table 1-2-5. Thus the plantation crop which is exported is an important agricultural product. Some changes are expected considering the international balance of supply and demand.

The population of the agricultural sector which is assumed from the employment in the Kabupaten is 76.4% of the total population as shown in Table 1-2-6. Thus this is an agricultural Kabupaten.

It is suggested that the kabupaten takes measures to improve paddy productivity by the development of irrigation facilities in addition to the promotion of food crops other than paddy.

Table 1-2-4 AREA AND PRODUCTION OF FOOD CROPS

KABUPATEN : TANA TORAJA

CULTIVATED AREA

(ha)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	24,972	24,573	24,051	24,845	22,822	25,333	
OTHERS	9,186	13,291	7,535	6,126	13,043	4,804	
TOTAL	34,158	37,864	31,586	30,971	35,865	30,137	

PRODUCTION

(ton)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	71,951	74,769	82,215	87,328	78,856	91,817	
OTHERS	39,382	43,862	35,567	32,198	50,244	31,736	
TOTAL	111,333	118,631	117,782	119,526	129,100	123,553	

YIELD RATE

(ton/ha)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	2.88	3.04	3.42	3.51	3.46	3.62	

Notes :

1. AAGR : Average annual growth rate
2. Source : Kabupaten concerned with the study

Table 1-2-5 AREA AND PRODUCTION OF PLANTATION CROPS
Year : 1983

PROVINCE : SULAWESI SELATAN

KABUPATEN	AREA (ha)	PRODUCTION (ton)	AREA	PRODUCTION
GOWA	-	-	-	-
PANGKAJENE KEPULAUAN	11,200	4,025	2.8	5.6
BARRU	-	-	-	-
SOPPENG	-	-	-	-
WAJO	21,437	19,396	7.1	11.0
TANA TORAJA	11,306	11,400	-	-
MAMUJU	-	-	-	-

Table 1-2-6 POPULATION OF AGRICULTURAL SECTOR

PROVINCE : SULAWESI SELATAN

KABUPATEN	AGRICULTURAL SECTOR	TOTAL POPULATION	PROPORTION (%)	AAGR (%)	SURVEY YEAR
GOWA	226,000	368,552	61.3	0.05	1983
PANGKAJENE KEPULAUAN	146,000	224,630	64,8	2.0	1984
BARRU	89,000	137,392	64.8	1.0	1982
SOPPENG	166,000	293,335	69.4	0.25	1984
WAJO	243,000	379,948	63.8	4.0	1984
TANA TORAJA	260,000	340,015	76.4	3.0	1984
MAMUJU	101,000	124,315	81.5	6.0	1984

Notes :

1. AAGR : Average annual growth rate
2. Source : Kabupaten concerned with the Study

1.2.4 Other Economic Activities

Notable economic activities excluding agriculture in Kabupaten Tanah Toraja are tourism and livestock sectors.

Economic activities in the Kabupaten are characterized the tourism sector. A varisty of racial cultures of Traja attracts the foreign tourist, therefore the tourism industry is developed in the field of Hotel business. However the actual conditions of hotel business is not cleared because of lacking data concerned.

The current growth of the livestock production volume is shown in the following table.

	1980	1984	AAGR (%)
Production (ton)	1,660	2,275	8.2

Notes : 1. AAGR : Average annual growth rate
2. Source : Kabupaten data

It is presumed that yealy approx. 1,000 tons excluding the consumption of the Kabupaten itself are exported out of the Kabupaten and this sector is expected to become continuously prosperous.

1.3 Present Status of Kabupaten Roads

1.3.1 Outline of Road Networks

In Kabupaten Tana Toraja there is one national road called the 'Trans Sulawesi Highway' which runs from south to northeast through the central area of the Kabupaten and acts as an important regional trunk road.

Since the boundary of Kabupaten Toraja is surrounded by a mountainous area, all the Kabupaten road networks are developing around the national road with the Kabupaten basin as a center. In particular the Kabupaten roads northeast of Makale, the Kabupaten capital, form high density road networks.

The Kabupaten roads west of Rantepao will have an important role as a facility for developing future plantation crops which are now being planned for utilization of the hilly area.

1.3.2 Road Inventory

From the road inventory data prepared by the Kabupaten, the number and total length of Kabupaten roads to be studied in Kabupaten Tana Toraja are confirmed as 61 links and 484 Km respectively. These figures exclude Kabupaten roads with no data are not included.

According to the data the present status of the Kabupaten roads is as follows:

(1) Density of Kabupaten Roads

The density of the Kabupaten roads is 2.48 m per ha. This is higher than the national density of 0.48 m per ha and also higher than 2.11 m per ha which is the density in Jawa Island, excluding DKI Jakarta, as shown in the following table.

	Total Length (km)	Area (ha)	Density (m/ha)
Kabupaten : Tana Toraja	484	195,000	2.48
Province : Sulawesi Selatan	2,730	2,104,377	1.30
Jawa Is.(Excluding DKI Jakarta)	27,715	13,159,700	2.11
Indonesia	92,038	191,944,300	0.48

Notes : 1. The value for the province is the total value for the Kabupatens included in the study.

2. The sources of data are as follows:
Kabupaten and Province : Bina Marga Inventory
Jawa and Indonesia : Statistical Yearbook of Indonesia 1984, published by the Central Statistics Bureau

(2) Kabupaten Road Surface Type

The type of surface on the Kabupaten roads in the Kabupaten is shown in Table 1-3-1.

The legend used in the table is as follows:

ASP : Asphalt

KRK : Gravel/Stone/Telford/Water Bound Macadam

Table 1-3-1 EXISTING ROAD LENGTH BY SURFACE TYPE

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(Km)

102	71	BIB	KRK	TNH	ASP	L.L	TOTAL
LINK	1	3					3
LINK	2	5	1	3			9
LINK	3				5		5
LINK	4						
LINK	5			17			17
LINK	6		5	11			16
LINK	7		5				5
LINK	8		4				4
LINK	9		6				6
LINK	10		15				15
LINK	11		6	6			12
LINK	12				7		7
LINK	13		9	4			13
LINK	14		15				15
LINK	15	4	12				16
LINK	16		12				12
LINK	17						
LINK	18						
LINK	19						
LINK	20	1	7				8
LINK	21						
LINK	22						
LINK	23	1	3		1		5
LINK	24		7		3		10
LINK	25		5				5
LINK	26	1				5	6
LINK	27				2		2
LINK	28		12	1			13
LINK	29	2	1	2			5
LINK	30				4		5
LINK	31		13				13
LINK	32	1	1		9		10
LINK	33	7					7
LINK	34	9	3	8			20
LINK	35		1	10			10
LINK	36		2	40			42
LINK	37	15					15
LINK	38				8		8
LINK	39			7			7
LINK	40		2				2
LINK	41			5			5
LINK	42		2	2			4
LINK	43		1	8			9
LINK	44			10			10
LINK	45		1	6			6
LINK	46		1	6			6
LINK	47		1	9			9
LINK	48		1	4			4
LINK	49		1	8			8
LINK	50		1	4			4
LINK	51		1	3		1	4
LINK	52		3	1			3
LINK	53		1	4			4
LINK	54		1	4			4
LINK	55		1	10			10
LINK	56		1	4		1	5
LINK	57		1	8			8
LINK	58	1	1	6			7
LINK	59		1	8			8
LINK	60	1	1	11			12
LINK	61		1	5			5
TOTAL		49	155	234	39	7	484
RATIO		10	32	48	8	1	(%)

TNH : Earth

LL : Others

Comparison of the proportions of surface type in the Kabupaten with other regions is as follows:

	ASP	KRK	TNH/LL
Kabupaten : Tana Toraja	8.1	42.1	49.7
Province : Sulawesi Selatan	13.0	46.0	41.0
Jawa Is.(Excluding DKI Jakarta)	56.2	25.0	18.8
Indonesia	26.0	26.6	47.4

Thus, in the Kabupaten the proportion of Kabupaten roads with asphalt surface is much lower than either that of Indonesia or Jawa Island. The proportion of low grade roads such as earth roads and others is fairly high. This means that the road classification in the Kabupaten is low.

(3) Surface Condition of Kabupaten Roads

The surface condition of the Kabupaten roads classified as good, fair, poor and bad which are shown as BA, SD, RU and RB respectively, are summarized in Table 1-3-2.

Comparison of the proportions of the various surface conditions of the Kabupaten roads in the Kabupaten with other regions is as follows:

	Good	Fair	Poor	Bad
Kabupaten : Tana Toraja	24.4	31.0	31.8	12.8
Province : Sulawesi Selatan	41.1	27.3	25.8	5.8
Jawa Is.(Excluding DKI Jakarta)	45.6	29.8	19.6	5.0
Indonesia	43.5	21.8	21.1	13.6

Table 1-3-2 EXISTING ROAD CONDITION BY SURFACE TYPE

PROVINCE : SULAWESI SELATAN

KABUPATEN : TANA TORAJA

(1)

NO		BTB				KRK				TNH				ASP				L.L			
NO		BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB
LINK	1	27	43	30																	
LINK	2	78	20	2		30	50	20		37	55	8									
LINK	3													46	42	12					
LINK	4																				
LINK	5										4	87	9								
LINK	6					15	85				7	93									
LINK	7					95	5														
LINK	8					50	33	18													
LINK	9					33	43	23													
LINK	10					55	13	19	13												
LINK	11					95	5			44	21	7	28								
LINK	12													78	22						
LINK	13						52	48			8	51	41								
LINK	14					66	26	8													
LINK	15	15	5	80		12	52	28	8												
LINK	16					43	42	16													
LINK	17						10	90													
LINK	18																				
LINK	19																				
LINK	20	80		20		49	17	34													
LINK	21																				
LINK	22																				
LINK	23		95	5		10	62	25	3					95	5						
LINK	24					78	18	11						77	20	3					
LINK	25					65	27	8													
LINK	26	10	50	40														39	46	15	
LINK	27													70	25	5					
LINK	28					43	32	26		30	30	40									
LINK	29		78	23			90	10			20	35	45								
LINK	30					10	25	15	50					69	23	10					
LINK	31					32	35	33													
LINK	32		80	20										58	31	31					
LINK	33	67	21	11																	
LINK	34	49	30	21		47	33	20				4	31	65							
LINK	35											11	45	44							
LINK	36					75	5	20		19	37	33	11								
LINK	37	37	56	8																	
LINK	38													99							
LINK	39												75	25							
LINK	40					20	50	30													
LINK	41											12	88								
LINK	42					85	15						1	99							
LINK	43					50	25	25		10	28	42	20								
LINK	44										99	1									
LINK	45										99	1									
LINK	46										99	1									
LINK	47											99	1								
LINK	48										99	1									
LINK	49									9	23	38	33								
LINK	50									9	55	36	1								
LINK	51										9	27	65						45	55	
LINK	52						3	98	8												
LINK	53												86	14							
LINK	54												12	89							
LINK	55												88	13							
LINK	56									15	51	34						75	25		
LINK	57										66	14									
LINK	58					70	15	10	5	4	4	46	46								
LINK	59											6	63	37							
LINK	60							60	40	6	27	94	25								
LINK	61										60	40									
AVERAGE		33	43	24	0	36	32	28	5	6	35	41	23	74	19	8	0	38	39	23	0
LENGTH		49 Km				155 Km				234 Km				39 Km				7 Km			
(Km)		16	21	12	0	56	50	43	8	14	73	96	54	29	7	3	0	3	3	2	0

The surface condition levels of the Kabupaten roads in the Kabupaten is lower than both that of Indonesia and Jawa Island. The proportion in good condition is relatively low. Therefore improvement of Kabupaten roads in poor or bad condition is desirable.

(4) Terrain Conditions of Kabupaten Roads

The difficulty of road improvement is mainly dependent upon the terrain conditions.

The terrain conditions of the Kabupaten roads, classified as flat, hilly, mountainous and swampy which are shown as DT, BK, GN and RW, are summarized in Table 1-3-3.

The proportions of terrain conditions in the Kabupaten are 6.0% flat, 74.0% hilly, 19.0% mountainous.

1.3.3 Bridge Inventory

A bridge inventory showing the existing condition of bridges on the Kabupaten roads in Kabupaten Tana Toraja was prepared by the Kabupaten.

The bridge types are classfied as timber, concrete, steel and others which are shown in the inventory as KY, BT, BJ and LL respectively.

The inventories shown in Table 1-3-4 and Table 1-3-5 indicates a total of 131 bridges with a total length of 1,144 m of which 29 or 22.1% are timber, 63 or 48.1% are concrete and 37 or 28.2% are others. Steel bridges account for only 2 or 1.5% of the total. On the other hand, 27 bridges with a total length of 194 m are required to be newly constructed.

Table 1-3-3 EXISTING ROAD LENGTH BY TERRAIN CONDITION

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(Km)

I02 (3)	BK	GN	DT	RW	TOTAL
LINK 1	3				3
LINK 2		8	1		9
LINK 3	5				5
LINK 4					
LINK 5	17				17
LINK 6	16				16
LINK 7	5				5
LINK 8	4				4
LINK 9	6				6
LINK 10	15				15
LINE 11	12				12
LINK 12	3		4		7
LINK 13	6	1	6		13
LINK 14	10		5		15
LINK 15	16				16
LINK 16	11		1		12
LINK 17	1				1
LINK 18					
LINK 19					
LINK 20	8				8
LINK 21					
LINK 22					
LINK 23	5				5
LINK 24	10				10
LINK 25	1		4		5
LINK 26	2	4			6
LINK 27	2				2
LINK 28	13				13
LINK 29	4	1			5
LINK 30	3		2		5
LINK 31	13				13

(Km)

I02 (3)	BK	GN	DT	RW	TOTAL
LINK 32	10				10
LINK 33	7				7
LINK 34	1	18	1		20
LINK 35	9			1	10
LINK 36	1	39	3		42
LINK 37	15				15
LINK 38	6		2		8
LINK 39	7				7
LINK 40	2				2
LINK 41	5				5
LINK 42	4				4
LINK 43	9				9
LINK 44	10				10
LINK 45	6				6
LINK 46	6				6
LINK 47	9				9
LINK 48	4				4
LINK 49	4	4			8
LINK 50	1	3			4
LINK 51	4				4
LINK 52	3				3
LINK 53	4				4
LINK 54	4				4
LINK 55	1	10			10
LINK 56	5				5
LINK 57	8				8
LINK 58	6		1		7
LINK 59	2	6			8
LINK 60	12				12
LINK 61	5				5
TOTAL	359	94	30		484
RATIO	74	19	6	0	(%)

Table 1-3-4 NUMBER AND LENGTH OF BRIDGES

PROV : SULAWESI SELATAN KAB : TANA TORAJA

<<<< BRIDGE >>>> (UNIT: m)

	EXISTING		NOT EXIST		TOTAL	
LINK NO	NO.	LENGTH	NO.	LENGTH	NO.	LENGTH
1	2	11.00			2	11.00
2	3	17.00			3	17.00
3	1	8.00			1	8.00
5	1	8.00	1	10.00	2	18.00
6	1	10.00			1	10.00
7	5	98.00			5	98.00
8	2	13.50			2	13.50
9	4	16.60			4	16.60
10	2	7.00			2	7.00
11	4	40.00			4	40.00
13	6	24.00			6	24.00
14	3	25.00	10	79.00	13	104.00
15	1	3.00			1	3.00
16	5	26.00			5	26.00
20	1	6.00			1	6.00
23	1	3.00			1	3.00
24	3	44.00			3	44.00
25	3	51.50			3	51.50
26			4	40.00	4	40.00
27	1	14.00			1	14.00
28	9	32.00			9	32.00
29	1	10.00			1	10.00
30	2	11.00			2	11.00
31	6	37.00			6	37.00
32	3	57.00			3	57.00
33	1	40.00			1	40.00
34	20	165.50			20	165.50
35	7	60.00	5	15.00	12	75.00
36	3	60.50	6	46.00	9	106.50
37	3	9.00			3	9.00
38	2	19.40			2	19.40
40	1	7.00			1	7.00
42	1	4.00			1	4.00
43	3	10.00			3	10.00
44	2	10.00			2	10.00
47	9	46.00			9	46.00
51	1	60.00			1	60.00
53	1	20.00			1	20.00
54	1	4.00			1	4.00
56	1	30.00			1	30.00
57	1	6.00			1	6.00
60	4	20.00			4	20.00
61			1	4.00	1	4.00
TOTAL	131	1144.00	27	194.00	158	1338.00

Table 1-3-5 NUMBER OF EXISTING BRIDGES BY BRIDGE TYPE

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(No)

103 (18)	LL	BT	KY	BJ	TOTAL
LINK 1	1	1			2
LINK 2		3			3
LINK 3		1			1
LINK 5	1				1
LINK 6			1		1
LINK 7	1	2	1	1	5
LINK 8	2				2
LINK 9		3		1	4
LINK 10	1	1			2
LINK 11			4		4
LINK 13		6			6
LINK 14	1	2			3
LINK 15	1				1
LINK 16	3	1	1		5
LINK 20		1			1
LINK 23		1			1
LINK 24		3			3
LINK 25	1	2			3
LINK 26					
LINK 27		1			1
LINK 28		9			9
LINK 29		1			1
LINK 30		2			2
LINK 31		6			6
LINK 32	1	1	1		3
LINK 33		1			1
LINK 34	12	8			20
LINK 35	7				7
LINK 36			3		3
LINK 37		3			3
LINK 38		2			2
LINK 40	1				1
LINK 42		1			1
LINK 43	1		2		3
LINK 44	2				2
LINK 47			9		9
LINK 51			1		1
LINK 53			1		1
LINK 54			1		1
LINK 56	1				1
LINK 57			1		1
LINK 60		1	3		4
LINK 61					
TOTAL	37	63	29	2	131
RATIO	28	48	22	2	(%)

The number of existing bridges by span length is as follows:

Bridge Type	3	<5	<8	<10	<12	<14	<16	<18	<20	<99	Total
Timber	5	7	6	2	-	2	1	-	1	5	29
Concrete	17	21	12	8	2	-	1	-	1	1	63
Steel	1	-	-	-	-	-	-	-	-	1	2
Others	9	8	10	4	1	-	2	-	2	1	37
Total	32	36	28	14	3	2	4	-	4	8	131

Thus, most of the existing bridges on the Kabupaten roads is are concrete and the majority of spanlengths is within the range of 3 m to 5 m.

1.3.4 Traffic

Inventories of the average daily traffic (ADT) on the Kabupaten roads in Kabupaten Tana Toraja were prepared by the Kabupaten and are shown in Chapter 2.

From the inventories, total value of average daily trips by vehicle type and their proportions in the Kabupaten in 1985 are summarized as follows:

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Total Trips	2,370	270	1,214	3,370	5,545
Proportion (%)	32.81	3.74	16.80	46.65	100.00

Source : Bina Marga Inventory

The proportions of registered vehicles by vehicle type are as follows:

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Proportion (%)	0.00	19.50	15.50	65.00	100.00

Source : Kabupaten.

Thus, the proportion of motorcyles in the Kabupaten is by far the highest.

From the above tables the following can be observed:

- Number of total trips might be underestimated
- Proportions are probably reasonable.

Essentially, for estimation of future traffic volumes past and present traffic data together with the trend in the number of registered vehicles are important basic data. However the data obtained for the study was traffic count data for each road link in 1985 and of low reliability.

Therefore the future traffic volumes are estimated by the calculation process recommended in chapter 3 of the Main Report.

Chapter 2 ESTIMATIONS OF FUTURE TRAFFIC VOLUME AND BENEFIT

2.1 Future Traffic Volume

2.1.1 Traffic Growth Rate

The traffic growth rate used for estimation of the future traffic volume on the Kabupaten roads was estimated by the following calculation process.

Growth of Production Basis "A":

$$\sqrt{\text{Annual Population Growth of the Kabupaten} \times \text{Growth of the Total Cultivated Area}}$$

Growth of Productivity "B" :

$$\sqrt{\text{Growth of the Total Paddy Field Area} \times \text{Growth of the Paddy Production per ha}}$$

Traffic Growth Rate: Initial estimated figure:

$$\overline{GR'} = \sqrt{A \times B}$$

Traffic Growth Rate GR =Final adjusted figure:

$$\sqrt{GR' \times \text{Trend of GDP/Capita of the Province Concerned}}$$

Results of the estimation are shown in Table 2-1-1.

Table 2-1-1 TRAFFIC GROWTH RATE ESTIMATION

PROV : SULAWESI SELATAN KAB : TANA TORAJA

A)	Growth Rate of Population	:	0.60 (%)
B)	Growth Rate of Cultivated Area	:	3.50 (%)
C)	Growth Rate of Rice field	:	1.50 (%)
D)	Growth Rate of Rice yield rate	:	4.50 (%)
E)	Growth Rate of GDP / capita	:	6.60 (%)
a)	Geometrical Mean (A x B)	:	2.04 (%)
b)	Geometrical Mean (C x D)	:	2.99 (%)
c)	Geometrical Mean (a x b)	:	2.51 (%)
d)	Geometrical Mean (c x E)	:	4.54 (%)
	TRAFFIC GROWTH RATE	:	4.54 (%)

2.1.2 Present and Future Traffic Volume

The future traffic volumes on the Kabupaten roads in 1998 for the Project life time of ten years were estimated by the following formula :

$$Tn = Te\ (1 + r)^n$$

Where :

Tn : Future traffic volume n years later
Te : Traffic volume in 1985
r : Traffic growth rate

The results are shown in Table 2-1-2 together with the traffic volume in 1985.

Table 2-1-2 (1) EXISTING AND FUTURE TRAFFIC VOLUME

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
1	40	0	15	40	75	4.5%	71	0	27	71	134	IIIB-2
2	15	0	5	50	45	4.5%	27	0	9	89	80	IIIB-2
3	75	6	45	110	181	4.5%	134	11	80	196	322	IIIB-1
4	0	0	0	0	0	4.5%	0	0	0	0	0	IIIC
5	12	0	3	20	25	4.5%	21	0	5	36	45	IIIC
6	20	0	15	40	55	4.5%	36	0	27	71	98	IIIB-2
7	90	30	50	180	260	4.5%	160	53	89	321	463	IIIB-1
8	8	0	2	20	20	4.5%	14	0	4	36	36	IIIC
9	15	0	6	20	31	4.5%	27	0	11	36	55	IIIB-2
10	20	0	10	25	43	4.5%	36	0	18	45	77	IIIB-2
11	60	0	10	30	85	4.5%	107	0	18	53	151	IIIB-2
12	66	6	42	95	162	4.5%	118	11	75	169	289	IIIB-1
13	25	0	5	20	40	4.5%	45	0	9	36	71	IIIB-2
14	6	2	0	15	16	4.5%	11	4	0	27	28	IIIC
15	12	0	6	14	25	4.5%	21	0	11	25	45	IIIC
16	15	0	2	10	22	4.5%	27	0	4	18	39	IIIC
17	30	6	20	60	86	4.5%	53	11	36	107	153	IIIB-2
18	0	0	0	0	0	4.5%	0	0	0	0	0	IIIC
19	0	0	0	0	0	4.5%	0	0	0	0	0	IIIC
20	12	0	6	10	23	4.5%	21	0	11	18	41	IIIC
21	0	0	0	0	0	4.5%	0	0	0	0	0	IIIC
22	0	0	0	0	0	4.5%	0	0	0	0	0	IIIC
23	35	15	45	100	145	4.5%	62	27	80	178	258	IIIB-1
24	19	3	10	20	42	4.5%	34	5	18	36	75	IIIB-2
25	5	12	3	45	43	4.5%	9	21	5	80	77	IIIB-2
26	6	2	2	4	12	4.5%	11	4	4	7	21	IIIC
27	65	6	35	80	146	4.5%	116	11	62	142	260	IIIB-1
28	5	0	10	10	20	4.5%	9	0	18	18	36	IIIC
29	50	12	40	180	192	4.5%	89	21	71	321	342	IIIB-1
30	40	15	5	35	78	4.5%	71	27	9	62	139	IIIB-2
31	95	10	50	40	175	4.5%	169	18	89	71	312	IIIB-1
32	600	10	194	204	906	4.5%	1069	18	346	363	1614	IIIA
33	250	30	100	200	480	4.5%	445	53	178	356	855	IIIA
34	90	15	45	420	360	4.5%	160	27	80	748	641	IIIA
35	0	0	1	2	2	4.5%	0	0	2	4	4	IIIC
36	0	0	0	0	0	4.5%	0	0	0	0	0	IIIC
37	30	0	10	20	50	4.5%	53	0	18	36	89	IIIB-2
38	270	25	100	250	520	4.5%	481	45	178	445	926	IIIA
39	3	0	5	5	11	4.5%	5	0	9	9	20	IIIC
40	18	0	2	12	26	4.5%	32	0	4	21	46	IIIC
41	50	15	60	450	350	4.5%	89	27	107	801	623	IIIA
42	20	0	40	60	90	4.5%	36	0	71	107	160	IIIB-2
43	0	0	10	15	10	4.5%	0	0	18	27	32	IIIC
44	0	0	0	5	3	4.5%	0	0	0	9	5	IIIC
45	0	0	5	10	10	4.5%	0	0	9	18	18	IIIC
46	0	0	5	15	13	4.5%	0	0	9	27	23	IIIC
47	5	0	5	5	13	4.5%	9	0	9	9	23	IIIC
48	5	0	10	10	20	4.5%	9	0	18	18	36	IIIC
49	70	25	45	95	188	4.5%	125	45	80	169	335	IIIB-1
50	0	0	10	15	18	4.5%	0	0	18	27	32	IIIC

Table 2-1-2 (2) EXISTING AND FUTURE TRAFFIC VOLUME

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
51	0	0	10	20	20	4.5%	0	0	18	36	36	IIIC
52	10	0	10	60	50	4.5%	18	0	18	107	89	IIIB-2
53	2	0	16	30	33	4.5%	4	0	28	53	59	IIIB-2
54	0	0	2	6	5	4.5%	0	0	4	11	9	IIIC
55	4	0	6	14	17	4.5%	7	0	11	25	30	IIIC
56	2	0	0	2	3	4.5%	4	0	0	4	5	IIIC
57	10	0	5	20	25	4.5%	18	0	9	36	45	IIIC
58	0	0	15	0	15	4.5%	0	0	27	0	27	IIIC
59	90	25	60	140	245	4.5%	160	45	107	249	436	IIIB-1
60	0	0	1	2	2	4.5%	0	0	2	4	4	IIIC
61	0	0	0	10	5	4.5%	0	0	0	18	9	IIIC
PERCENT	32.81	3.74	16.81	46.65			32.81	3.74	16.81	46.65		

2.2 Benefit

2.2.1 Benefit Estimation Method

Generally, estimation of the benefit on each Kabupaten road due to the Project was made by analyzing the direct benefit i.e. the VOC reduction benefit, which was estimated by comparing "with project" and "without project" based upon the future traffic volume on the road. However for the following road links it was decided to estimate the indirect benefit through the producer's surplus benefit.

a) Road links with present traffic volume (ADT) less than 60 equivalent 4-wheel vehicles.

b) Road links with no 4-wheel vehicle operation at present.

The indirect benefit was changed into the future traffic volume and the VOC reduction benefit was estimated.

The VOC adopted for the estimation is shown in Table 2-2-1.

Table 2-2-1 VEHICLE OPERATION COST ON KABUPATEN ROADS

(KM)

SURFACE	CONDITION	SEDAN	BUS	TRUCK	MOTORCYCLE
ASPHALT	GOOD	104.7	86.2	85.4	15.9
	Fair	125.5	101.0	98.0	18.2
	Poor	164.1	135.2	138.5	22.8
	Bad	222.1	202.0	205.0	29.1
GRAVEL	Good	125.7	101.4	102.5	18.5
	Fair	145.0	124.6	127.1	21.1
	Poor	198.6	172.6	178.4	27.1
	Bad	242.7	228.9	231.2	31.8
EARTH	Fair	201.8	180.0	185.1	28.0
	Poor	240.7	218.2	225.8	31.8
	Bad	264.9	278.0	281.7	35.5

Source : Bina Marga

Table 2-2-2 FUTURE TRAFFIC VOLUME ESTIMATED

BY THE PRODUCER'S SURPLUS

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(1998)

LINK NO	CLASS	SURFACE	MOBIL	BUS	TRUCK	SEPEDA	TOTAL
2	IIIC	KRK	11	1	5	10	22
5	IIIB-1	ASP	109	7	50	99	216
6	IIIB-2	KRK	98	7	45	89	195
8	IIIB-2	KRK	26	2	12	23	52
9	IIIB-2	KRK	26	2	12	24	52
10	IIIB-2	KRK	49	3	23	45	98
13	IIIC	KRK	14	1	7	13	29
14	IIIC	KRK	3	0	1	2	5
15	IIIC	KRK	7	0	3	6	13
16	IIIC	KRK	15	1	7	13	30
20	IIIC	KRK	9	1	4	8	18
24	IIIC	KRK	12	1	6	11	25
25	IIIC	KRK	1	0	0	1	2
26	IIIC	KRK	1	0	0	1	2
28	IIIB-2	KRK	60	4	28	55	120
35	IIIC	KRK	19	1	8	17	37
36	IIIB-2	KRK	56	4	25	51	111
37	IIIC	KRK	19	1	9	17	38
39	IIIC	KRK	10	1	5	9	21
40	IIIC	KRK	13	1	6	12	26
43	IIIC	KRK	24	2	11	22	48
44	IIIC	KRK	12	1	5	11	24
45	IIIC	KRK	9	1	4	8	18
46	IIIC	KRK	9	1	4	8	18
47	IIIC	KRK	14	1	6	13	28
48	IIIC	KRK	5	0	2	5	10
50	IIIC	KRK	3	0	1	2	5
51	IIIC	KRK	3	0	1	2	5
53	IIIC	KRK	4	0	2	4	8
54	IIIC	KRK	9	1	4	9	18
55	IIIC	KRK	12	1	6	11	25
56	IIIC	KRK	1	0	0	1	2
57	IIIB-2	KRK	47	3	22	43	94
58	IIIC	KRK	7	0	3	6	13
60	IIIB-2	KRK	32	2	14	29	63
61	IIIB-2	KRK	32	2	15	29	64

2.2.2 Benefit

The benefit estimation was carried out for each Kabupaten road. Table 2-2-3 shows a sample of the result of benefit estimation. In the table "surplus" and "VOC" show the estimation method utilized and III A, III B-1, III B-2 and III C show the road classification.

Table 2-2-3

RESULTS OF BENEFIT ESTIMATION

(1000Rupiah)

	LINK 1	LINK 2	LINK 3	LINK 4	LINK 6	LINK 7	LINK 8	LINK 9	LINK 10	LINK 11
	11 Km	14 Km	14 Km	15 Km	11 Km	5 Km	3 Km	4 Km	16 Km	7 Km
	IIIB-1	IIIA	IIIA	IIIB-1	IIIB-1	IIIB-2	IIIB-2	IIIB-2	IIIA	IIIA
YEAR	VOC	VOC	VOC	VOC	VOC	VOC	VOC	Surplus	VOC	VOC
1988	0	0	0	0	0	0	0	0	0	0
1989	12105	43095	33875	29532	18994	5033	64	408	18560	6495
1990	12754	45621	35844	31048	20118	5359	68	408	19609	6855
1991	13309	47937	37560	32694	21241	5521	70	434	20603	7216
1992	14158	50496	39687	34474	22288	5845	74	448	21728	7622
1993	15006	53216	41832	36285	23524	6171	78	462	22855	8027
1994	15760	56077	43977	38213	24760	6495	82	475	24066	8462
1995	16722	59074	46422	40436	26195	6819	87	513	25414	8935
1996	17502	62222	48979	42529	27544	7307	93	514	26826	9416
1997	18464	65628	51582	44918	29091	7631	97	539	28259	9900
1998	19452	69196	54344	47306	30639	8030	101	553	29709	10427
SUM	155432	552562	434102	377435	244394	64211	814	4754	237629	83355
COST	31905	249890	179996	141118	84350	19879	-10322	-11563	53260	11132
/Km	2900	17849	12857	9408	7668	3976	-3441	-2691	3329	1590

Chapter 3 ENGINEERING

3.1 Design Criteria and Specification

3.1.1 Geometric Design Criteria

Currently a technical standard for improvement of Kabupaten roads i.e. PETUNJUK TEKNIS INPRES PENUNJANGAN JALAN KABUPATEN, TAHUN 1984-1985 is established by Bina Marga.

The geometric design criteria in the above standard are recommended to be adopted in general for the Project. Following discussions with Bina Marga, exceptions to this are allowed for Pavement width and pavement type to minimize the construction cost of the Kabupaten road improvement, if necessary. The geometric design criteria adopted for the Project are shown in Table 3-1-1. The typical cross sections of Kabupaten roads are shown in Fig. 3-1-1.

3.1.2 Loading Specification

The LOADING SPECIFICATIONS FOR HIGHWAY BRIDGES BY DIRECTORATE GENERAL BINA MARGA is used in principle as the basic specification of loading and the TECHNICAL STANDARD FOR KABUPATEN ROADS compiled by Bina Marga shows that the design live load for bridges on Kabupaten roads is 70% of the Bina Marga live road. However, after discussions with Bina Marga the following loads were decided as the design live loads for the standard bridges of Kabupaten roads:

a. 50% of Bina Marga live load (hereinafter BM 50) is applied for concrete and timber bridges on roads of III A classification.

b. 10-ton truck load is applied for timber bridges on roads of III B-1, III B-2 and III C classification.

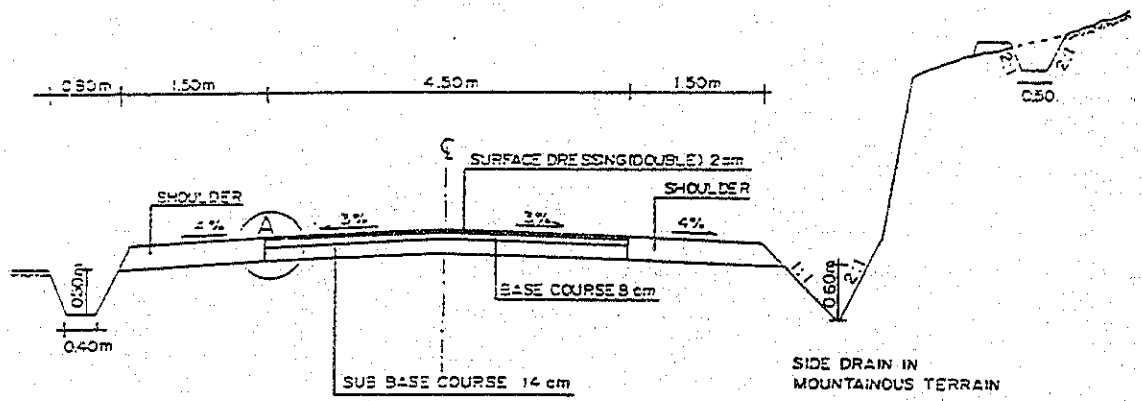
Table 3-1-1

DESIGN CRITERIA FOR KABUPATEN ROADS

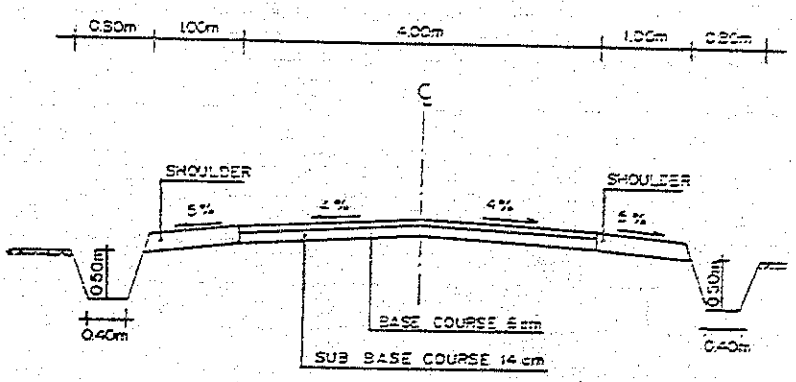
ROAD CLASSIFICATION		CLASS III A			CLASS III B-1			CLASS III B-2			CLASS III C		
SURFACE TYPE		ASPHALT SEAL (DOUBLE)			ASPHALT SEAL (SINGLE)			GRAVEL			GRAVEL		
TRAFFIC VOLUME : ADT (Forecast 10 th year average per day)		3000 - 500			500 - 200			200 - 50			50		
T E R R A I N		FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS
TRAFFIC LANES		1+	1+	1+	1+	1+	1+	1+	1+	1+	1	1	1
DESIGN SPEED (Km/hr)	DESIRABLE	70	60	40	70	40	30	60	40	30	50	30	AS PRACTI-CABLE
	MINIMUM	30	30	30	30	30	AS PRACTI-CABLE	30	30	AS PRACTI-CABLE	30	AS PRACTICABLE	
GRADIENT (LIMITING) (%)	DESIRABLE	4	5	8	4	6	8	4	7	8	5	8	12
	MAXIMUM	7	7	10	7	8	10	7	9	12	7	12	16
PAVEMENT WIDTH (M)	DESIRABLE	6.0	6.0	6.0	4.5	4.5	4.5	4.5	4.5	4.5	3.5	3.5	3.5
	MINIMUM	4.5	4.5	4.5	3.5	3.5	3.5	3.5	3.5	3.5	3.0	3.0	3.0
SHOULDER WIDTH (M)	DESIRABLE	2.0	1.5	1.5	1.5	1.5	1.0	1.5	1.0	1.0	1.0	1.0	0.75
	MINIMUM	1.5	1.0	0.75	1.0	1.0	0.75	1.0	0.75	0.5	0.75	0.5	0.5
ROAD BED WIDTH (M)	DESIRABLE	10.0	9.0	9.0	8.0	7.5	6.5	7.5	6.5	6.5	5.5	5.5	5.0
	MINIMUM	6.0	6.0	6.0	5.5	5.5	5.0	5.5	5.0	4.5	4.5	4.0	4.0
RIGHT OF WAY (M)	DESIRABLE	16			12			12			12		
	MINIMUM	12			10			10			8		
ROAD CAMBER (%)	PAVEMENT	3			3			4			4		
	SHOULDER	4			4			5			5		

Fig. 3-1-1 STANDARD ROAD CROSS SECTIONS

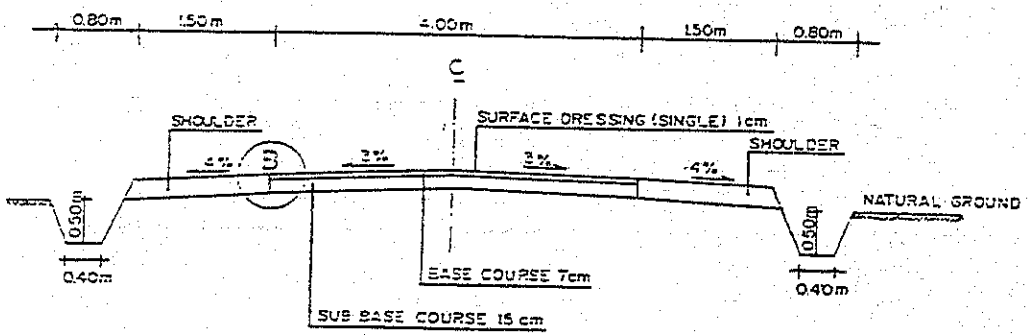
CLASS III A



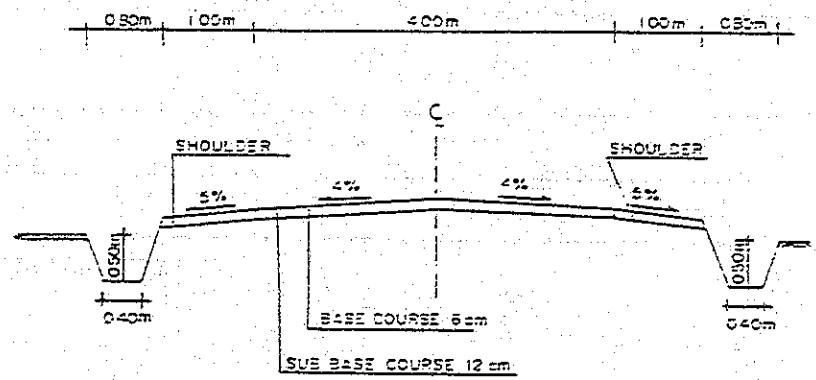
CLASS III B-2



CLASS III B-1



CLASS III C



3.2 Pavement Design

3.2.1 Design Conditions

From the engineering data prepared by the Kabupaten it is noted that the pavement structure of the Kabupaten roads seems to have been determined without adequate designs, therefore the Kabupaten roads generally have insufficient capacity. The standards generally used for highway pavement design such as Road Note 29, Road Note 31 and AASHTO are not suitable for Kabupaten roads with small traffic volumes and loads.

Therefore formulae suitable for the pavement design of Kabupaten roads are recommended as described in Chapter 5 of the Main Report.

The following are important factors for the design of pavement thickness.

1) Design Traffic Volume

As the pavement thickness is designed for each road classification the design traffic volume of which the target year is 1998, is adopted for each classification as follows:

Road Classification	Design Traffic Volume (vpd)
III A	1,000
III B-1	500
III B-2	200
III C	50

2) Strength of Roadbed

The CBR value of the existing roadbed is a very important factor for the pavement design but no results are available from CBR tests on the Kabupaten roads.

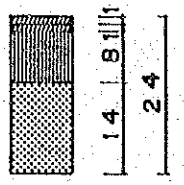
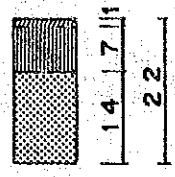
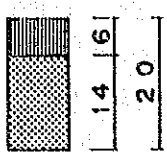
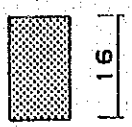
CBR of the laterite is generally in the range of CBR 4 to 10. However site CBR tests should be conducted before construction to finally decide the pavement thickness.

3.2.2 Pavement Structure

Fig. 3-2-1 shows the standard pavement structure adopted for the Kabupaten roads.

Fig. 3-2-1 PAVEMENT STRUCTURE

(cm)

CBR	ROAD CLASSIFICATION			
	III A	III B-1	III B-2	III C
6				

= SURFACE DRESSING (ASPHALT)

= BASE COURSE (CRUSHER · RUN)

= SUBBASE COURSE (SANDY GRAVEL)

3.3 Design of Bridges and Other Structures

3.3.1 Standard Bridge

There are so many bridges to be improved or to be constructed on the Kabupaten roads in the Project Area that it is very difficult to prepare an individual design for each bridge. Therefore, standardization is recommended as being necessary for the bridge design with conclusions as described below.

(1) Bridge Type

1) Superstructure

The following two types have been finally selected with the agreement of Bina Marga after studying the actual rural conditions of bridge construction. Fig. 3-3-1 shows the cross sections of standard types.

a. Timber beam bridge (hereinafter timber bridge) for roads class III B-1, III B-2 and III C.

b. Reinforced concrete T-girder bridge (hereinafter RC-bridge) for roads class III A.

2) Substructure

Taking account of the actual combinations of super and substructure types noted from the field survey, the following two types are recommended as standard because of ease of construction and economy.

a) Timber pile bents for timber bridge
b) Rubble in Mortar masonry for RC bridge

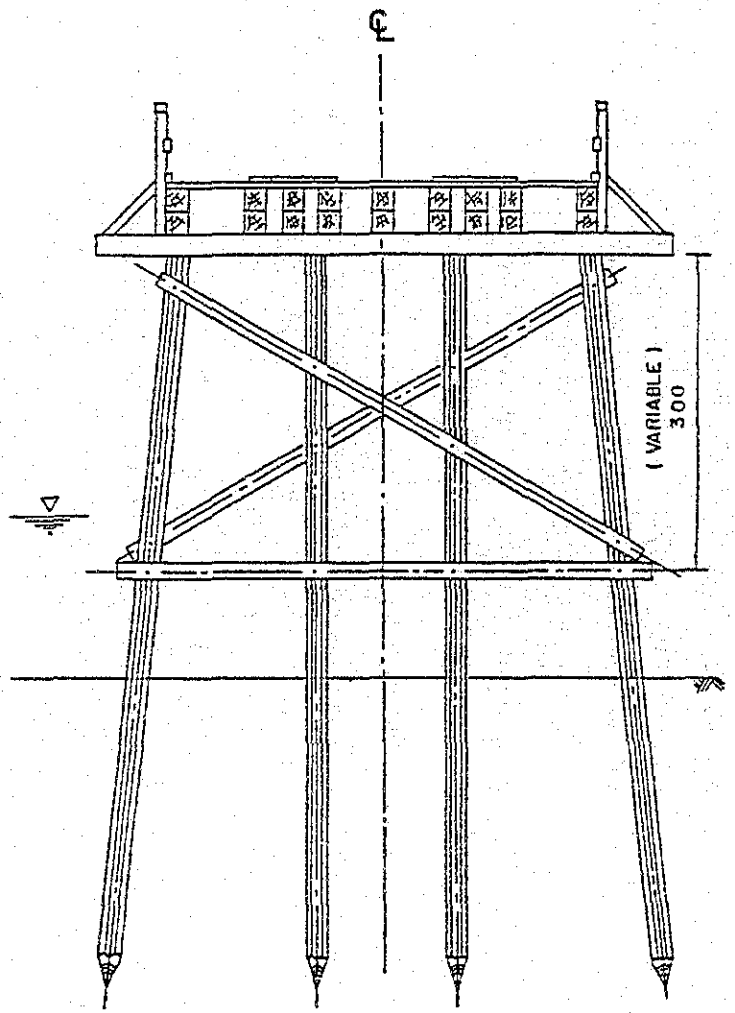
3) Foundation

There is no information of subsoil conditions in the inventory data. However, timber piles of 20 cm diameter are generally recommended as piles of this type are in common use.

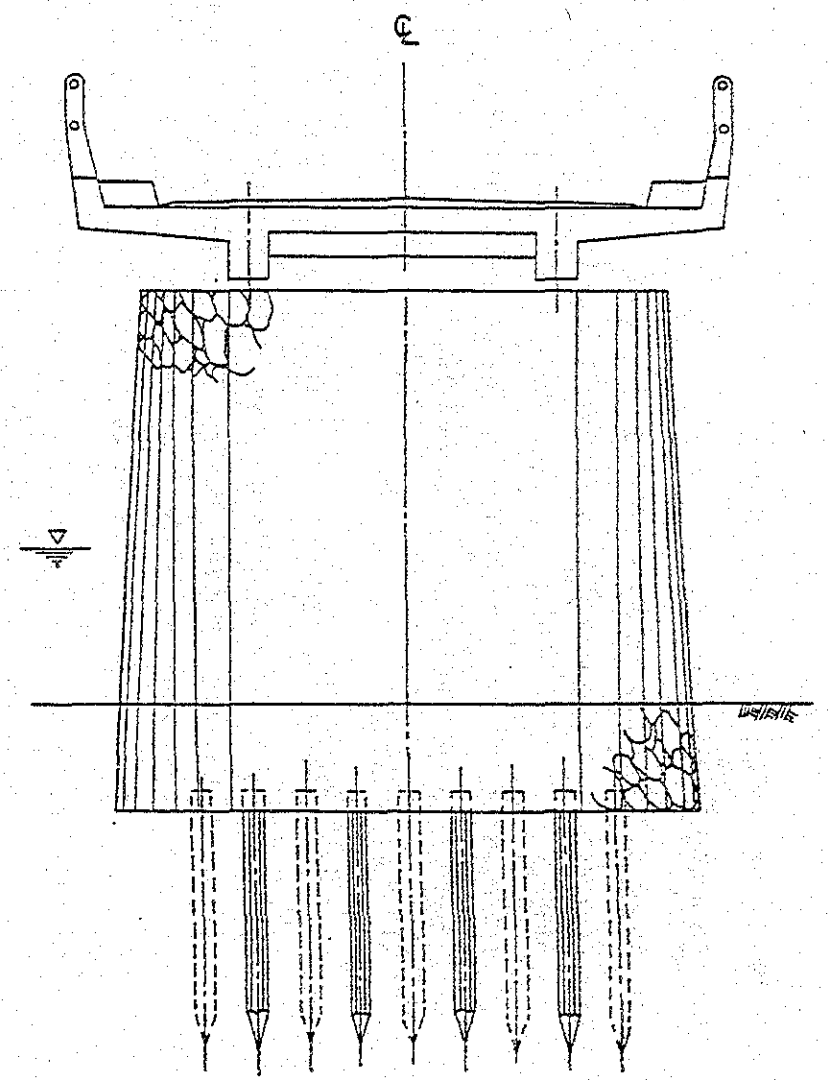
The pile length is suggested to be a minimum of 3 meters under the bottom of the foundation. The length and number of piles should be decided in order to be adequate for the condition of the foundation materials.

Fig. 3-3-1 CROSS SECTIONS OF STANDARD BRIDGES

TIMBER BRIDGE



REINFORCED CONCRETE BRIDGE



(2) Bridge Width

The effective bridge widths for the standard bridges have been decided as follows through discussions with Bina Marga considering the actual width of Kabupaten roads:

a) Timber bridge: 4.0 m in general
b) RC bridge : 4.5 m in general

(3) Span Length

The range of span lengths are determined as:

a) Timber bridge: 3.0, 5.0 and 8.0 m
b) RC bridge : 3.0, 5.0, 10.0 and 15.0 m

3.3.2 Other Structure

Culverts and retaining walls shown in Fig. 3-3-2 and Fig. 3-3-3 are recommended as standard structures.

(1) Culvert

The following two culvert types have been adopted for the transverse drainage.

a) Reinforced concrete pipe culvert ϕ 80 cm
b) Rubble in mortar box culvert with RC slab 80 cm X 80 cm

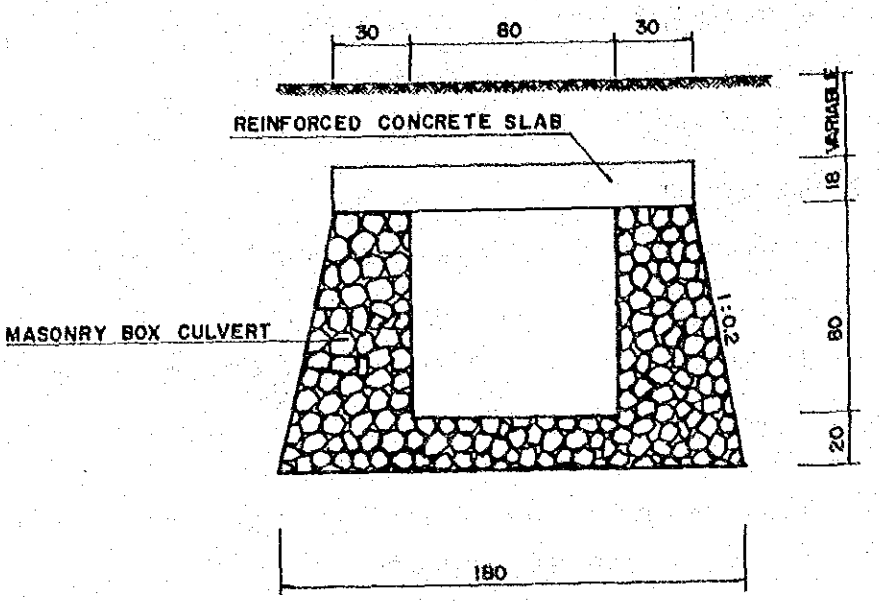
(2) Retaining Wall

The following two types of retaining walls have been adopted because of ease of construction, economy and familiarity in Indonesia.

a) Rubble in mortar retaining wall
b) Timber retaining wall

Fig. 3-3-2 STANDARD CULVERTS

80 x 80 RUBBLE IN MORTAR BOX CULVERTS



Ø 80 RENFORCED CONCRETE PIPE CULVERT

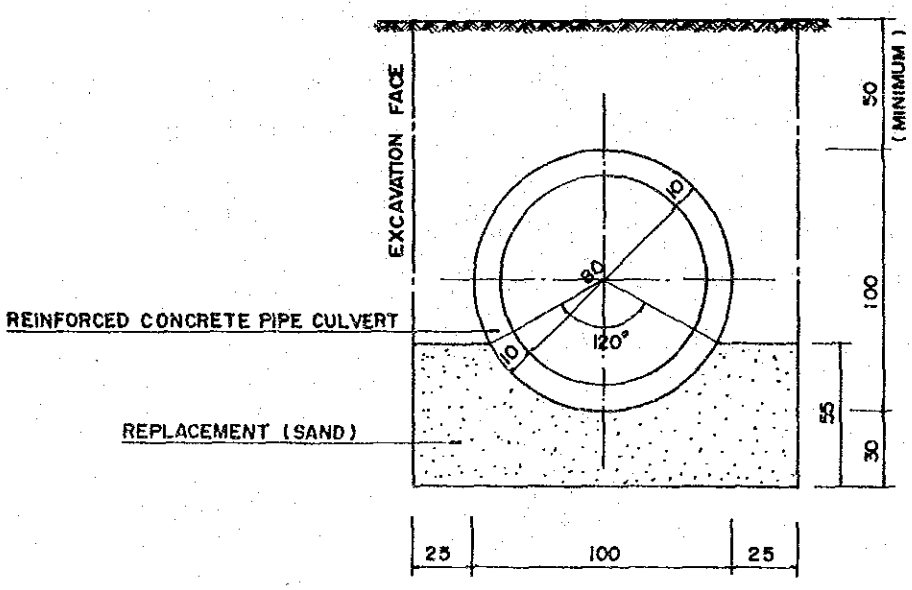
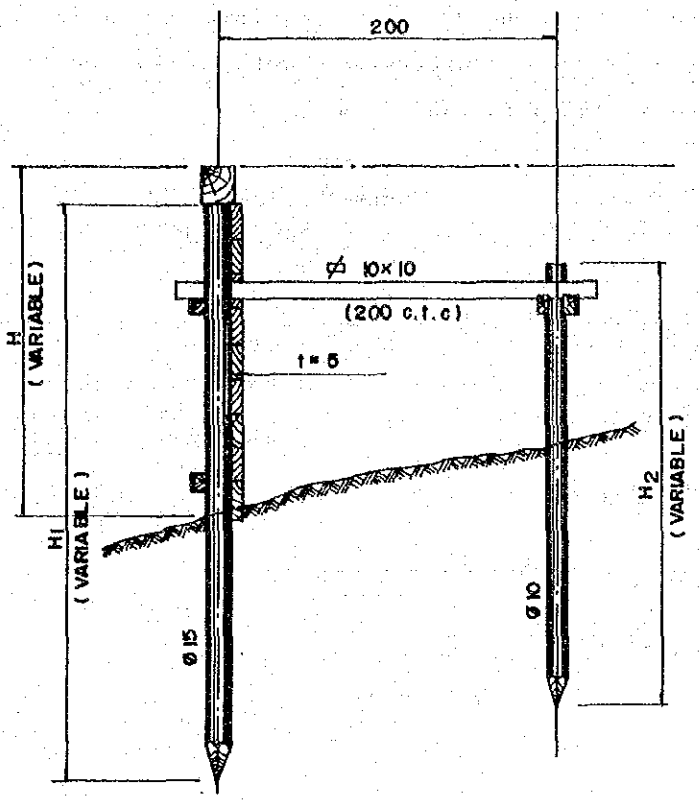
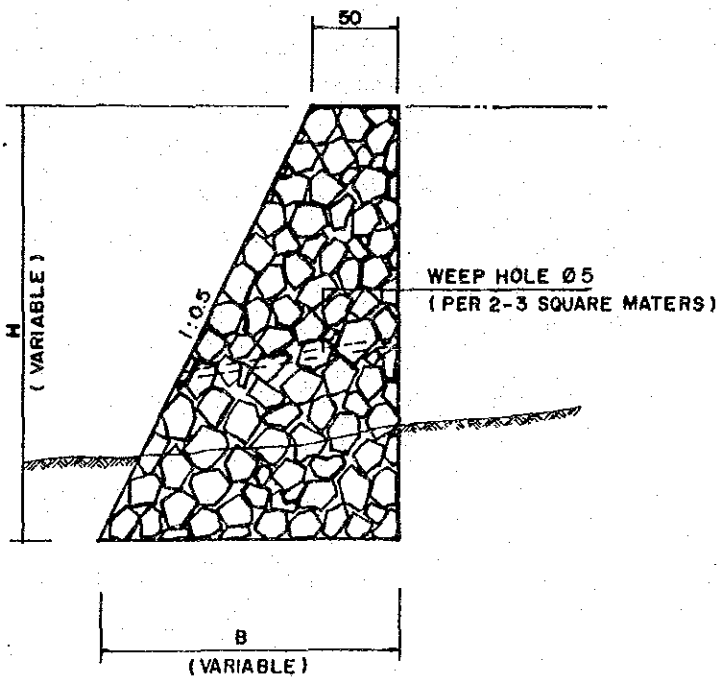


Fig. 3-3-3 STANDARD RETAINING WALLS

TIMBER RETAINING WALL



RUBBLE IN MORTAR WALL



3.4 Selection of Equipment Types

From the results of comparison of two types of Kabupaten road construction methods, i.e. equipment intensive method and labour intensive method construction methods for major works were basically decided as shown in Table 3-4-1.

Table 3-4-1 CONSTRUCTION METHODS FOR MAJOR WORKS

METHOD	WORK TYPE
Equipment Intensive	Earthwork, Base Course and Subbase Course
Labour Intensive	Surface Dressing, Drainage, Bridge and Other Structures.

3.4.1 Points to be Considered for the Selection

Full consideration was given to the following points in studying the selection of equipment type.

a. Most of the construction in the Project is pavement works for road improvement.

b. The pavement width adopted is equal to or less than 4.5 m and therefore large sized equipment is omitted from the selection process.

c. Equipment should be capable of with standing the heavy rainfall and poor soil quality. Equipment for construction in swampy areas is considered if necessary.

d. Uniformity of equipment types with existing equipment is considered to facilitate repair of the equipment in the provincial work shop.

e. Since the scale of the construction is small and transportation of equipment will frequently be necessary, wheel type equipment has been selected as much as possible as this can move by itself or by being towed.

f. The road like to be improved are scattered all over the Kabupatens and therefore a low bed truck or equivalent is necessary for transportation of crawler type equipment. It is desirable to protect the existing pavement from damage caused by the movement of crawler type equipment on the existing roads.

g. The capacity of the equipment has been decided taking into consideration the construction volume and the combination of equipment in the main work.

3.4.2 Combinations of Equipment for Major Works and Maintenance

The combinations of equipment for major works and maintenance are listed in Table 3-4-2 and 3-4-3 respectively.

Table 3-4-2 EQUIPMENT OF ONE WORK GANG FOR MAJOR TYPES OF WORK

TYPE OF WORK	EQUIPMENT REQUIRED	
1. Site Clearing in Light Bush	1- Bulldozer 90 HP 2- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m^3
2. Excavation & Embankment		
i) Normal Fill	1- Bulldozer 90 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
ii) Fill by Borrow Material	1- Bulldozer 90 HP 3- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m^3
iii) Fill in Swamp	1- Swamp Bulldozer 90 HP 1- Water Tank Truck 4,000 Ltr	1- Vibratory Roller 4.0 Ton (D&T)
iv) Excavation to Spoil	1- Bulldozer 90 HP 1- Wheel Loader 1.2 m^3	4- Dump Truck 3.0 Ton
3. Subgrade Preparation	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
4. Subbase Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
5. Base Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Water Tank Truck 4,000 Ltr
6. Cement Stabilizing	1- Motor Grader 70 HP 1- Bulldozer 90 HP 1- Wheel Loader 1.2 m^3 1- Flat Bed Truck 3.0 Ton	1- Vibratory Roller 4.0 Ton (D&T) 1- Road Stabilizer 1- Water Tank Truck 4,000 Ltr
7. Surface Course	1- Asphalt Sprayer 850 Ltr 1- Tyre Roller 8-15 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Flat Bed Truck 3.0 Ton
8. Concrete	1- Concrete Mixer 0.5 m^3 1- Water Pump 200 Ltr/Min 1- Concrete Vibrator 3.3 HP	1- Flat Bed Truck 3.0 Ton 1- Hand-Guided Vibratory Roller 1000 Kg

Table 3-4-3 EQUIPMENT OF ONE WORK GANG FOR MAINTENANCE

TYPE OF WORK	EQUIPMENT REQUIRED
Road	1- Motor Grader
	1- Tyre Roller 8-15 Ton
	1- Hand-Guided Vibratory Roller 1000 Kg
	1- Flat Bed Truck 3.0 Ton
	1- Dump Truck 3.0 Ton
Bridge and Other Structure	1- Flat Bed Truck With Crane 3.0 Ton

3.5 Workshop and Laboratory

3.5.1 Policy of the Kabupaten Workshop

A workshop will be provided for each Kabupaten. The function of the workshop is to cope with requests from the construction site. The main service will be routine maintenance while the secondary service will be light repairs which can be carried out by changing parts. Dismantling and assembling of units which need setting or adjustment using special equipment or facilities will not be carried out in the Kabupaten workshop. Such repairs are planned to be carried out by the provincial workshop or the regional Workshop of Bina Marga.

Accordingly the main tasks of the Kabupaten workshop are as follows:

1) Administration for and storage of equipment
2) Routine maintenance and light repair of equipment
3) Storage and supply of spare parts
4) Operation of equipment including crushing plant.

3.5.2 Workshop Equipment and Tools

Equipment and tools for the workshop are recommended as shown in Table 3-5-1.

Table 3-5-1 WORKSHOP EQUIPMENT AND TOOLS

DESCRIPTION	QUANTITY
Upright Drilling Machine	1 Set
Electric Hand Drill	1
Electric Portable Grinder	1
Disc Grinder	1
Bench Electric Grinder	1
Engineer's Vice	1
DC Electric Welder with Engine	1 Set
Portable Hydraulic Jack, Screw Head	1
Hydraulic Jack	1
Grease Gun	2
Suction Pump for Oil Recovery	2
High Pressure Grease Pump	1

continued

DESCRIPTION	QUANTITY
Drum Opening Spanner	1
Silicon Normal Charger	1
Tyre Changer Air Operated	1
Tyre Service Tool Set	1
Tyre Pressure Gauge	1
Automatic Tyre Inflator	1
Plug Cleaner and Tester	1
Mechanics Tool Set, Heavy Equipment	1
Mechanics Tool Set, Large Vehicle	1
Portable Air Compressor	1
Electric Cord Reel, 15 A, 50 m	1
Oil Measure, Polyethylene	1
Funnel 200 mm, Steel	3
Hand Truck (Cart), 4-Wheel	1
Nylon Sling, 10 ton	2
Chain Block, 1 ton	2
Wire Rope (for sling), 1.8 ton	2
Wire Rope (for sling) 3.2 ton	2
Generator	1

3.5.3 Laboratory

For quality control of construction in the Project it is recommended that a laboratory is provided for each Kabupaten. For each laboratory, provision of laboratory test equipment for the following tests is recommended:

- Physical characteristic, compaction and strength tests for the road bed and pavement materials.
- Slump and strength tests for the bridge concrete.

In the laboratory a fixed water tank should be provided for CBR tests and curing of concrete specimens.

The proposed laboratory equipment is listed in Table 3-5-2.

Table 3-5-2 LABORATORY TEST EQUIPMENT

DESCRIPTION	QUANTITY
Soil Moisture Test Set (JIS A1203)	1
Liquid Limit Set (JIS A1205)	1
Plastic Limit Set (JIS A1206)	1
Compaction Set (JIS A1210)	1
CBR Laboratory Set, Mechanical (JIS A1211)	1
Sand Density Apparatus (JIS A1214)	1
Aggregate Test Sieve Set	1
Portable Cone Pnenetrometer	1
Compression & Bending Test Machine	1
Cylinder Mold (JIS A1132, 1108)	9
Slump Test Apparatus (JIS A1101)	2

To conduct the surveys necessary for road and structure construction such as centering, profile leveling, cross section leveling etc., the surveying equipment listed in Table 3-5-3 recommended.

Table 3-5-3 SURVEYING EQUIPMENT

DESCRIPTION	QUANTITY
Transit	1
Level	1
Staff	3

Chapter 4 CONSTRUCTION AND MAINTENANCE COST ESTIMATIONS

4.1 Unit Price

With regard to the unit prices of materials and labor, the data were collected from each Kabupaten through Bina Marga. The collected data were compared with those of Jakarta using BAHAN BANGUNAN DKI-JAKARTA MAY & JUNE 1985 compiled by PUSAT INFORMASI TEHNIK PEMBANGUNAN, and then finalized.

4.1.1 Unit Labour Price

The unit labour prices of Kabupaten Tana Toraja and other Kabupatens in Sulawesi Selatan Province are shown in Table 4-1-1.

Table 4-1-1 UNIT LABOUR PRICE

(Rp)

KABUPATEN	MAN	SKL LAB	CAP	MAS	LAB	DRIV	OPE
Gowa	2,000	2,000	2,500	2,500	1,500	3,000	3,750
Pangkajene Kepulauan	2,000	2,000	3,000	3,000	1,500	3,500	3,500
Barru	3,000	2,500	3,000	3,000	2,000	3,000	3,500
Soppeng	2,250	2,200	3,000	3,000	1,700	2,750	3,000
Wajo	2,500	2,000	3,000	3,000	1,500	3,000	4,500
Tana Toraja	3,000	2,500	3,000	3,000	2,000	3,500	7,500
Mamuju	2,500	2,000	3,500	3,500	1,500	3,500	5,000
Average	2,464	2,171	3,000	3,000	1,671	3,179	4,393

Notes :

MAN : Mandur
SKL LAB : Skilled Labour
CAP : Carpenter
MAS : Mason
LAB : Labourer
DRIV : Driver
OPE : Operater

4.1.2 Unit Price of Materials

Table 4-1-2 shows the unit price of materials for Kabupaten Tana Toraja together with for other Kabupatens in Sulawesi Selatan Province.

Table 4-1-2 UNIT PRICE OF MATERIALS

(Rp)

MATERIAL	UNIT	GOWA	PANGKAJENE KEPULAUAN	BARRU	SOPPENG
Bitumen	L	275	250	325	250
Asphalt Oil	L	700	700	750	700
Gasoline	L	250	250	250	250
Sand	M^3	4,000	5,000	6,000	5,250
Cement	bag	3,750	3,750	3,750	4,250
River Stone	M^3	4,000	4,500	6,000	5,250
Steel Moulds	Set	7,500	7,000	7,000	7,000
Timber	M^3	200,000	150,000	180,000	225,000
Pain	L	3,500	2,500	2,500	2,500
Reinforcing Steel	Kg	750	750	750	1,000
Tying Wire	Kg	1,200	1,200	1,500	1,500
Equivalent Royalty	M^3	250	250	250	250

MATERIAL	UNIT	WAJO	TANA TORAJA	MAMUJU	AVERAGE
Bitumen	L	275	400	270	295
Asphalt Oil	L	700	800	700	1,000
Gasoline	L	250	250	250	250
Sand	L	5,000	8,000	3,500	5,250
Cement	bag	4,000	4,500	4,500	4,070
River Stone	M^3	7,500	7,000	3,500	5,393
Steel Moulds	Set	7,500	7,000	7,000	7,143
Timber	M^3	200,000	175,000	160,000	184,285
Paint	L	3,500	2,500	2,750	2,820
Reinforcing Steel	Kg	750	1,000	800	825
Tying Wire	Kg	1,500	1,500	1,100	1,357
Equivalent Royalty	M^3	250	250	250	250

4.1.3 Hourly Equipment Cost

The hourly equipment cost for Kabupaten is shown in Table 4-1-3.

Table 4-1-3

HOURLY EQUIPMENT COST

PROVINCE : SULAWESI SELATAN
KABUPATEN : TANA TORAJA

(UNIT : Rp) (6'85)

CODE NO	EQUIPMENT NAME	CLASS	LOCAL COST OWERSHIP	LOCAL COST OPERATION	LOCAL COST SUB-TOTAL	FOREIGN COST OWERSHIP	FOREIGN COST OPERATION	FOREIGN COST SUB-TOTAL	TOTAL COST
	Bulldozer	120 HP	311	12,442	12,753	7,769	1,034	8,803	21,556
	Bulldozer/Ripper	120 HP	340	13,463	13,803	8,500	1,591	10,091	23,894
	Swamp Bulldozer	120 HP	356	13,707	14,063	8,879	1,662	10,541	24,604
	Bulldozer	90 HP	197	8,485	8,682	4,914	654	5,568	14,250
	Bulldozer/Ripper	90 HP	212	9,081	9,293	5,300	992	6,292	15,585
	Bulldozer	65 HP	140	6,163	6,303	3,500	465	3,965	10,268
	Bulldozer/Ripper	65 HP	153	6,616	6,769	3,819	714	4,533	11,302
	Swamp Bulldozer	90 HP	212	9,071	9,283	5,284	989	6,273	15,556
	Swamp Bulldozer	65 HP	162	6,474	6,636	4,050	758	4,808	11,444
	Motor Grader	110 HP	277	10,877	11,154	6,919	1,295	8,214	19,368
	Motor Grader	75 HP	192	7,456	7,648	4,779	894	5,673	13,321
	Motor Grader	65 HP	172	6,564	6,736	4,300	804	5,104	11,840
	Road Stabilizer	W=1850 mm	344	3,414	3,758	8,594	428	9,022	12,780
	Vibratory Roller	4 ton	116	3,261	3,377	2,900	385	3,285	6,662
	Hand-guide Vib. Roller	1000 Kg	102	594	696	850	30	880	1,576
	Tire Roller	8-15 ton	125	7,150	7,275	3,106	103	3,209	10,484
	Vibratory Roller (D&T)	4 ton	116	3,261	3,377	2,900	385	3,285	6,662
	Hand-guide Vib. Roller	600 Kg	72	405	477	600	21	621	1,098
	Rough Terrain Crane	10 ton	402	12,677	13,079	10,039	751	10,790	23,869
	Hydraulic Excavator; Wheel	0.3 m3	165	7,608	7,773	4,109	546	4,655	12,428
	Wheel Loader	1.2 m3	281	8,286	8,567	7,019	934	7,953	16,520
	Wheel Loader	0.3 m3	91	2,888	2,979	2,269	302	2,571	5,550
	Water Tank Truck	4000 ltr.	105	2,751	2,856	868	124	992	3,848
	Fuel Tank Truck	4000 ltr.	106	2,758	2,864	882	126	1,008	3,872
	Dump Truck	3.0 ton	177	3,473	3,650	1,469	210	1,679	5,329
	Flat Bed Truck with Crane	3.0 ton	69	2,989	3,058	1,717	128	1,845	4,903
	Dump Loader Truck	12 ton	154	18,257	18,411	3,838	127	3,965	22,376
	Dump Truck	5.0 ton	263	5,727	5,990	2,189	313	2,502	8,492
	Flat Bed Truck	3.0 ton	23	2,559	2,582	563	42	605	3,187
	Portable Crusher/Screening	30-40 t/h	752	21,038	21,790	18,800	2,502	21,302	43,092
	Concrete Mixer	0.5 m3	648	2,460	3,108	5,400	435	5,835	8,943
	Water Pump	200 l/min	23	254	277	188	6	194	471
	Concrete Vibrator	3.3 HP	9	217	226	73	2	75	301
	Asphalt Sprayer	850 ltr.	123	765	888	1,019	145	1,164	2,052

4.2 Unit Construction Cost by Work Type

4.2.1 All Works Except Bridges

The unit construction costs by work type, excluding bridge construction costs, have been estimated using the combination of equipment described in Clause 3.4 and the unit prices already listed. The results are summarized in Table 4-2-1.

Table 4-2-1 UNIT COST BY WORK TYPE EXCEPT BRIDGE WORK

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Site Clearance in Light Bush	m2	170	91	261
Subgrade Preparation	m2	22	11	33
Normal Fill	m3	1,740	865	2,605
Fill in Swamp	m3	2,586	1,055	3,641
Normal Excavation to Spoil	m3	1,011	524	1,535
Sub Base Course	m3	3,272	1,351	4,623
Base Course	m3	4,500	2,303	6,803
Shoulder	m2	311	146	457
Asphalt Patching	m2	3,848	1,515	5,363
Surface Dressing (Single)	m2	658	766	1,424
Surface Dressing (Double)	m2	814	1,207	2,021
Earth Drain	m	925	119	1,044
Earth Drain in Swamp (by machine)	m3	1,231	475	1,706
Pipe Culvert D80cm	m	47,928	50,157	98,085
Masonry Culvert (80x80cm)	m	67,346	40,314	107,660
Retaining Wall and Wing Wall (Timber)	m2	16,210	246	16,456
Retaining Wall and Wing Wall (Masonry)	m3	48,423	11,706	60,129
Gabion Protection	m3	13,236	121	13,357
Manual routine maintenance of road	Km	149,984	7,260	157,244
Routine maintenance of earth road	Km	97,686	37,948	135,634
Routine maintenance of gravel road	Km	195,757	88,186	283,943
Routine maintenance of asphalt road	Km	384,800	151,500	536,300

4.2.2 Bridges

The unit construction costs by bridge type including the cost of demolition of existing bridges are shown in Table 4-2-2.

Table 4-2-2 BRIDGE COST

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Superstructure (Timber;Span 3m;10T)	m2	57,099	3,541	60,640
Superstructure (Timber;Span 5m;10T)	m2	63,246	3,910	67,156
Superstructure (Timber;Span 8m;10T)	m2	83,772	5,137	88,909
Superstructure (Timber;Span 3m;BM50)	m2	70,800	4,379	75,179
Superstructure (Timber;Span 5m;BM50)	m2	77,295	4,745	82,040
Superstructure (Timber;Span 8m;BM50)	m2	98,031	6,007	104,038
Superstructure (Concrete;Span 3m;BM50)	m2	61,533	105,772	167,305
Superstructure (Concrete;Span 5m;BM50)	m2	63,026	118,305	181,331
Superstructure (Concrete;Span 8m;BM50)	m2	64,794	128,925	193,719
Superstructure (Concrete;Span10m;BM50)	m2	70,745	146,523	217,268
Superstructure (Concrete;Span15m;BM50)	m2	75,991	172,720	248,711
Substructure (Pier;for Timber;10T)	NO	497,331	32,863	530,194
Substructure (Abut;for Timber;10T)	NO	1,344,783	154,495	1,499,278
Substructure (Pier;for Timber;BM50)	NO	731,419	48,632	780,051
Substructure (Abut;for Timber;BM50)	NO	1,521,240	171,666	1,692,906
Substructure (Pier;for Concrete;BM50)	NO	1,859,838	467,969	2,327,807
Substructure (Abut;for Concrete;BM50)	NO	3,911,821	984,591	4,896,412
Demolition of Bridge (Timber->Timber)	m2	15,752	1,374	17,126
Demolition of Bridge (Timber->Concrete)	m2	15,752	1,374	17,126
Demolition of Bridge (Concrete)	m2	93,530	79,848	173,378
Maintenance of Timber Bridge (New)	m2	10,146	1,121	11,267
Maintenance of Concrete Bridge (New)	m2	2,161	3,002	5,163
Maintenance of Timber Bridge (Exist)	m2	8,831	2,405	11,236
Maintenance of Concrete Bridge (Exist)	m2	4,190	2,445	6,635

Chapter 5 RESULTS OF ECONOMIC FEASIBILITY EVALUATION

5.1 Preliminary Screening

The road links to be improved should be effective for development of the Project Area. The road links where improvements were assumed to be inefficient for development of the Project Area were generally screened out using the following cut-off criteria.

(1) Very short roads, less than 2 Km long, which have no connection with the trunk road network.

(2) Roads not connected to the network at any point

(3) Unpreferred roads, due to poor suitability for transportation compared to other existing alternative roads serving the same purpose.

(4) Road in good condition according to the Bina Marga road inventory which lists improvement projects carried out in the last two or three years

(5) Roads with asphalt surface in good condition

(6) Urban roads, except those forming part of a longer route

(7) Roads serving single large organizations rather than the general public

(8) Roads with no inventory data

(9) Kabupaten roads also assigned as provincial roads

The road links to be screened out in Kabupaten Tana Toraja are shown in Table 5-1-1.

Table 5-1-1 ROAD LINKS TO BE SCREENED OUT

KABUPATEN : TANA TORAJA

CRITERIA NO	ROAD LINK NO
(8)	04,18,19,21,22

5.2 Evaluation

5.2.1 Primary Analysis

The Kabupaten roads were classified by using the future traffic volume on the road links in 1998. The primary analysis of the IRR was carried out using the construction and maintenance costs. Road links where IRRs were more than 10% were defined as feasible links.

Results of primary analysis are shown in Table 5-2-1.

5.2.2 Secondary Analysis

From the infeasible road links evaluated by the primary analysis, road links where the IRRs were between 1% and 10%, i.e. road links which could become feasible if down graded by one rank, in classification were down graded and the costs re-estimated. Using these costs, a secondary analysis of IRR was carried out. Road links where these IRRs were then more than 10% were also defined as feasible links. This reflected that even though the road classification was rather low the road link should be improved.

Results of secondary analysis are shown in Table 5-2-2.

5.2.3 Ranking of Feasible Road Links

From the results of the primary and secondary analysis, road links where the IRRs were more than 10% were selected and their NPVs and B/Cs were estimated. The ranking of feasible road links from the economic evaluation are decided in the order of the NPVs, i.e. the larger the NPV the higher the road link priority as shown in Table 5-2-3.

Table 5-2-1 (1) RESULTS OF PRIMARY ANALYSIS

PROVINCE : SULAWESI SELATAN KABUPATEN : TANA TORAJA

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
32	10 Km	IIIA	71.607	VOC
59	8 Km	IIIB-1	61.986	VOC
49	8 Km	IIIB-1	53.959	VOC
41	5 Km	IIIA	47.201	VOC
34	20 Km	IIIA	37.572	VOC
33	7 Km	IIIA	37.254	VOC
29	5 Km	IIIB-1	35.879	VOC
6	16 Km	IIIB-2	31.789	Surplus
5	17 Km	IIIB-1	28.667	Surplus
31	13 Km	IIIB-1	24.332	VOC
42	4 Km	IIIB-2	23.495	VOC
17	1 Km	IIIB-2	16.903	VOC
7	5 Km	IIIB-1	11.220	VOC
23	5 Km	IIIB-1	6.188	VOC
57	8 Km	IIIB-2	1.332	Surplus
1	3 Km	IIIB-2	0.078	VOC
20	8 Km	IIIC	0.078	Surplus
2	9 Km	IIIC	0.078	Surplus
24	10 Km	IIIC	0.078	Surplus
25	5 Km	IIIC	0.078	Surplus
26	6 Km	IIIC	0.078	Surplus
27	2 Km	IIIB-1	0.078	VOC
28	13 Km	IIIB-2	0.078	Surplus
3	5 Km	IIIB-1	0.078	VOC
30	5 Km	IIIB-2	0.078	VOC
8	4 Km	IIIB-2	0.078	Surplus
9	6 Km	IIIB-2	0.078	Surplus
10	15 Km	IIIB-2	0.078	Surplus
11	12 Km	IIIB-2	0.078	VOC
35	10 Km	IIIC	0.078	Surplus
36	42 Km	IIIB-2	0.078	Surplus
37	15 Km	IIIC	0.078	Surplus
38	8 Km	IIIA	0.078	VOC
39	7 Km	IIIC	0.078	Surplus
40	2 Km	IIIC	0.078	Surplus
12	7 Km	IIIB-1	0.078	VOC
13	13 Km	IIIC	0.078	Surplus
43	9 Km	IIIC	0.078	Surplus
44	10 Km	IIIC	0.078	Surplus
45	6 Km	IIIC	0.078	Surplus
46	6 Km	IIIC	0.078	Surplus
47	9 Km	IIIC	0.078	Surplus
48	4 Km	IIIC	0.078	Surplus
14	15 Km	IIIC	0.078	Surplus
50	4 Km	IIIC	0.078	Surplus
51	4 Km	IIIC	0.078	Surplus
53	4 Km	IIIC	0.078	Surplus
54	4 Km	IIIC	0.078	Surplus
55	10 Km	IIIC	0.078	Surplus
56	5 Km	IIIC	0.078	Surplus

Table 5-2-1 (2) RESULTS OF PRIMARY ANALYSIS

PROVINCE : SULAWESI SELATAN KABUPATEN : TANA TORAJA

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
15	16 Km	IIIC	0.078	Surplus
58	7 Km	IIIC	0.078	Surplus
16	12 Km	IIIC	0.078	Surplus
60	12 Km	IIIB-2	0.078	Surplus
61	5 Km	IIIB-2	0.078	Surplus

Table 5-2-2 RESULTS OF SECONDARY ANALYSIS

PROVINCE : SULAWESI SELATAN KABUPATEN : TANA TORAJA

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
23	5 Km	IIIB-2	13.270	VOC
57	8 Km	IIIC	3.263	Surplus

Table 5-2-3 RANKING OF FEASIBILITY ROAD LINKS

PROVINCE : SULAWESI SELATAN KABUPATEN : TANA TORAJA

LINK NO	LENGTH	CLASS	NPV (1000Rp)	B/C	IRR (%)	REMARK
34	20 Km	IIIA	631150	2.251	37.572	VOC
59	8 Km	IIIB-1	546586	3.745	61.986	VOC
32	10 Km	IIIA	434221	3.351	71.607	VOC
49	8 Km	IIIB-1	369978	3.197	53.959	VOC
5	17 Km	IIIB-1	362721	1.846	28.667	Surplus
41	5 Km	IIIA	249602	2.905	47.201	VOC
6	16 Km	IIIB-2	238938	1.991	31.789	Surplus
33	7 Km	IIIA	159986	2.176	37.254	VOC
31	13 Km	IIIB-1	124090	1.564	24.332	VOC
29	5 Km	IIIB-1	93248	2.108	35.879	VOC
42	4 Km	IIIB-2	25854	1.555	23.495	VOC
7	5 Km	IIIB-1	5263	1.041	11.220	VOC
23	5 Km	IIIB-2	4584	1.109	13.270	VOC
17	1 Km	IIIB-2	3001	1.271	16.903	VOC
SUM	124 Km		3249222			

Chapter 6 IMPLEMENTATION PROGRAMME

6.1 Implementation Schedule

6.1.1 Project Cost

The total Project Cost for the Kabupaten is composed of the cost of construction and maintenance, supplementation as described later, and workshop, laboratory and survey equipment. The total Project Cost for the Kabupaten is summarized in Table 6-1-1.

Table 6-1-1 TOTAL PROJECT COST (1)

KABUPATEN: Tana Toraja

(Rpx10^6)

COST	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
CONSTRUCTION	995	1,567	2,562
MAINTENANCE	156	516	672
SUPPLEMENTATION	413	-	413
WORKSHOP EQUIPMENT & TOOLS	28	-	28
LABORATORY EQUIPMENT	12	-	12
SURVEY EQUIPMENT	5	-	5
TOTAL	1,609	2,083	3,692

The total Project Cost can be divided into costs as shown in Table 6-1-2.

Table 6-1-2 TOTAL PROJECT COST (2)

(Rpx10^6)

COST	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
CIVIL WORK	539	2,064	2,603
CONSTRUCTION & MAINTENANCE EQUIPMENT	951	-	951
SPARE PARTS	74	19	93
WORKSHOP/LABORATORY/SURVEY EQUIPMENT	45		
TOTAL	1,609	2,083	3,692

The cost for civil work is composed of the cost of labour and materials, operation cost excluding spare parts, indirect cost and transportation cost of equipment.

6.1.2 Proposed Road Links

(1) Road Link to be Improved

The road links to be improved were generally selected taking into consideration the following criteria:

(1) Feasible road links
- Feasible road links from the primary evaluation
- Feasible road links from the secondary evaluation

(2) Road links selected from the engineering points of view

(3) Road links selected because of basic human needs.

The road links finally proposed to be improved in the Kabupaten are the 16 links with the total length of 141 km which is 29% of the 484 km total length of Kabupaten roads studied. The proposed road links are shown in Table 6-1-3.

Table 6-1-3 ROAD LINKS TO BE IMPROVED

KABUPATEN : TANA TORAJA

REASON FOR SELECTION	ROAD LINK NO
Feasible	
- Primary	5,6,7,17,29,31,32,33,34,41,42,49,59
- Secondary	23
Engineering Point of View	36,54
Basic Human Needs	-

As the table shows all feasible road links are proposed to be improved.

Since Road Links No 36 and No 54 are key road links which are located at the strategic point to complete the local road network consisting of feasible road links, these road links are selected from the engineering points of view.

The order of proceeding with the improvement of the proposed road links are decided as shown in Table 6-1-4.

Table 6-1-4 ROAD LINKS TO BE IMPROVED BY YEAR

PROV : SULAWESI SELATAN KAB : TANA TORAJA

YEAR	LINK NO	( ) : rate
1988	7, 17, 32	
1989	6, 33, 34 (50%), 42	
1990	5 (40%), 34 (50%), 41, 49	
1991	5 (60%), 23, 29, 31, 54, 59	
1992	36 (30%)	

KAB · TANA TORAJA

CONSTRUCTION PROGRAMME

ROAD LINK NUMBER	FISCAL YEAR				
	1989/90	1990/91	1991/92	1992/93	
37,17,53	202				
38,53		626			
34,48					
39,36			579		
41,49					
39,29,28				711	
31,54,59					
58					542
TOTAL COST (10⁶ Rp)	202	626	579	711	542

KEC · RINDINGALLO

KEC · SESEAN

KEC · SALUPUTTI

KEC · BONGGAKARADENG

KEC · MAKALE

KEC · SANGGALANGI

KEC · SANGALLA

KEC · MENGKENDEK

KEC · RANTE-PAO

SAPAN

BARUPPU

KEPALA PITU

SANGKAROPI

SADAN ULUSALU

SADAN MALIMBONG

SADAN

TONDOK-LITAK

KEPE'

PANGLI

TANDUNG

KE PALOPO

SOLOKAN

TIKALA

SARANA

SARAMBU

SEKO

SINGKI

RANTEPAO

SUMTULEPONG

NANGGALA

RURA

MASANDA

REMBON

DENDE'

PIONGAN

SALU

ALANG

LONDA

LABO

SULLUKAN

TANDUNG

ULUSALU

SP. SALU

MADAMAN

TOMBANG-KALUA

BUNTAO'

PITUMB-PENANIAN

LAPANDAN

RANTE TAYO

LEMO

BOKIN

BATU SURA

SUNTANG

SALLUALLO TETEBASSI

TOKA-LINDARAN

KIATANG

KONDORAN

KAERO

PENANDA

BATU PAPAN

KOKARA

PASSOBO

SP. RUISUK

SUSUK

LAMUNAN

LEON

MAKALE

LEATUNG

SUNGALU

SERA

SALA

MAKULA

BATU ALU

MAPPA

TOBUAKON

MARINGGO

SAPAN DEATA

MINANGA

GETENGAN

PABUARAN

BUAKAYU

NEBALI

TINORING

SINGUANG

GANDANGBATU

PATENGKO

BUANGIN

LANGSO

SALUBA-RAMI

KARANGAN

MALIBA

ULUWAI

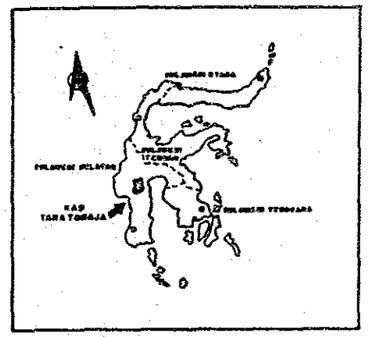
RANO

KE ENREKANG

SCALE :

0 5 10 15 Km

LOCATION MAP



LEGEND :

- KABUPATEN CAPITAL
- KECAMATAN CAPITAL
- OTHER CITY
- (3) LINK NUMBER
- PROVINCIAL BOUNDARY
- KABUPATEN BOUNDARY
- KECAMATAN BOUNDARY
- NATIONAL ROAD
- PROVINCE ROAD
- KABUPATEN ROAD
- VILLAGE ROAD
- RIVER

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

TITLE : CONSTRUCTION PROGRAMME

SOURCE:	SCALE:	PROVINCE : SULAWESI SELATAN
DIREKTORAT JENDERAL CIPTA KARYA	AS SHOWN	KABUPATEN : TANA TORAJA

(2) Road Links to Be Maintained

It is desirable that all Kabupaten roads are maintained. However, because of the limited budget it is inevitable that some road links in the Kabupatens will be left without maintenance for the time being. The budget should be used for those which are effective in producing more useful development of the Kabupaten through the road development project. The road links to be maintained are finally proposed as shown in Table 6-1-5.

Table 6-1-5 ROAD LINKS TO BE MAINTAINED

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(1000Rp)

LINK NO	LENGTH (Km)	BA (%)	SD (%)	RU (%)	RB (%)	ASPHAL (Km)	GRAVEL (Km)	EARTH (Km)	TH NO	AREA (m2)	BC NO	AREA (m2)	BRIDGE COST	LOCAL COST	FOREIGN COST	TOTAL COST
1	3	26.7	43.3	30.0	0.0	0	3	0	0	0.00	2	60.00	398	1,289	433	1,722
2	9	58.9	35.0	6.1	0.0	0	6	3	0	0.00	3	68.00	451	3,102	875	3,977
3	5	46.0	42.0	12.0	0.0	5	0	0	0	0.00	1	48.00	318	2,875	911	3,786
8	4	50.0	32.5	17.5	0.0	0	4	0	1	44.00	1	10.00	561	1,813	512	2,325
9	6	33.3	43.3	23.3	0.0	0	6	0	0	0.00	4	61.80	410	2,333	724	3,057
10	15	55.0	13.0	19.3	12.7	0	15	0	0	0.00	2	28.00	186	5,303	1,500	6,803
11	12	69.7	12.8	3.3	14.2	0	6	6	4	160.00	0	0.00	1,798	4,973	1,229	6,202
12	7	77.6	22.4	0.0	0.0	7	0	0	0	0.00	0	0.00	0	3,743	1,111	4,854
15	16	13.1	40.1	40.6	6.3	0	16	0	0	0.00	1	18.00	119	5,607	1,571	7,178
16	12	42.5	41.7	15.8	0.0	0	12	0	2	64.00	3	40.00	985	4,882	1,397	6,279
20	8	52.5	15.0	32.5	0.0	0	8	0	0	0.00	1	36.00	239	2,917	852	3,769
23	5	25.0	57.0	16.0	2.0	1	4	0	0	0.00	1	12.00	80	1,968	570	2,538
24	10	72.5	18.5	9.0	0.0	3	7	0	0	0.00	3	264.00	1,752	5,131	1,790	6,921
25	5	65.0	27.0	8.0	0.0	0	5	0	0	0.00	3	210.00	1,446	2,642	1,010	3,652
27	2	70.0	25.0	5.0	0.0	2	0	0	0	0.00	1	84.00	557	1,422	523	1,945
28	13	41.5	31.5	26.9	0.0	0	12	1	0	0.00	9	119.50	793	4,897	1,483	6,380
29	5	0.0	57.0	25.0	18.0	0	3	2	0	0.00	1	40.00	265	1,700	475	2,175
30	5	56.0	23.0	11.0	10.0	4	1	0	0	0.00	2	66.00	438	2,761	892	3,653
31	13	31.5	35.4	33.1	0.0	0	13	0	0	0.00	6	174.00	1,154	5,224	1,666	6,890
32	10	52.2	17.8	29.5	0.5	9	1	0	1	469.53	2	42.00	5,554	9,481	2,756	12,237
33	7	67.1	21.4	11.4	0.0	0	7	0	0	0.00	1	160.00	1,062	3,091	1,059	4,150
37	15	36.5	55.7	7.8	0.0	0	15	0	0	0.00	3	54.00	358	5,412	1,564	6,976
38	8	98.9	0.0	1.1	0.0	8	0	0	0	0.00	2	116.40	772	4,766	1,555	6,321
40	2	20.0	50.0	30.0	0.0	0	2	0	0	0.00	1	28.00	186	809	259	1,068
48	4	0.0	99.0	1.0	0.0	0	0	4	0	0.00	0	0.00	0	991	181	1,172
50	4	7.5	55.0	36.3	1.3	0	0	4	0	0.00	0	0.00	0	991	181	1,172
57	8	0.0	85.6	14.4	0.0	0	0	8	1	18.00	0	0.00	202	2,140	405	2,545
SUM	213					39	146	28	9	755.53	53	1747.70	20,085	92,263	27,484	119,747

6.1.3 Annual Construction and Maintenance Cost

The annual allocation of the total construction and maintenance cost in the five years programme for Kabupaten Tana Toraja is finally recommended as shown in Tables 6-1-6 (1), (2) and (3) for the construction, maintenance and total respectively.

The proposed construction cost is Rp 2,562 x 10^6 and maintenance cost is Rp 672 x 10^6 which is approximately 21% of the total expenditure.

Table 6-1-6 (1) CONSTRUCTION AND MAINTENANCE COST
(CONSTRUSTION)

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(UNIT : 1000Rp)

I T E M	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	115,837	316,489	338,780	426,479	369,503	1,567,088	(61.2%)
Ownership Cost	1,923	5,823	5,897	7,287	8,347	29,277	(1.9%)
Operation Cost	50,010	142,289	145,841	180,929	217,556	736,625	(47.0%)
Material Cost	26,864	48,608	65,021	86,591	10,762	237,846	(15.2%)
Labour Cost	21,931	70,488	77,832	96,044	84,642	358,937	(22.9%)
Contingency	15,109	41,281	44,189	55,628	48,196	204,403	(13.0%)
FOREIGN CURRENCY :	86,971	209,536	241,169	284,634	172,712	995,022	(38.8%)
Ownership Cost	28,380	81,638	83,289	103,413	123,054	419,774	(42.2%)
Operation Cost	4,026	11,571	11,679	14,565	18,954	60,795	(6.1%)
Material Cost	43,221	88,996	114,744	129,530	8,176	384,667	(38.7%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	11,344	27,331	31,457	37,126	22,528	129,786	(13.0%)
TOTAL COST :	202,808	526,025	579,948	711,113	542,215	2,562,109	
Ownership Cost	30,303	87,461	89,186	110,700	131,401	449,051	(17.5%)
Operation Cost	54,036	153,860	157,520	195,494	236,510	797,420	(31.1%)
Material Cost	70,085	137,604	179,765	216,121	18,938	622,513	(24.3%)
Labour Cost	21,931	70,488	77,832	96,044	84,642	358,937	(14.0%)
Contingency	26,453	68,612	75,645	92,754	70,724	334,188	(13.0%)

(Contingency : 15%)

Table 6-1-6 (2) CONSTRUCTION AND MAINTENANCE COST

(MAINTENANCE)

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	43,719	96,389	106,249	123,158	146,610	516,125	(76.8%)
Ownership Cost	595	1,321	1,465	1,759	2,176	7,316	(1.4%)
Operation Cost	20,669	44,886	49,341	55,631	63,982	234,509	(45.4%)
Material Cost	1,704	4,764	5,074	6,412	7,604	25,558	(5.0%)
Labour Cost	20,751	45,418	50,369	59,356	72,848	248,742	(48.2%)
FOREIGN CURRENCY :	13,047	28,985	31,905	37,566	44,800	156,303	(23.2%)
Ownership Cost	10,409	22,735	24,959	28,212	32,347	118,662	(75.9%)
Operation Cost	1,190	2,554	2,822	3,163	3,651	13,380	(8.6%)
Material Cost	1,448	3,696	4,124	6,191	8,802	24,261	(15.5%)
Labour Cost	0	0	0	0	0	0	(0.0%)
TOTAL COST :	56,766	125,374	138,154	160,724	191,410	672,428	
Ownership Cost	11,004	24,056	26,424	29,971	34,523	125,978	(18.7%)
Operation Cost	21,859	47,440	52,163	58,794	67,633	247,889	(36.9%)
Material Cost	3,152	8,460	9,198	12,603	16,406	49,819	(7.4%)
Labour Cost	20,751	45,418	50,369	59,356	72,848	248,742	(37.0%)

Table 6-1-6 (3) CONSTRUCTION AND MAINTENANCE COST

(TOTAL)

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	159,556	412,878	445,029	549,637	516,113	2,083,213	(64.4%)
Ownership Cost	2,518	7,144	7,362	9,046	10,523	36,593	(1.8%)
Operation Cost	70,679	187,175	195,182	236,560	281,538	971,134	(46.6%)
Material Cost	28,568	53,372	70,095	93,003	18,366	263,404	(12.6%)
Labour Cost	42,682	123,906	128,201	155,400	157,490	607,679	(29.2%)
Contingency	15,109	41,281	44,189	55,628	48,196	204,403	(9.8%)
FOREIGN CURRENCY :	100,018	238,521	273,074	322,200	217,512	1,151,325	(35.6%)
Ownership Cost	38,789	104,373	108,248	131,625	155,401	538,436	(46.8%)
Operation Cost	5,216	14,125	14,501	17,728	22,605	74,175	(6.4%)
Material Cost	44,669	92,692	118,868	135,721	16,978	408,928	(35.5%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	11,344	27,331	31,457	37,126	22,528	129,786	(11.3%)
TOTAL COST :	259,574	651,399	718,102	871,837	733,625	3,234,537	
Ownership Cost	41,307	111,517	115,610	140,671	165,924	575,029	(17.8%)
Operation Cost	75,895	201,300	209,683	254,288	304,143	1,045,309	(32.3%)
Material Cost	73,237	146,064	188,963	228,724	35,344	672,332	(20.8%)
Labour Cost	42,682	123,906	128,201	155,400	157,490	607,679	(18.8%)
Contingency	26,453	68,612	75,645	92,754	70,724	334,188	(10.3%)

(Contingency : 15%)

6.1.4 Construction and Maintenance Equipment Cost

(1) Required Number of Equipment

The required numbers of construction equipment for Kabupaten Tana Toraja are estimated from the annual proposed construction quantities as shown in Table 6-1-7.

The proposed numbers of equipment to be purchased are finally decided considering the following number of existing equipment in the Kabupaten which are available for the Project .

- Nil

The proposed numbers of maintenance equipment have been decided as shown below from the proposed annual maintenance volume taking into account the capacity of the proposed maintenance gangs.

a. Equipment for Road Maintenance

- 1-Flat Bed Truck 3 Ton

b. Equipment for Bridge Mintenance

- Nil

(2) Equipment Cost

The proposed construction and maintenance equipment and their purchase costs are shown in Table 6-1-8. In the Project the supplementation cost or equipment cost supplemented is the difference between the purchase cost for newly supplied equipment and the depreciated value.

This comes about because full depreciation of the supplied equipment would not be completed within the Project Period of 5 years.

Table 6-1-7 REQUIRED NUMBER OF EQUIPMENT

PROV : SULAWESI SELATAN KAB : TANA TORAJA

EQUIPMENT NAME	WORKABLE	EXISTING	(1988)	(1989)	(1990)	(1991)	(1992)
Bulldozer/Ripper	220	0	0.64	1.31	1.28	1.69	5.59
Swamp Bulldozer	220	0	0.00	0.00	0.00	0.00	0.00
Motor Grader	240	0	0.28	0.89	0.95	1.21	0.36
Hand-guide Vib. Roller	240	0	0.08	0.43	0.41	0.53	0.21
Tire Roller	220	0	0.39	0.58	0.86	1.00	0.00
Vibratory Roller (D&T)	240	0	0.35	1.13	1.12	1.40	3.19
Hydraulic Excavator; Wheel	220	0	0.00	0.00	0.01	0.01	0.00
Wheel Loader	240	0	0.65	1.73	1.77	2.22	2.49
Water Tank Truck	240	0	0.16	0.71	0.70	0.84	1.64
Dump Truck	240	0	4.23	13.54	13.40	16.53	18.85
Flat Bed Truck with Crane	240	0	0.01	0.30	0.25	0.40	0.17
Flat Bed Truck	240	0	0.43	0.77	1.07	1.27	0.08
Portable Crusher/Screening	240	0	0.10	0.33	0.32	0.37	0.01
Concrete Mixer	220	0	0.01	0.13	0.14	0.16	0.05
Water Pump	220	0	0.01	0.11	0.11	0.13	0.04
Concrete Vibrator	220	0	0.01	0.05	0.04	0.07	0.03
Asphalt Sprayer	220	0	0.39	0.58	0.86	1.00	0.00

NOTE WORKABLE : workable days in a year
EXISTING : number of existing equipment

Table 6-1-8 EQUIPMENT PURCHASE COST

PROV : SULAWESI SELATAN KAB : TANA TORAJA

(1000 Rp)

EQUIPMENT NAME	CLASS	CIF (JAKARTA)	PURCHASE NO.	PURCHASE COST
Bulldozer	90 HP	49,150	-	-
Bulldozer/Ripper	90 HP	53,000	2	106,000
Swamp Bulldozer	90 HP	52,850	-	-
Swamp Bulldozer	65 HP	40,500	-	-
Motor Grader	75 HP	47,800	2	95,600
Road Stabilizer	W=1850 mm	85,950	-	-
Hand-guide Vib. Roller	1000 Kg	8,500	1	8,500
Tire Roller	8-15 ton	31,070	1	31,070
Vibratory Roller (D&T)	4 ton	29,000	2	58,000
Vibratory Roller	4 ton	29,000	-	-
Rough Terrain Crane	10 ton	100,400	-	-
Hydraulic Excavator; Wheel	0.3 m3	41,100	-	-
Wheel Loader	1.2 m3	70,200	2	140,400
Water Tank Truck	4000 ltr.	12,750	1	12,750
Dump Truck	3.0 ton	14,700	15	220,500
Dump Loader Truck	12 ton	56,300	-	-
Flat Bed Truck with Crane	3.0 ton	25,190	1	25,190
Flat Bed Truck	3.0 ton	11,275	2	22,550
Portable Crusher/Screening	30-40 t/h	188,000	1	188,000
Concrete Mixer	0.5 m3	18,000	-	-
Water Pump	200 l/min	630	-	-
Concrete Vibrator	3.3 HP	740	-	-
Asphalt Sprayer	850 ltr.	10,200	1	10,200
Service Car	3 ton	11,600	1	11,600
4 Wheel Drive Vehicle	70 HP	17,500	1	17,500
Motorcycle	100 cc	1,100	3	3,300

PURCHASE COST TOTAL	951,160
OWNERSHIP COST (FOREIGN)	538,436
EQUIPMENT COST SUPPLEMENTED	412,724

6.1.5 Other Costs

Cost other items includes the costs of workshop equipment and tools, laboratory test equipment and survey equipment which are recommended in Sub-Clause 3.5. These total costs are summarized in Table 6-1-1.

6.1.6 Quantities by Work Type

The annual construction and maintenance quantities for all proposed road links are shown in Table 6-1-9.

Table 6-1-9 CONSTRUCTION QUANTITIES FOR ALL PROPOSED LINKS

PROV : SULAWESI SELATAN KAB : TANA TORAJA

I T E M	UNIT	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)
Site Clearance in Light Bush	m2	24000.00	37000.00	45850.00	67150.00	23460.00	197460.00
Subgrade Preparation	m2	0.00	96500.00	151200.00	157300.00	72000.00	477000.00
Normal Fill	m3	7620.00	21789.00	18089.00	22992.00	137751.60	208241.60
Fill in Swamp	m3	0.00	0.00	0.00	0.00	0.00	0.00
Normal Excavation to Spoil	m3	4955.00	5549.00	8946.40	9367.60	1218.30	30036.30
Sub Base Course	m3	2305.50	12599.60	13746.00	16305.00	7690.80	52646.90
Base Course	m3	1960.00	10240.00	8706.00	10724.00	144.00	31774.00
Shoulder	m2	48000.00	66000.00	71400.00	111100.00	25200.00	321700.00
Asphalt Patching	m2	673.00	0.00	0.00	12.00	0.00	685.00
Surface Dressing (Single)	m2	56000.00	0.00	55800.00	157200.00	0.00	269000.00
Surface Dressing (Double)	m2	4000.00	68000.00	60000.00	0.00	0.00	132000.00
Earth Drain	m	4400.00	31200.00	29400.00	28600.00	22140.00	114740.00
Earth Drain in Swamp (by machine)	m3	0.00	0.00	0.00	0.00	0.00	0.00
Pipe Culvert 080cm	m	6.00	340.50	220.30	481.20	174.90	1222.90
Masonry Culvert (80x80cm)	m	0.00	0.00	66.00	24.00	0.00	90.00
Retaining Wall and Wing Wall (Timber)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Retaining Wall and Wing Wall (Masonry)	m3	0.00	186.20	149.98	168.02	54.72	558.92
Gabion Protection	m3	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 3m;10T)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 5m;10T)	m2	0.00	40.00	16.00	40.00	10.80	106.80
Superstructure (Timber;Span 8m;10T)	m2	0.00	0.00	0.00	0.00	44.40	44.40
Superstructure (Timber;Span 3m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 5m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 8m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 3m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 5m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 8m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span10m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span15m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Pier;for Timber;10T)	NO	0.00	1.00	0.40	0.60	0.60	2.60
Substructure (Abut;for Timber;10T)	NO	0.00	2.00	0.80	3.20	3.60	9.60
Substructure (Pier;for Timber;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Abut;for Timber;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Pier;for Concrete;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Abut;for Concrete;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Demolition of Bridge (Timber->Timber)	m2	0.00	0.40	0.00	12.00	0.00	12.40
Demolition of Bridge (Timber->Concrete)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Demolition of Bridge (Concrete)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Manual routine maintenance of road	Km	104.00	215.50	239.00	260.50	301.00	1120.00
Routine maintenance of earth road	Km	14.00	28.00	28.00	27.00	26.00	123.00
Routine maintenance of gravel road	Km	72.75	142.50	159.00	149.00	143.00	666.25
Routine maintenance of asphalt road	Km	17.25	45.00	52.00	84.50	132.00	330.75
Maintenance of Timber Bridge (New)	m2	0.00	0.00	0.00	40.00	0.00	40.00
Maintenance of Concrete Bridge (New)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Maintenance of Timber Bridge (Exist)	m2	260.38	895.53	895.53	967.53	999.53	4018.50
Maintenance of Concrete Bridge (Exist)	m2	863.35	1969.70	2065.70	2589.20	2702.20	10190.15

6.2 Organization and Construction System

6.2.1 Organization

The Bupati as head of the Kabupaten has been authorized by Law No. 13, 1980 as an official responsible for the Local Road Development Project implementation. This means that the DPUK is considered as a responsible agency for the actual execution of the Project.

According to instruction letter dated June 24, 1982 Ref. No. 620/975-/BANGDA, the Project Manager appointed by the Bupati will be responsible for the operation and maintenance of the equipment. Accordingly the Equipment Coordinator appointed from the staff of the Regional Public Works (Kantor Wilayah) by Bina Marga as a coordinator between the Governor and the Bupati will be responsible for delivery, effectual utilization and maintenance of the equipment.

The standard organization of DPUK consists of a minimum of four sections, i.e. Road Section, Housing and City Planning Section, Irrigation Section and Administration Section. For execution of the Project it is strongly recommended that the structural organization of DPUK is established. It will be necessary not only to organize new sections but also to reorganize the current structure through a review of the roles and responsibilities of each inter-related section.

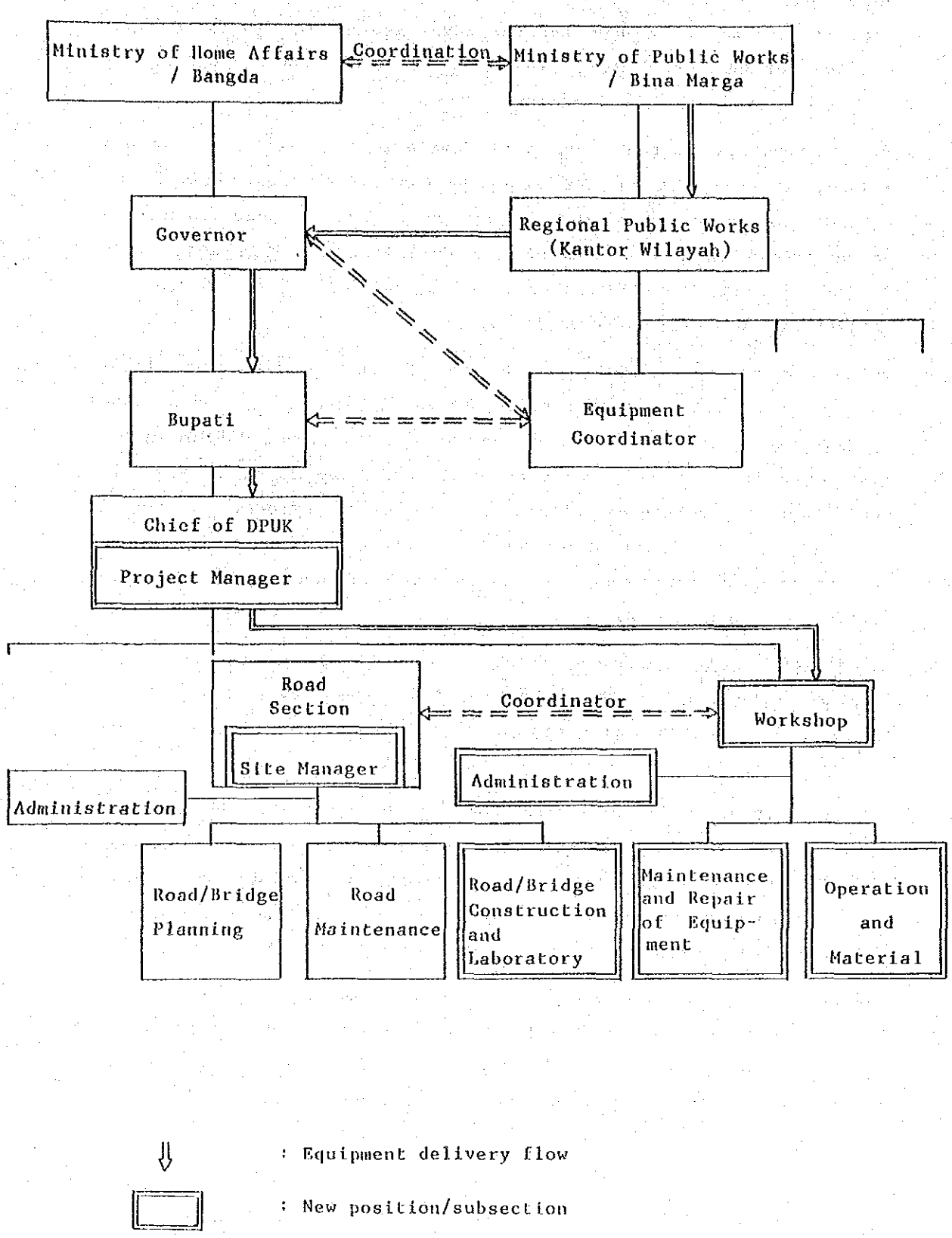
It is recommended that the workshop is newly organized to consist of three sub-sections, i.e. maintenance and repair of equipment, operation and materials, and administration to execute the main tasks described in Clause 3.5.

The sub-section of laboratory would be under the relevant Road Section. The proposed organization is shown in Fig. 6-2-1.

6.2.2 Construction System

For the construction of Kabupaten roads with a ten year effective design life, it has been recommended in Clause 3.4 that the equipment intensive method should be adopted for earth work and pavement work with the exception of surface dressing.

Fig. 6-2-1 PROPOSED ORGANIZATION



Current road construction in the Kabupatens is obliged to rely upon the traditional labour intensive method. It is therefore assumed that both the DPUK and the local contractors in the Kabupatens do not have sufficient experience and technique for the equipment intensive method of road construction.

For realization of the Local Road Development Project the GOI has ensured availability of the required human resources of DPUK and intends to conduct training programmes for those human resources as described in Clause 8.3 of the Main Report. This means that the GOI intends the Kabupatens to have the ability to execute the Project by force account (Swakelola).

It should be recognized from the experiences in the first local road project, which was assisted by OECF, ADB and IBRD, that because of their poor construction management and traditional labour intensive methods most of the road construction by local contractors could not be completed within the contract periods. Therefore execution of the road improvement by force account is desirable as recommended from their experience by the consultants for the first local road project.

It is strongly recommended that except for labourers the staff of the force account team should not be hired by the day as it would then not be able to consolidate the foundations for development of self reliability.

However, it will be very difficult to execute all the Projects by force account because of the need for many Kabupaten staff. The GOI has emphasized the need to promote the employment of local weak contractors in order to up-grade their capability in the road project schemes within the Fourth Five-Year Plan (REPELITA)

Taking into consideration the conditions mentioned above it is strongly recommended that the DPUK is obliged to lend some equipment with skilled operators to the local contractors in the Kabupatens for the execution of a part of the road improvement works.

The types of work executed only by force account are recommended as follows:

- Routine maintenance work for the Kabupaten roads
- Laboratory tests
- Production of crushed stone
- Technical service for the equipment