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 34

KABUPATEN WAJO

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 Wajo 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.

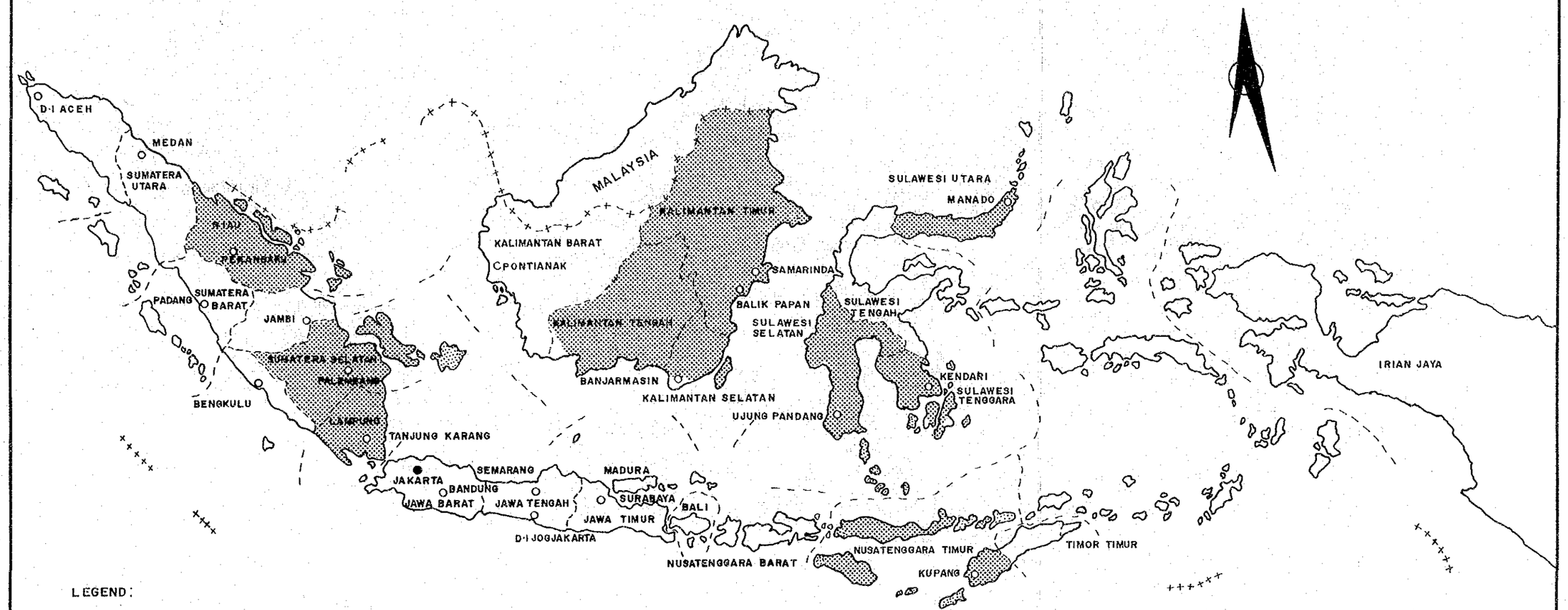
Since the study period was limited, without cooperation of Bina Marga, Bangda and local governments of both province and Kabupaten in collecting the data, the study would not have been completed within the period.

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.

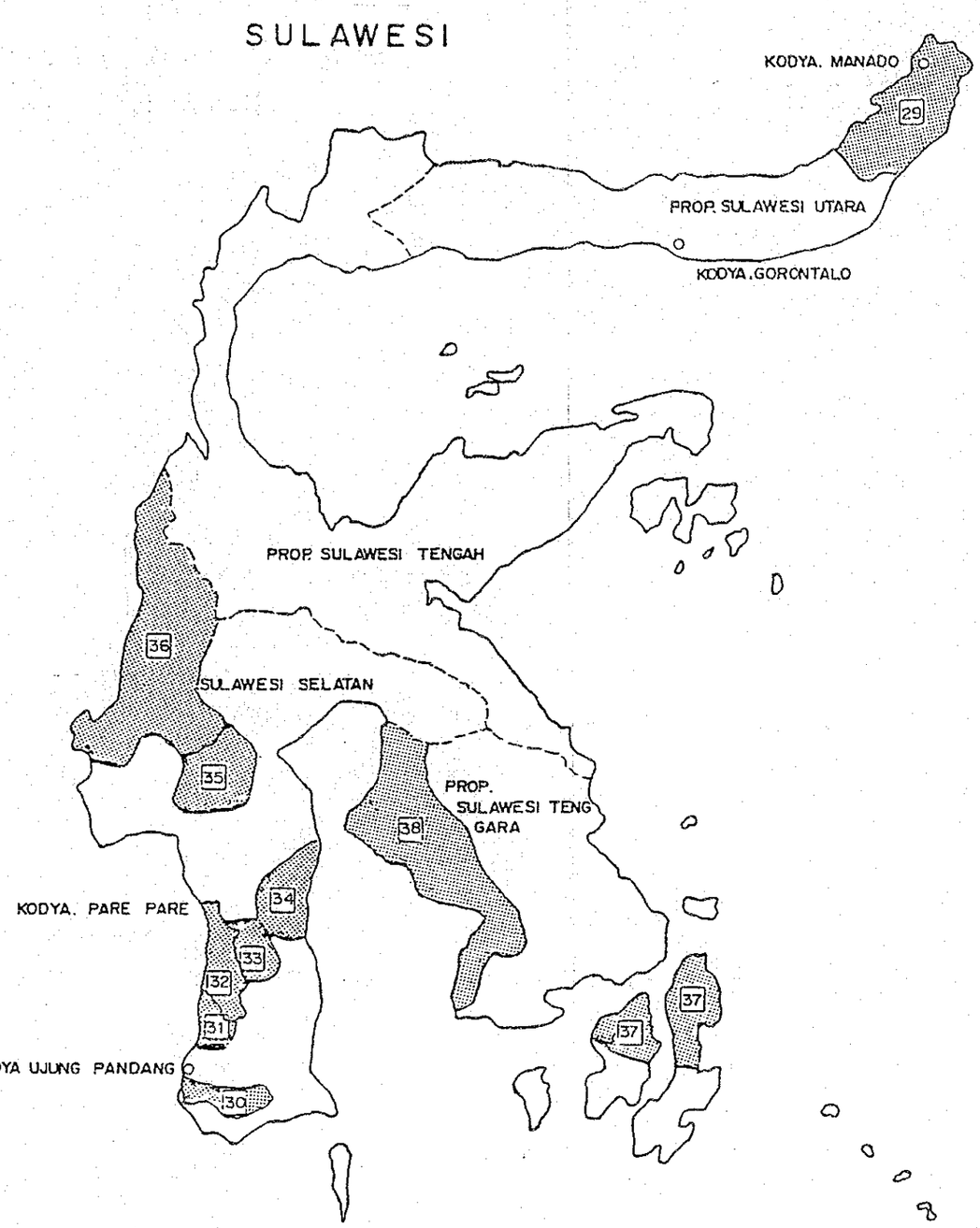
LOCATION MAP OF THE PROJECT AREAS



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

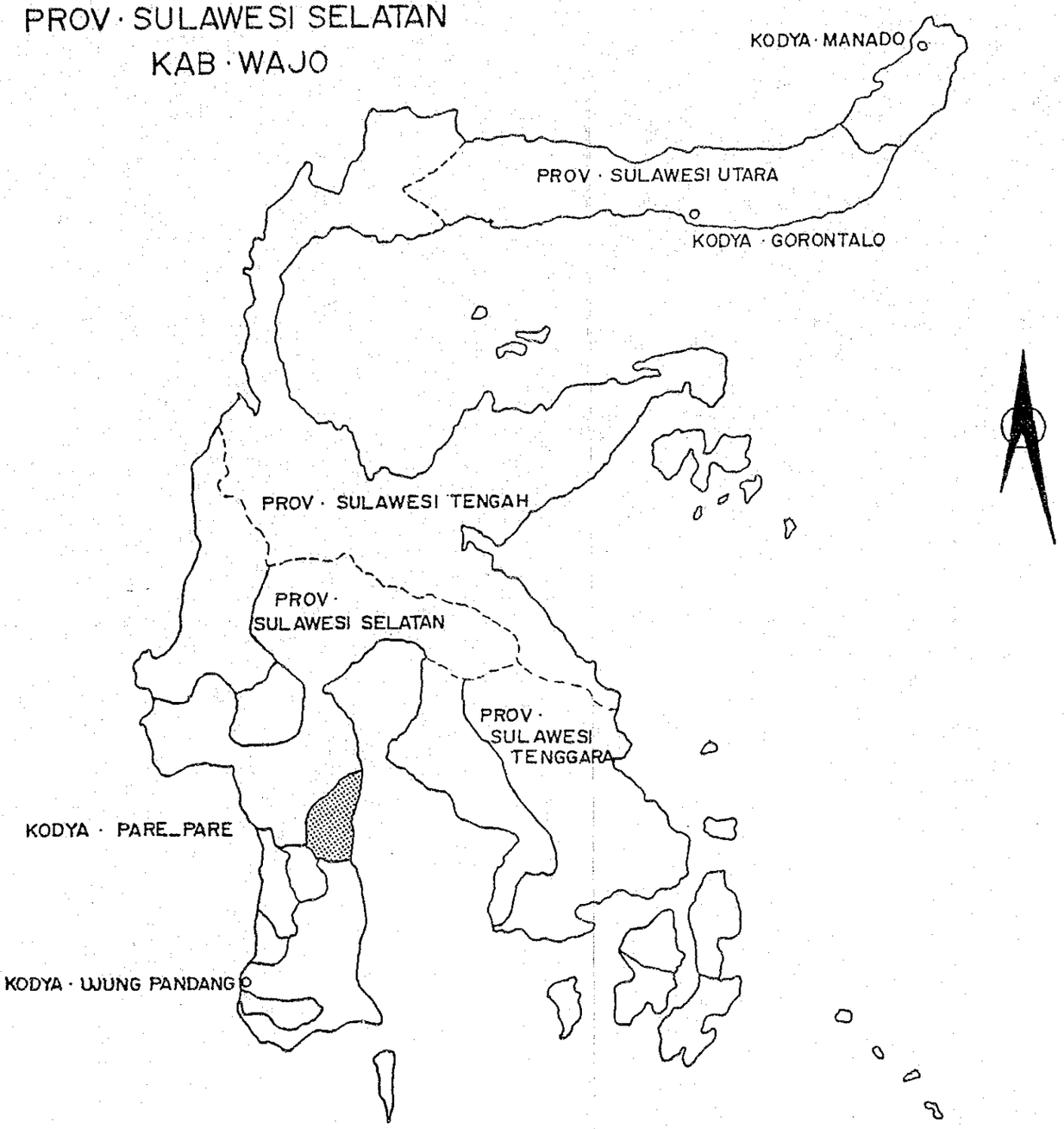
SCALE :

0 92 184 276 460 Km

SULAWESI

PROV · SULAWESI SELATAN

KAB · WAJO



LEGEND :

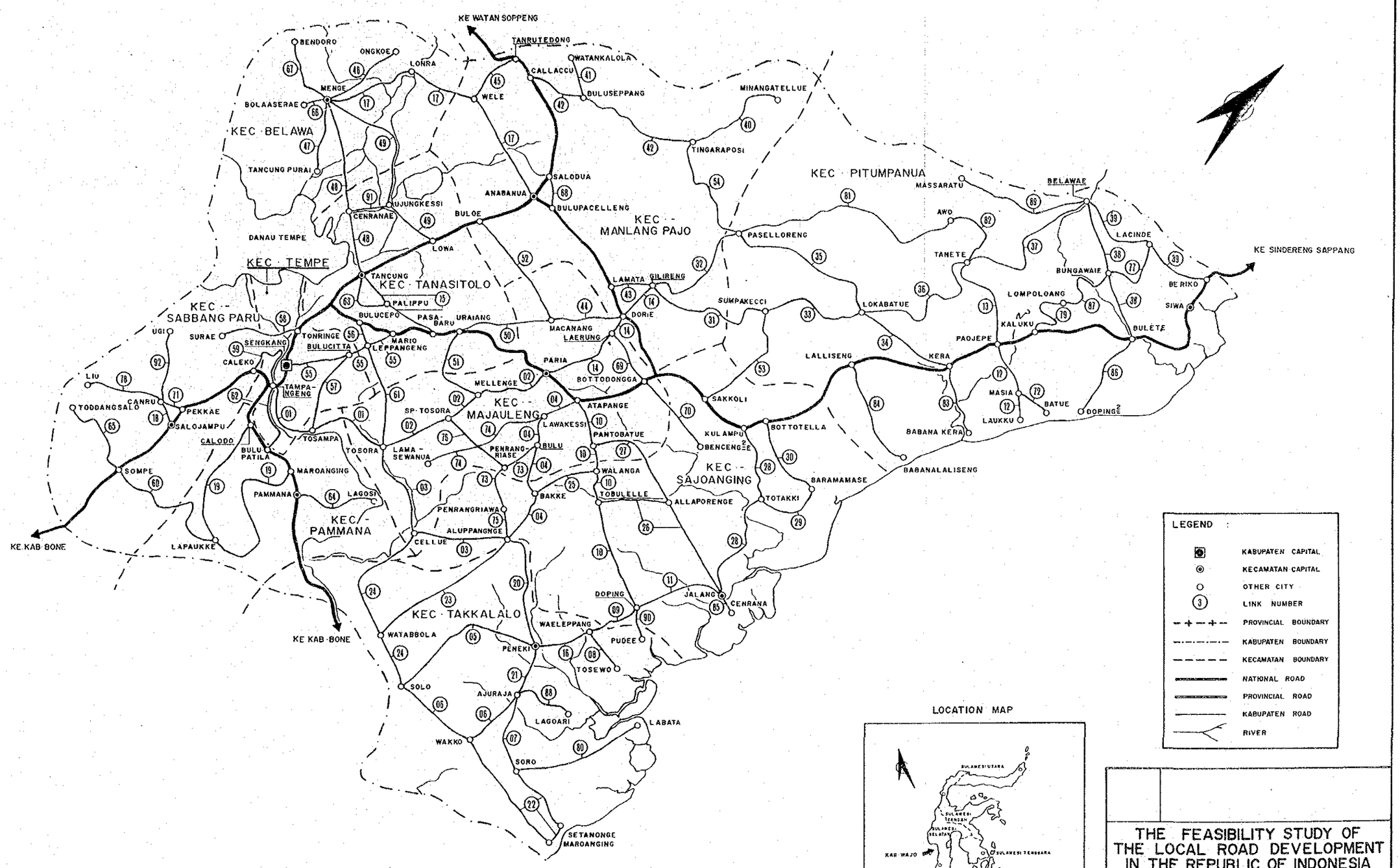
---- PROVINCIAL BOUNDARY

LOCATION OF THE PROJECT AREA

SCALE :

0 92 184 276 460 Km

KAB · WAJO



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
- PROVINCIAL ROAD
- KABUPATEN 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 : WAJO

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Chapter 1 BACKGROUND OF THE KABUPATEN

1.1 Topographic and Meteorological Conditions

1.1.1 Location and Topography

Kabupaten Wajo is located in the middle west of Sulawesi Selatan Province. It is bordered on the north by Kabupaten Luwu, on the west by Kabupatens Sinderedng Rappang and Soppeng and on the south by Kabupaten Bone, while on the east it has a long coast line facing the Bone Gulf.

All of the Kabupaten area is formed of flat land, and the region around Tempe Lake in the west and the coastal zone facing the Bone Gulf are widely covered with swamps. Furthermore plains spread out from the centre to the south.

The Kabupaten has an area of 2,506 square kilometers, approximately 3 percent of the total of the province. It consists administratively of 10 Kecamatans.

1.1.2 Meteorological Conditions

The average number of rainy days and the average amount of yearly rainfall in Kabupaten Wajo are 126 days and 1,873 mm respectively.

One year in the Kabupaten consists of a rainy season and a dry season. The dry season is from March through June 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 240 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 : Wajo STATION : No. 10

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	5	57	4	31	8	103	12	147	9	72
February	6	67	6	41	7	88	12	116	9	81
March	8	84	12	248	12	249	9	68	15	281
April	22	14	17	224	16	386	14	146	22	350
May	17	417	15	388	15	329	18	413	25	389
June	13	217	11	220	12	265	20	535	19	258
July	5	44	21	432	3	11	18	238	19	245
August	11	48	5	75	3	9	9	65	5	43
September	1	5	11	137	1	15	3	29	13	184
October	4	48	10	192	1	14	9	174	4	33
November	6	83	10	167	4	49	8	67	11	153
December	11	146	8	77	10	129	9	133	7	56
Total	109	1,230	130	2,232	92	1,647	141	2,131	158	2,145

1.2 Socio-Economic Conditions

1.2.1 Population

The population of Kabupaten Wajo in 1984 was 379,948 which was approximately 5.9% of the 6,475,000 total population of Sulawesi Selatan Province as shown in Table 1-2-1.

The population density was 1.52 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 0.5% which is lower than both the provincial rate of 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 : WAJO

KECAMATAN	POPULATION	PROPORTION (%)
SOBBANG PARU	37,966	10.0
PAMMANA	36,658	9.6
TAKKALALA	40,661	10.7
SAJOANGING	39,599	10.4
MAJAULENG	34,899	9.2
TEMPE	45,806	12.1
BELAWA	34,464	9.1
TANA SITOLO	38,021	10.0
MONIANG PAJO	23,859	6.3
PITUMPANUA	48,015	12.6
TOTAL	379,948	100

1.2.2 Land Use

In Kabupaten Wajo, 153,924 ha of the current available land use area, which is approximately 61.4% of the 250,619 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 98,902 ha of agricultural harvest area, 6,422 ha of residential area and 48,600 ha of usable open space which are 64.3%, 4.2% and 31.5% of the current available land use area respectively.

The agricultural harvest area consists of 58,374 ha of paddy field, 14,400 ha of plantation and 26,128 ha of other cultivated area which are 59.0%, 14.6% and 26.4% 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 Wajo in 1983 were 84,885 ha and 344,219 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 64,649 ha and 301,779 ton respectively which are 82.0% and 87.7% of the total food crops. The yield rate of paddy production is 4.33 ton per ha. 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 1983 were 1.5% and 8.3% 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 and the increase of double crop fields.

The commodity crops, of which fruits such as banana, pineapple and orange are major, are produced in the plantations. The area and production of plantation crops in 1983 were 21,437 ha and 19,396 ton respectively with current growth rates of 7.1% and 11.0% 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 63.8% of the total population as shown in Table 1-2-7. Thus this is an agricultural Kabupaten.

It is suggested that the Kabupaten takes measures to foster food crops other than paddy as well as establishing a stable increase in production of paddy.

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

KABUPATEN : WAJO

CULTIVATED ATEA

(ha)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	66,462	69,333	67,617	25,617	69,649	-	
OTHERS	8,704	12,339	3,863	7,513	15,236	-	
TOTAL	75,166	81,672	71,480	33,130	84,885	-	

PRODUCTION

(ton)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	194,367	237,493	259,848	92,778	301,779	-	
OTHERS	5,792	70,192	70,942	91,830	42,440	-	
TOTAL	200,159	307,685	330,790	184,608	344,219	-	

YIELD RATE

(ton/ha)

ITEM	YEAR						AAGR (%)
	1979	1980	1981	1982	1983	1984	
PADDY	2.92	3.43	3.84	3.62	4.33	-	

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 Wajo are forestry and fishery sectors.

The following table shows the current growth of the forestry production.

	1981	1984	AAGR (%)
Production (m^3)	760,346	804,244	1.9

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

And the current growth rates of the fishery and the livestock production's are shown in the following table.

	1980	1984	AAGR (%)
Catch (ton)	8,673	20,056	23.3
Livestock production	2,069	3,082	10.5

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

It is presumed that yearly approx. 15,000 tons of the catch and 2,000 tons of the livestock are respectively exported out of the Kabupaten. The above both sectors show a high growth tendency, therefore they are expected to become continuously prosperous.

1.3 Present Status of Kabupaten Roads

1.3.1 Outline of Road Networks

Kabupaten Wajo seems to be in a favorable situation in terms of regional trunk roads because two main provincial roads run across the Kabupaten from east to west and from south to north. The whole area of the Kabupaten is flat, accordingly the Kabupaten road networks are mostly uniformly developed.

However, the southwest area around Danau Tempe is covered by low swamps.

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 Wajo are confirmed as 92 links and 425 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 1.70 m per ha. This is higher than the national density of 0.48 m per ha but lower than 2.11 m per ha which is the density in Jawa Island, excluding DKI Jakarta, as shown in the following table. Thus, the Kabupaten is not so backward in density of Kabupaten roads.

	Total Length (km)	Area (ha)	Density (m/ha)
Kabupaten : Wajo	425	250,619	1.70
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 : WAJO

(Km)

NO	FROM	KRK	BTB	TNH	ASP	L.L	TOTAL
LINK 1		11					11
LINK 2		14					14
LINK 3		7	7				14
LINK 4		15					15
LINK 5							
LINK 6		10	1				11
LINK 7		3		2			5
LINK 8		2	1				3
LINK 9		4					4
LINK 10		3	2		11		16
LINK 11		2			5		7
LINK 12		4	1				5
LINK 13		8					8
LINK 14		11					11
LINK 15		6					6
LINK 16		4					4
LINK 17							
LINK 18						1	1
LINK 19		4		13			17
LINK 20		8					8
LINK 21			5				5
LINK 22				17			17
LINK 23							
LINK 24							
LINK 25				4			4
LINK 26				11			11
LINK 27				10			10
LINK 28		14	1	1			16
LINK 29							
LINK 30		6					6
LINK 31							
LINK 32		10					10
LINK 33							
LINK 34							
LINK 35							
LINK 36							
LINK 37							
LINK 38		8		3			11
LINK 39		6		6			12
LINK 40							
LINK 41							
LINK 42		12					12
LINK 43							
LINK 44		3		5			8
LINK 45							
LINK 46					8		8

(Km)

NO	FROM	KRK	BTB	TNH	ASP	L.L	TOTAL
LINK 47							
LINK 48							
LINK 49							
LINK 50		1		5			6
LINK 51				4			4
LINK 52		8					8
LINK 53							
LINK 54		3		4		1	8
LINK 55		8	1				9
LINK 56		1		1		1	3
LINK 57		4		3			7
LINK 58		4		1			5
LINK 59		4	1				5
LINK 60							
LINK 61							
LINK 62							
LINK 63		5					5
LINK 64			1	4		1	6
LINK 65							
LINK 66				3			3
LINK 67		6					6
LINK 68		2					2
LINK 69				4			4
LINK 70				7			7
LINK 71		1					1
LINK 72				2			2
LINK 73				8			8
LINK 74				11			11
LINK 75							
LINK 76				6			6
LINK 77							
LINK 78			8				8
LINK 79							
LINK 80							
LINK 81							
LINK 82							
LINK 83				3			3
LINK 84							
LINK 85			2				2
LINK 86							
LINK 87							
LINK 88							
LINK 89							
LINK 90							2
LINK 91							
LINK 92			4				4
TOTAL		223	36	138	24	4	425
RATIO		52	8	32	6	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 : Wajo	5.6	61.0	33.4
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 : Wajo	79.0	9.4	11.5	-
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 (1) EXISTING ROAD CONDITION BY SURFACE TYPE

PROVINCE : SULAWESI SELATAN

KABUPATEN : WAJO

(1)

I02	I3	KRK				DTB				TNH				ASP				L.L			
I02		BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB
LINK	1	92	1	7																	
LINK	2	80	17	3																	
LINK	3	89		8	3	94	1	6													
LINK	4	87	6	7																	
LINK	5																				
LINK	6	94	1	5		94		6													
LINK	7	91		9						20	40	40									
LINK	8	95	6			99	1														
LINK	9	89		11																	
LINK	10	82		18		88		13						96	1	4					
LINK	11	86	5	9										96	4						
LINK	12	86		14		95		5													
LINK	13	99	1																		
LINK	14	98	2																		
LINK	15	95		5																	
LINK	16	93		5	3																
LINK	17																				
LINK	18																			99	
LINK	19	89		11						50	50										
LINK	20	95		5																	
LINK	21					79	19	2													
LINK	22									78	17	5									
LINK	23																				
LINK	24																				
LINK	25									99	1										
LINK	26									80	15	5									
LINK	27									93	13	4									
LINK	28	76	17	7		99	1			60	20	20									
LINK	29																				
LINK	30	93	2	5																	
LINK	31																				
LINK	32	93	7																		
LINK	33																				
LINK	34																				
LINK	35																				
LINK	36																				
LINK	37																				
LINK	38	69	10	12						67	25	8									
LINK	39	86	4	10						56	19	25									
LINK	40																				
LINK	41																				
LINK	42	96	3																		
LINK	43																				
LINK	44	80	20							36	22	34	8								
LINK	45																				
LINK	46													89	3	9					
LINK	47																				
LINK	48																				
LINK	49																				
LINK	50			99	1							99	1								
LINK	51									73	20	6	1								
LINK	52	99	1																		
LINK	53																				
LINK	54	95	5							95	5							95	5		
LINK	55	98	1	1		99	1														
LINK	56	99	1							99	1							99	1		
LINK	57	97	1							82	13	5									
LINK	58	99	1							60	10	30									
LINK	59	97	1	3		99	1														
LINK	60																				
LINK	61																				
LINK	62																				
LINK	63	90	9	1																	
LINK	64					60	20	20		60	20	20						60	20	20	
LINK	65																				
LINK	66									99	1										
LINK	67	85	1	14																	
LINK	68	99	1																		
LINK	69									40	25	29									
LINK	70									36	20	44									
LINK	71	99	1																		
LINK	72									30	10	60	1								
LINK	73										99	1									
LINK	74									59	25	15									
LINK	75																				

Table 1-3-2 (2) EXISTING ROAD CONDITION BY SURFACR TYPE

PROVINCE : SULAWESI SELATAN

KABUPATEN : WAJO

(%)

NO	KRK				BTB				TNH				ASP				E.L			
NO	BA	SB	RU	RB	BA	SB	RU	RB	BA	SB	RU	RB	BA	SB	RU	RB	BA	SB	RU	RB
LINK 76									57	23	21									
LINK 77																				
LINK 78					62	2	35													
LINK 79																				
LINK 80																				
LINK 81																				
LINK 82																				
LINK 83									50	13	37									
LINK 84																				
LINK 85					99	1														
LINK 86																				
LINK 87																				
LINK 88																				
LINK 89																				
LINK 90	99	1			99	1														
LINK 91																				
LINK 92					79	15	6													
AVERAGE	89	8	7	0	89	5	7	0	59	20	20	0	93	3	4	0	64	7	30	0
LENGTH	223 Km				36 Km				138 Km				24 Km				4 Km			
(Km)	198	9	16	0	32	2	3	0	81	28	28	0	22	1	1	0	3	0	1	0

The surface condition level of the Kabupaten roads in the Kabupaten is higher than both that of Indonesia and Jawa Island. The proportion in good condition is relatively high.

However, due to the low proportion of asphalt roads it is still desirable that the Kabupaten roads are improved.

(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 62.0% flat, 31.0% hilly, 6.0% mountainous and 1.0% swampy.

There are mostly flat and hilly areas in the Kabupaten so that road construction is anticipated to be rather easy.

1.3.3 Bridge Inventory

A bridge inventory showing the existing condition of bridges on the Kabupaten roads in Kabupaten Wajo 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 inventory shown in Table 1-3-4 and Table 1-3-5 indicates a total of 70 bridges with a total length of 642 m of which 4 or 5.7% are timber, 47 or 67.1% are concrete and 16 or 22.9% are others. Steel bridges account for only 3 or 4.3% of the total. On the other hand, 8 bridges with a total length of 43 m are required to be newly constructed.

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

PROV : SULAWESI SELATAN KAB : WAJO

(Km)

102 (3)	DT	BK	RH	GN	TOTAL
LINK 1	11				11
LINK 2	4	10			14
LINK 3	9	4			14
LINK 4	3	12			15
LINK 5					
LINK 6	8	3			11
LINK 7	4	1			5
LINK 8	3				3
LINK 9	3	1			4
LINK 10	4	12			16
LINK 11	6	1			7
LINK 12	3	2			5
LINK 13	4	3		1	8
LINK 14	4	7			11
LINK 15	4	1	1		6
LINK 16	2	2			4
LINK 17					
LINK 18	1				1
LINK 19	17				17
LINK 20	6	2			8
LINK 21	4	1			5
LINK 22	16	1			17
LINK 23					
LINK 24					
LINK 25	2	2			4
LINK 26	11				11
LINK 27	10				10
LINK 28	14	2			16
LINK 29					
LINK 30	3	3			6
LINK 31					
LINK 32	1	1		8	10
LINK 33					
LINK 34					
LINK 35					
LINK 36					
LINK 37					
LINK 38	4			7	11
LINK 39	3	4		5	12
LINK 40					
LINK 41					
LINK 42	5	7			12
LINK 43					
LINK 44	3	5			8
LINK 45					
LINK 46	8				8

PROV : SULAWESI SELATAN KAB : WAJO

(Km)

102 (3)	DT	BK	RH	GN	TOTAL
LINK 47					
LINK 48					
LINK 49					
LINK 50	1	5			6
LINK 51	2	2			4
LINK 52	5	3			8
LINK 53					
LINK 54		1	3	4	8
LINK 55	6	3			9
LINK 56		1		2	3
LINK 57	1	6			7
LINK 58	5				5
LINK 59	5				5
LINK 60					
LINK 61					
LINK 62					
LINK 63	1	4			5
LINK 64	6				6
LINK 65					
LINK 66	3				3
LINK 67	6				6
LINK 68		2			2
LINK 69	4				4
LINK 70	5	2			7
LINK 71	1				1
LINK 72	1	1			2
LINK 73	2	6			8
LINK 74	8	3			11
LINK 75					
LINK 76	3	3			6
LINK 77					
LINK 78	8				8
LINK 79					
LINK 80					
LINK 81					
LINK 82					
LINK 83	3				3
LINK 84					
LINK 85	2				2
LINK 86					
LINK 87					
LINK 88					
LINK 89					
LINK 90	1	1			2
LINK 91					
LINK 92	4				4
TOTAL	263	130	5	27	425
RATIO	62	31	1	6	(%)

Table 1-3-4 NUMBER AND LENGTH OF BRIDGES

PROV : SULAWESI SELATAN KAB : MAJO

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

	EXISTING		NOT EXIST		TOTAL	
LINK NO	NO.	LENGTH	NO.	LENGTH	NO.	LENGTH
2	4	34.50			4	34.50
3	2	66.00			2	66.00
4	5	22.00			5	22.00
7	2	10.00			2	10.00
9	1	15.50			1	15.50
10	5	40.00	1	4.00	6	44.00
11	2	22.00			2	22.00
12	1	5.00			1	5.00
13	5	42.00			5	42.00
14	4	41.00			4	41.00
16	3	31.00			3	31.00
19	3	17.00	1	5.00	4	22.00
21	2	37.00			2	37.00
22	4	20.00			4	20.00
26	1	5.00			1	5.00
27	2	16.00			2	16.00
28	1	9.00			1	9.00
32	2	39.40			2	39.40
39	2	12.00	1	4.00	3	16.00
42	4	35.00			4	35.00
44	1	7.00			1	7.00
46	2	22.00			2	22.00
55	3	17.00			3	17.00
57	1	5.00			1	5.00
59	1	5.00			1	5.00
67	2	10.00			2	10.00
70			1	8.00	1	8.00
73	1	5.00			1	5.00
74	1	10.00			1	10.00
76			4	22.00	4	22.00
78	1	7.00			1	7.00
85	1	25.00			1	25.00
92	1	10.00			1	10.00
TOTAL	70	642.40	8	43.00	78	685.40

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

PROV : SULAWESI SELATAN KAB : WAJO

(No)

IO3 (IB)	<<< BRIDGE >>> ST	LL	BJ	KY	TOTAL
LINK 2	4				4
LINK 3		2			2
LINK 6	5				5
LINK 7	1	1			2
LINK 9	1				1
LINK 10		5			5
LINK 11	1	1			2
LINK 12		1			1
LINK 13	5				5
LINK 14	4				4
LINK 16	3				3
LINK 19	3				3
LINK 21	2				2
LINK 22	4				4
LINK 26			1		1
LINK 27		2			2
LINK 28			1		1
LINK 32	2				2
LINK 39				2	2
LINK 42	4				4
LINK 44	1				1
LINK 46	2				2
LINK 55	2	1			3
LINK 57		1			1
LINK 59	1				1
LINK 67	1	1			2
LINK 70	1			1	
LINK 73	1			1	1
LINK 74	1	1			1
LINK 76	1			1	
LINK 78	1				1
LINK 85	1			1	1
LINK 92	1		1		1
TOTAL	47	16	3	4	70
RATIO	67	23	4	6	(%)

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

Bridge Type	Span Length (m)										
	<3	<5	<8	<10	<12	<14	<16	<18	<20	<99	Total
Timber	-	2	1	-	-	-	-	-	-	1	4
Concrete	-	23	7	8	1	-	5	1	-	2	47
Steel	-	1	-	2	-	-	-	-	-	-	3
Others	-	6	3	3	1	1	1	-	-	1	16
Total	-	32	11	13	2	1	6	1	-	4	70

Thus, most of the existing bridges on the Kabupaten roads are timber 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 Wajo 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	2,719	434	1,700	4,165	6,941
Proportion (%)	30.15	4.81	18.85	46.19	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	0.70	4.43	94.87	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 : WAJO

A)	Growth Rate of Population	:	0.50 (%)
B)	Growth Rate of Cultivated Area	:	7.00 (%)
C)	Growth Rate of Rice field	:	1.50 (%)
D)	Growth Rate of Rice yield rate	:	8.00 (%)
E)	Growth Rate of GDP / capita	:	6.60 (%)
a)	Geometrical Mean (A x B)	:	3.70 (%)
b)	Geometrical Mean (C x D)	:	4.70 (%)
c)	Geometrical Mean (a x b)	:	4.20 (%)
d)	Geometrical Mean (c x E)	:	5.39 (%)
	TRAFFIC GROWTH RATE	:	5.39 (%)

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 : WAJO

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
1	50	1	40	70	126	5.4%	99	2	79	139	249	IIIB-1
2	145	35	65	240	365	5.4%	287	69	129	475	722	IIIA
3	95	25	60	220	290	5.4%	188	49	119	435	574	IIIA
4	90	20	50	100	210	5.4%	178	40	99	198	416	IIIB-1
5	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
6	100	10	40	100	200	5.4%	198	20	79	198	396	IIIB-1
7	20	5	25	25	63	5.4%	40	10	49	49	125	IIIB-2
8	25	0	25	30	65	5.4%	49	0	49	59	129	IIIB-2
9	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
10	125	25	50	250	325	5.4%	247	49	99	495	643	IIIA
11	130	24	66	240	340	5.4%	257	47	131	475	673	IIIA
12	30	0	20	50	75	5.4%	59	0	40	99	148	IIIB-2
13	60	4	16	100	130	5.4%	119	8	32	198	257	IIIB-1
14	50	10	40	80	140	5.4%	99	20	79	158	277	IIIB-1
15	26	8	16	50	75	5.4%	51	16	32	99	148	IIIB-2
16	50	4	20	20	84	5.4%	99	8	40	40	166	IIIB-2
17	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
18	20	2	8	20	40	5.4%	40	4	16	40	79	IIIB-2
19	25	5	30	40	80	5.4%	49	10	59	79	158	IIIB-2
20	115	30	65	300	360	5.4%	228	59	129	594	712	IIIA
21	40	0	30	45	93	5.4%	79	0	59	89	184	IIIB-2
22	95	25	56	220	286	5.4%	188	49	111	435	566	IIIA
23	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
24	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
25	16	0	10	20	36	5.4%	32	0	20	40	71	IIIB-2
26	60	0	40	35	118	5.4%	119	0	79	69	233	IIIB-1
27	25	2	23	30	65	5.4%	49	4	46	59	129	IIIB-2
28	50	10	40	70	135	5.4%	99	20	79	139	267	IIIB-1
29	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
30	30	10	30	35	88	5.4%	59	20	59	69	174	IIIB-2
31	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
32	50	10	40	50	125	5.4%	99	20	79	99	247	IIIB-1
33	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
34	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
35	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
36	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
37	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
38	60	10	30	40	120	5.4%	119	20	59	79	237	IIIB-1
39	120	40	82	240	362	5.4%	237	79	162	475	716	IIIA
40	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
41	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
42	40	2	38	40	100	5.4%	79	4	75	79	198	IIIB-2
43	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
44	30	0	20	25	63	5.4%	59	0	40	49	125	IIIB-2
45	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
46	20	0	10	30	45	5.4%	40	0	20	59	89	IIIB-2
47	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
48	45	5	35	150	160	5.4%	89	10	69	297	317	IIIB-1
49	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
50	20	2	8	20	40	5.4%	40	4	16	40	79	IIIB-2

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

PROV : SULAWESI SELATAN KAB : WAJO

(SPD : 1/2)

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
51	20	4	16	25	53	5.4%	40	8	32	49	105	IIIB-2
52	40	6	35	80	121	5.4%	79	12	69	158	239	IIIB-1
53	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
54	18	0	4	10	27	5.4%	36	0	8	20	53	IIIB-2
55	50	10	40	100	150	5.4%	99	20	79	198	297	IIIB-1
56	15	0	10	25	38	5.4%	30	0	20	49	75	IIIB-2
57	25	5	10	50	65	5.4%	49	10	20	99	129	IIIB-2
58	5	0	10	50	40	5.4%	10	0	20	99	79	IIIB-2
59	30	10	60	75	138	5.4%	59	20	119	148	273	IIIB-1
60	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
61	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
62	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
63	70	10	20	50	125	5.4%	139	20	40	99	247	IIIB-1
64	20	2	18	20	50	5.4%	40	4	36	40	99	IIIB-2
65	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
66	45	5	25	30	90	5.4%	89	10	49	59	178	IIIB-2
67	20	0	20	30	55	5.4%	40	0	40	59	109	IIIB-2
68	40	5	15	50	85	5.4%	79	10	30	99	168	IIIB-2
69	60	0	40	35	118	5.4%	119	0	79	69	233	IIIB-1
70	20	0	10	20	40	5.4%	40	0	20	40	79	IIIB-2
71	75	15	35	80	165	5.4%	148	30	69	158	326	IIIB-1
72	14	0	6	10	25	5.4%	28	0	12	20	49	IIIC
73	65	25	62	180	242	5.4%	129	49	123	356	479	IIIB-1
74	30	2	20	35	70	5.4%	59	4	40	69	139	IIIB-2
75	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
76	30	2	18	40	70	5.4%	59	4	36	79	139	IIIB-2
77	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
78	40	5	35	80	120	5.4%	79	10	69	158	237	IIIB-1
79	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
80	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
81	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
82	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
83	50	0	30	25	93	5.4%	99	0	59	49	184	IIIB-2
84	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
85	10	0	2	20	22	5.4%	20	0	4	40	44	IIIC
86	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
87	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
88	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
89	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
90	20	0	5	10	30	5.4%	40	0	10	20	59	IIIB-2
91	0	0	0	0	0	5.4%	0	0	0	0	0	IIIC
92	50	4	26	50	105	5.4%	99	8	51	99	208	IIIB-1
PERCENT	30.15	4.81	18.85	46.19			30.15	4.81	18.85	46.19		

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 : WAJO

(1998)

LINK NO	CLASS	SURFACE	MOBIL	BUS	TRUCK	SEPEDA	TOTAL
9	IIIB-2	KRK	24	3	15	28	56
25	IIIC	KRK	13	2	8	16	31
46	IIIB-2	KRK	40	5	25	48	94
50	IIIB-2	KRK	28	3	18	33	66
51	IIIC	KRK	18	2	12	22	43
54	IIIB-2	KRK	23	3	14	27	54
56	IIIC	KRK	10	1	6	11	23
58	IIIC	KRK	20	2	12	23	46
64	IIIB-2	KRK	27	3	17	32	63
67	IIIB-2	KRK	35	4	22	41	82
70	IIIC	KRK	17	2	11	21	41
72	IIIC	KRK	3	0	2	4	7
85	IIIC	KRK	4	1	3	5	11
90	IIIC	KRK	11	1	7	13	26

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

KABUPATEN : MAJO

(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	13509	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	-2891	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.

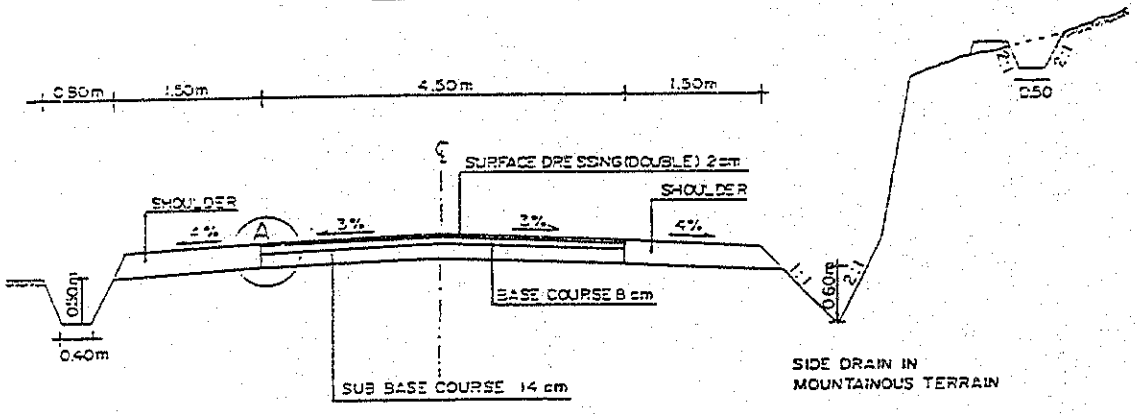
Table 3-1-1 DESIGN CRITERIA FOR KABUPATEN ROADS

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		

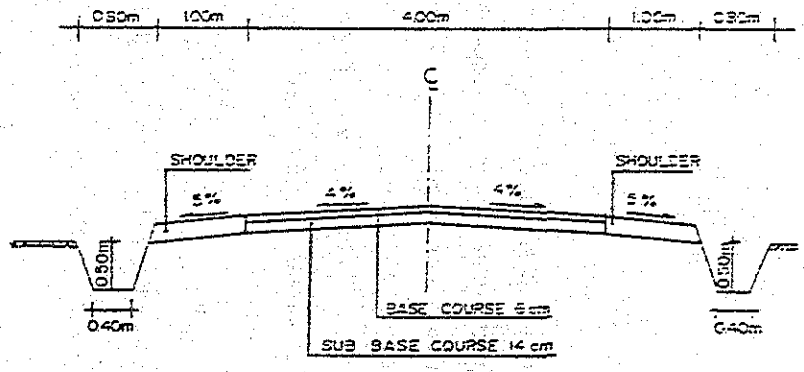
Fig. 3-1-1

STANDARD ROAD CROSS SECTIONS

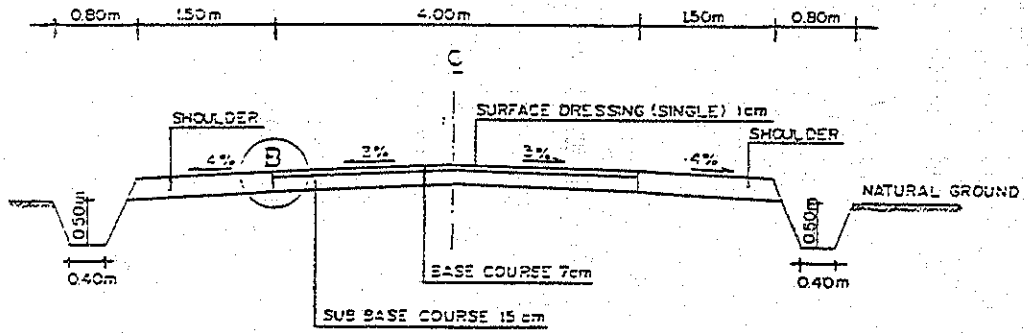
CLASS III A



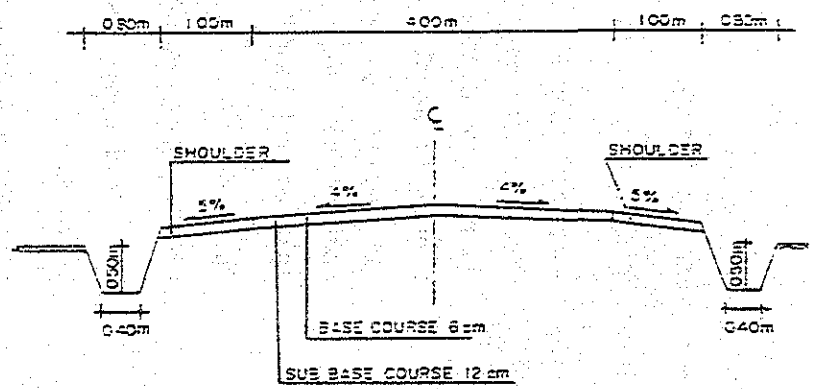
CLASS III B-2



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.

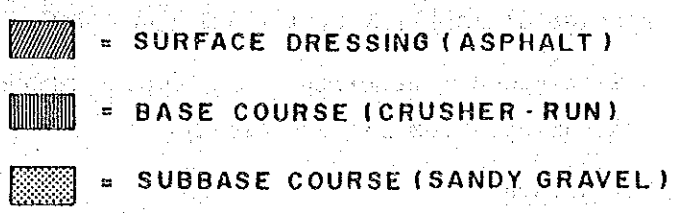
3.2.2 Pavement Structure

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	24 (14 + 8 + 1 + 1)	22 (14 + 7 + 1)	20 (14 + 6)	16



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

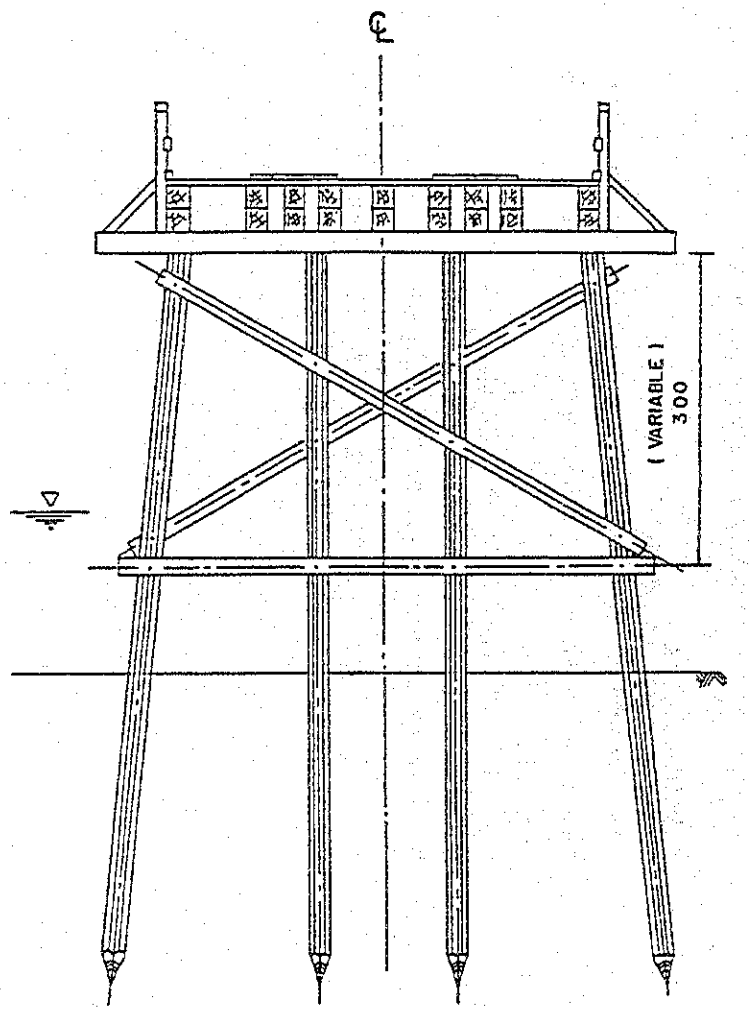
3) Foundation

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.

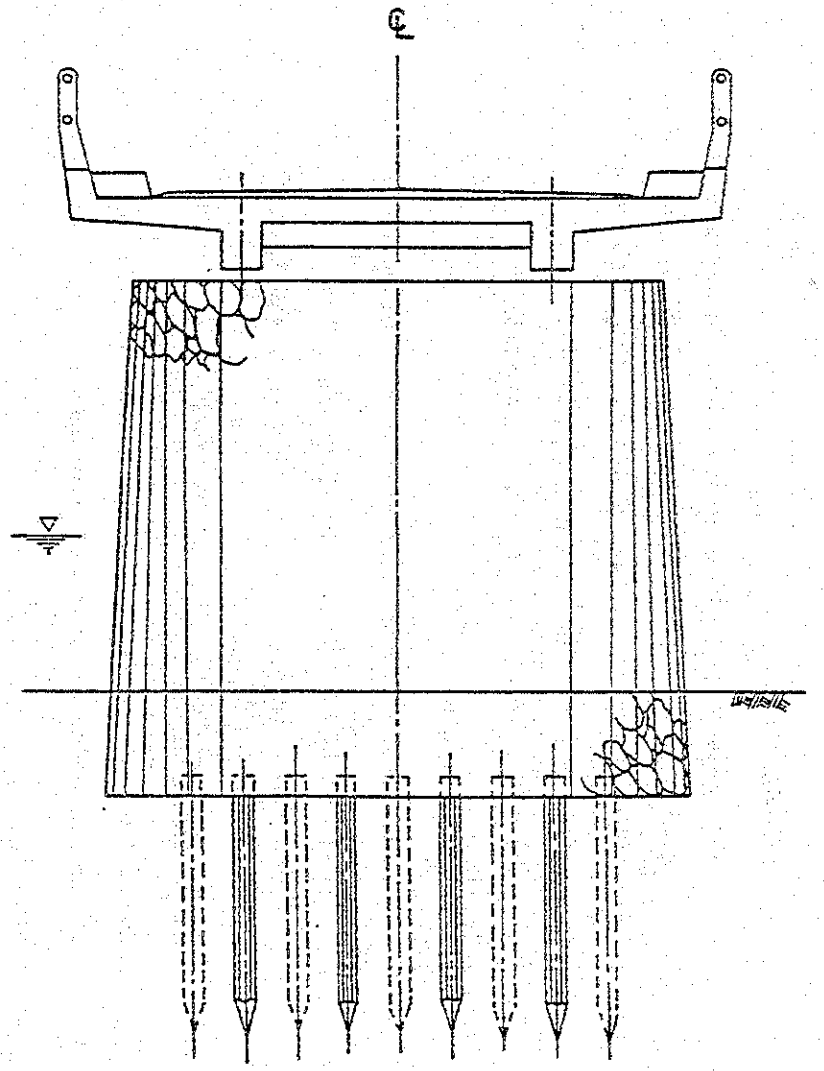
The pile length is suggested to be a minimum of 3 meters under the bottom of the foundation. The length and number of piles should be decided in order to be adequate for the condition of the foundation materials.

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

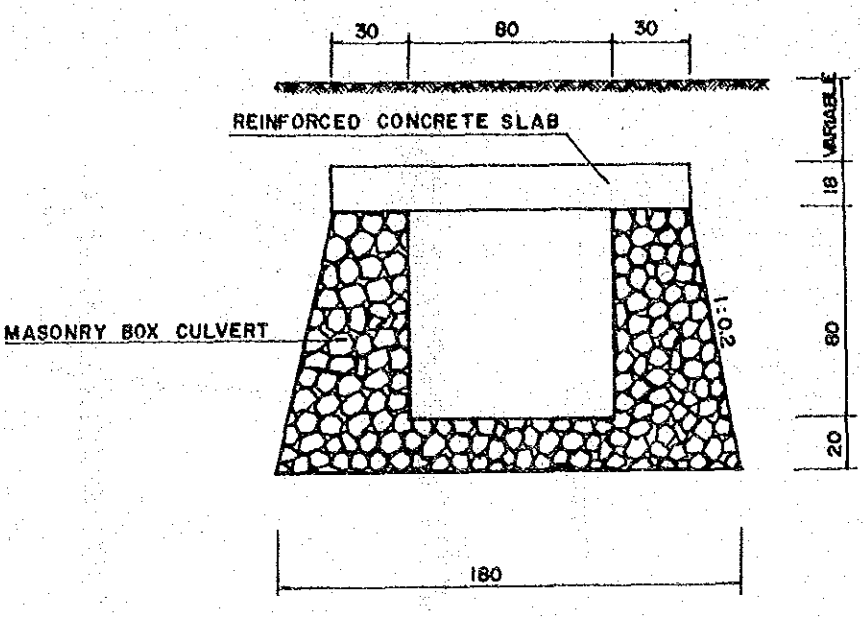
(2) Retaining Wall

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

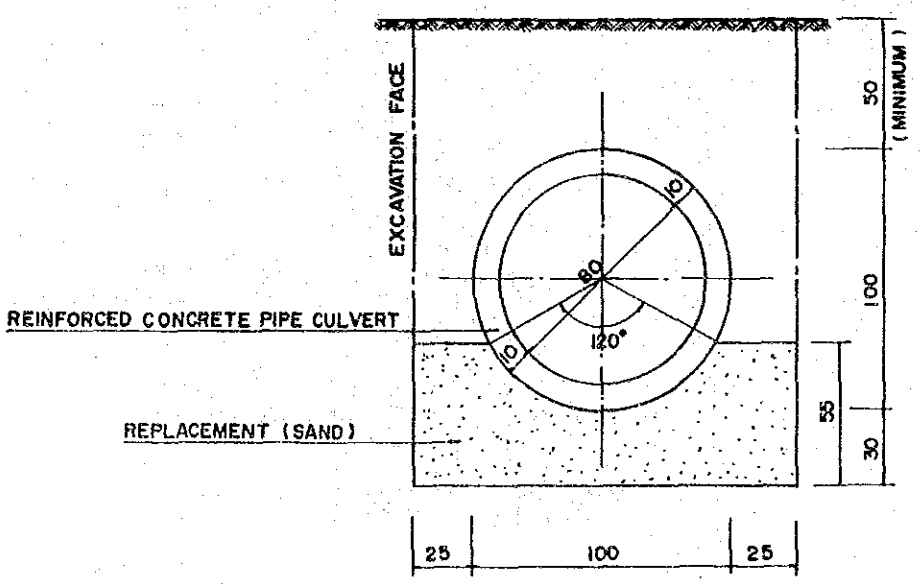
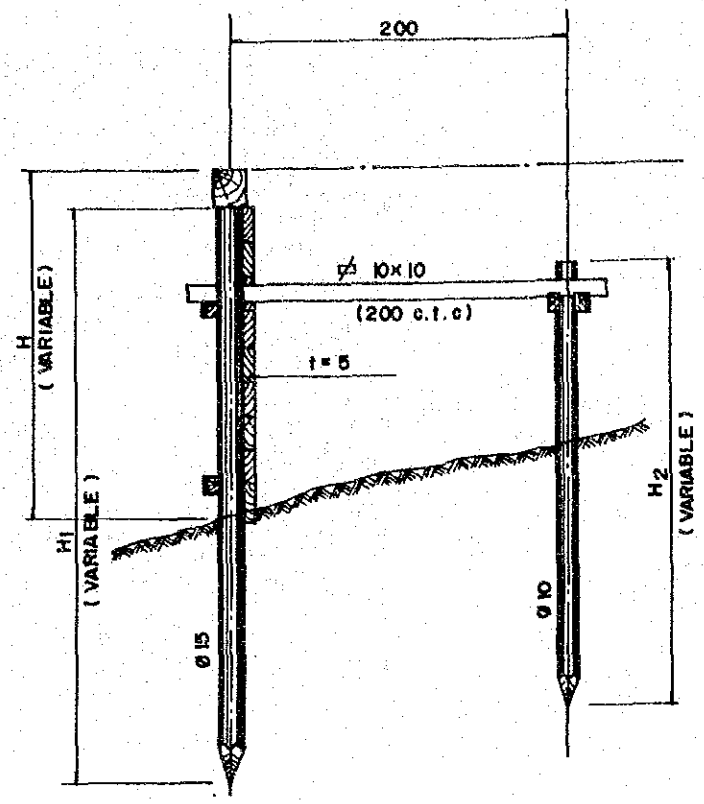
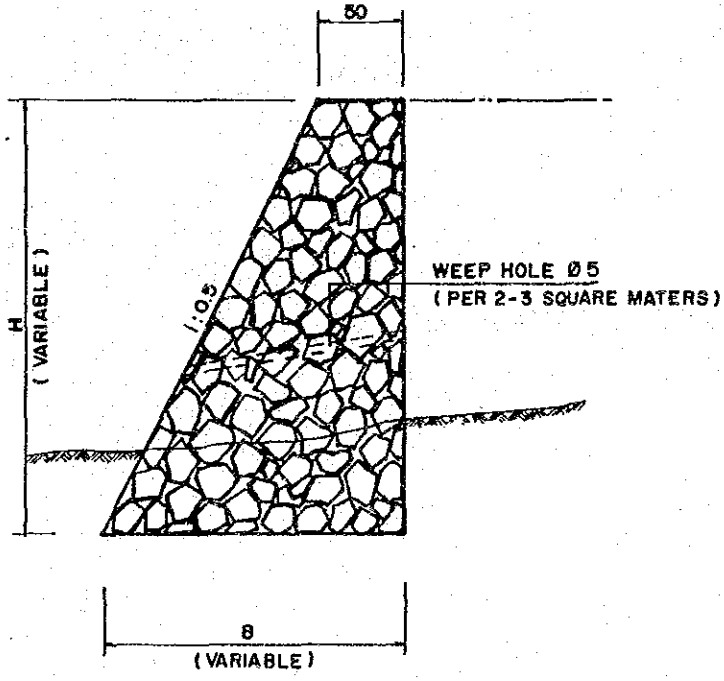


Fig. 3-3-3 STANDARD RETAINING WALLS

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 Penetrometer	1
Compression & Bending Test Machine	1
Cylinder Mould (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 Wajo 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 Wajo 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 : WAJO

(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	12,800	13,111	7,769	1,034	8,803	21,914
	Bulldozer/Ripper	120 HP	340	13,821	14,161	8,500	1,591	10,091	24,252
	Swamp Bulldozer	120 HP	356	14,065	14,421	8,879	1,662	10,541	24,962
	Bulldozer	90 HP	197	8,657	8,854	4,914	654	5,568	14,422
	Bulldozer/Ripper	90 HP	212	9,254	9,466	5,300	992	6,292	15,758
	Bulldozer	65 HP	140	6,290	6,430	3,500	465	3,965	10,395
	Bulldozer/Ripper	65 HP	153	6,744	6,897	3,819	714	4,533	11,430
	Swamp Bulldozer	90 HP	212	9,244	9,456	5,284	989	6,273	15,729
	Swamp Bulldozer	65 HP	162	6,647	6,809	4,050	758	4,808	11,617
	Motor Grader	110 HP	277	11,088	11,365	6,919	1,295	8,214	19,579
	Motor Grader	75 HP	192	7,600	7,792	4,779	894	5,673	13,465
	Motor Grader	65 HP	172	6,689	6,861	4,300	804	5,104	11,965
	Road Stabilizer	W=1850 mm	344	3,414	3,758	8,594	428	9,022	12,780
	Vibratory Roller	4 ton	116	3,323	3,439	2,900	385	3,285	6,724
	Hand-guide Vib. Roller	1000 Kg	102	605	707	850	30	880	1,587
	Tire Roller	8-15 ton	125	7,342	7,467	3,106	103	3,209	10,676
	Vibratory Roller (D&T)	4 ton	116	3,323	3,439	2,900	385	3,285	6,724
	Hand-guide Vib. Roller	600 Kg	72	413	485	600	21	621	1,106
	Rough Terrain Crane	10 ton	402	12,926	13,328	10,039	751	10,790	24,118
	Hydraulic Excavator; Wheel	0.3 m3	165	7,781	7,946	4,109	546	4,655	12,601
	Wheel Loader	1.2 m3	281	8,426	8,707	7,019	934	7,953	16,660
	Wheel Loader	0.3 m3	91	2,939	3,030	2,269	302	2,571	5,601
	Water Tank Truck	4000 ltr.	105	2,830	2,935	868	124	992	3,927
	Fuel Tank Truck	4000 ltr.	106	2,836	2,942	882	126	1,008	3,950
	Dump Truck	3.0 ton	177	3,558	3,735	1,469	210	1,679	5,414
	Flat Bed Truck with Crane	3.0 ton	69	3,067	3,136	1,717	128	1,845	4,981
	Dump Loader Truck	12 ton	154	18,820	18,974	3,838	127	3,965	22,939
	Dump Truck	5.0 ton	263	5,871	6,134	2,189	313	2,502	8,636
	Flat Bed Truck	3.0 ton	23	2,637	2,660	563	42	605	3,265
	Portable Crusher/Screening	30-40 t/h	752	21,619	22,371	18,800	2,502	21,302	43,673
	Concrete Mixer	0.5 m3	648	2,473	3,121	5,400	435	5,835	8,956
	Water Pump	200 l/min	23	263	286	188	6	194	480
	Concrete Vibrator	3.3 HP	9	226	235	73	2	75	310
	Asphalt Sprayer	850 ltr.	123	778	901	1,019	145	1,164	2,065

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 : WAJO

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Site Clearance in Light Bush	m2	162	91	253
Subgrade Preparation	m2	20	11	31
Normal Fill	m3	1,668	865	2,533
Fill in Swamp	m3	2,474	1,055	3,529
Normal Excavation to Spoil	m3	975	524	1,499
Sub Base Course	m3	3,158	1,351	4,509
Base Course	m3	4,327	2,303	6,630
Shoulder	m2	292	146	438
Asphalt Patching	m2	3,384	1,346	4,730
Surface Dressing (Single)	m2	591	552	1,143
Surface Dressing (Double)	m2	737	868	1,605
Earth Drain	m	773	119	892
Earth Drain in Swamp (by machine)	m3	1,151	475	1,626
Pipe Culvert 080cm	m	40,653	40,932	81,585
Masonry Culvert (80x80cm)	m	58,918	35,370	94,288
Retaining Wall and Wing Wall (Timber)	m2	17,117	246	17,363
Retaining Wall and Wing Wall (Masonry)	m3	42,283	11,516	53,799
Gabion Protection	m3	13,152	121	13,273
Manual routine maintenance of road	Km	122,920	7,260	130,180
Routine maintenance of earth road	Km	91,342	37,948	129,290
Routine maintenance of gravel road	Km	186,528	88,186	274,714
Routine maintenance of asphalt road	Km	338,400	134,600	473,000

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 : WAJO

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Superstructure (Timber;Span 3m;10T)	m2	58,908	4,626	63,534
Superstructure (Timber;Span 5m;10T)	m2	65,251	5,107	70,358
Superstructure (Timber;Span 8m;10T)	m2	86,430	6,706	93,136
Superstructure (Timber;Span 3m;BM50)	m2	73,045	5,719	78,764
Superstructure (Timber;Span 5m;BM50)	m2	79,747	6,195	85,942
Superstructure (Timber;Span 8m;BM50)	m2	101,141	7,841	108,982
Superstructure (Concrete;Span 3m;BM50)	m2	59,835	83,026	142,861
Superstructure (Concrete;Span 5m;BM50)	m2	61,034	92,741	153,775
Superstructure (Concrete;Span 8m;BM50)	m2	62,554	100,992	163,546
Superstructure (Concrete;Span10m;BM50)	m2	68,143	114,666	182,809
Superstructure (Concrete;Span15m;BM50)	m2	72,799	135,019	207,818
Substructure (Pier;for Timber;10T)	NO	513,015	43,123	556,138
Substructure (Abut;for Timber;10T)	NO	1,352,002	189,655	1,541,657
Substructure (Pier;for Timber;BM50)	NO	754,475	63,842	818,317
Substructure (Abut;for Timber;BM50)	NO	1,533,810	212,676	1,746,486
Substructure (Pier;for Concrete;BM50)	NO	1,760,817	457,927	2,218,744
Substructure (Abut;for Concrete;BM50)	NO	3,658,515	967,772	4,626,287
Demolition of Bridge (Timber->Timber)	m2	16,058	1,730	17,788
Demolition of Bridge (Timber->Concrete)	m2	16,058	1,730	17,788
Demolition of Bridge (Concrete)	m2	88,586	65,606	154,192
Maintenance of Timber Bridge (New)	m2	10,411	1,344	11,755
Maintenance of Concrete Bridge (New)	m2	2,049	2,523	4,572
Maintenance of Timber Bridge (Exist)	m2	8,941	2,517	11,458
Maintenance of Concrete Bridge (Exist)	m2	4,145	2,349	6,494

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 Wajo are shown in Table 5-1-1.

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

KABUPATEN : WAJO

CRITERIA NO	ROAD LINK NO
(1)	18,71
(8)	05,17,23,24,29,31,33,34,35,36,37,40,41,43,45,47, 48,49,53,60,61,62,65,75,77,79,80,81,82,84,86,87, 88,89,91

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 : WAJO

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
73	8 Km	IIIB-1	53.647	VOC
39	12 Km	IIIA	46.040	VOC
69	4 Km	IIIB-1	32.102	VOC
83	3 Km	IIIB-2	28.390	VOC
26	11 Km	IIIB-1	27.834	VOC
22	17 Km	IIIA	25.215	VOC
74	11 Km	IIIB-2	16.374	VOC
27	10 Km	IIIB-2	16.288	VOC
19	17 Km	IIIB-2	14.402	VOC
2	14 Km	IIIA	14.100	VOC
20	8 Km	IIIA	13.340	VOC
3	14 Km	IIIA	10.656	VOC
44	8 Km	IIIB-2	10.450	VOC
4	15 Km	IIIB-1	9.445	VOC
76	6 Km	IIIB-2	8.451	VOC
66	3 Km	IIIB-2	7.139	VOC
6	11 Km	IIIB-1	6.579	VOC
28	16 Km	IIIB-1	2.674	VOC
38	11 Km	IIIB-1	1.743	VOC
7	5 Km	IIIB-2	1.364	VOC
10	16 Km	IIIA	0.078	VOC
11	7 Km	IIIA	0.078	VOC
12	5 Km	IIIB-2	0.078	VOC
30	6 Km	IIIB-2	0.078	VOC
32	10 Km	IIIB-1	0.078	VOC
13	8 Km	IIIB-1	0.078	VOC
14	11 Km	IIIB-1	0.078	VOC
42	12 Km	IIIB-2	0.078	VOC
15	6 Km	IIIB-2	0.078	VOC
46	8 Km	IIIB-2	0.078	Surplus
50	6 Km	IIIB-2	0.078	Surplus
51	4 Km	IIIC	0.078	Surplus
52	8 Km	IIIB-1	0.078	VOC
54	8 Km	IIIB-2	0.078	Surplus
55	9 Km	IIIB-1	0.078	VOC
56	3 Km	IIIC	0.078	Surplus
57	7 Km	IIIB-2	0.078	VOC
58	5 Km	IIIC	0.078	Surplus
59	5 Km	IIIB-1	0.078	VOC
63	5 Km	IIIB-1	0.078	VOC
64	6 Km	IIIB-2	0.078	Surplus
16	4 Km	IIIB-2	0.078	VOC
67	6 Km	IIIB-2	0.078	Surplus
68	2 Km	IIIB-2	0.078	VOC
1	11 Km	IIIB-1	0.078	VOC
70	7 Km	IIIC	0.078	Surplus
72	2 Km	IIIC	0.078	Surplus
8	3 Km	IIIB-2	0.078	VOC
21	5 Km	IIIB-2	0.078	VOC
9	4 Km	IIIB-2	0.078	Surplus

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

PROVINCE : SULAWESI SELATAN KABUPATEN : WAJO

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
78	8 Km	IIIB-1	0.078	VOC
25	4 Km	IIIC	0.078	Surplus
85	2 Km	IIIC	0.078	Surplus
90	2 Km	IIIC	0.078	Surplus
92	4 Km	IIIB-1	0.078	VOC

Table 5-2-2 RESULTS OF SECONDARY ANALYSIS

PROVINCE : SULAWESI SELATAN KABUPATEN : WAJO

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
76	6 Km	IIIC	10.422	VOC
66	3 Km	IIIC	8.403	VOC
7	5 Km	IIIC	3.013	VOC
28	16 Km	IIIB-2	0.078	VOC
38	11 Km	IIIB-2	0.078	VOC
6	11 Km	IIIB-2	0.078	VOC
4	15 Km	IIIB-2	0.078	VOC

Table 5-2-3 RANKING OF FEASIBILITY ROAD LINKS

PROVINCE : SULAWESI SELATAN KABUPATEN : WAJO

LINK NO	LENGTH	CLASS	NPV (1000Rp)	B/C	IRR (%)	REMARK
22	17 Km	IIIA	527976	1.776	25.215	VOC
39	12 Km	IIIA	489865	2.845	46.040	VOC
73	8 Km	IIIB-1	325289	3.224	53.647	VOC
26	11 Km	IIIB-1	181768	1.831	27.834	VOC
69	4 Km	IIIB-1	81001	2.053	32.102	VOC
2	14 Km	IIIA	47692	1.167	14.100	VOC
74	11 Km	IIIB-2	38992	1.270	16.374	VOC
83	3 Km	IIIB-2	37323	1.870	28.390	VOC
19	17 Km	IIIB-2	36386	1.177	14.402	VOC
27	10 Km	IIIB-2	31210	1.258	16.288	VOC
20	8 Km	IIIA	18468	1.133	13.340	VOC
3	14 Km	IIIA	6051	1.024	10.656	VOC
76	6 Km	IIIC	1658	1.017	10.422	VOC
44	8 Km	IIIB-2	1592	1.017	10.450	VOC
SUM	143 Km		1825271			

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: Wajo

($Rpx10^6$)

COST	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
CONSTRUCTION	1,014	1,613	2,627
MAINTENANCE	171	545	716
SUPPLEMENTATION	457	-	457
WORKSHOP EQUIPMENT & TOOLS	28	-	28
LABORATORY EQUIPMENT	19	-	19
SURVEY EQUIPMENT	5	-	5
TOTAL	1,694	2,158	3,852

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	577	2,140	2,717
CONSTRUCTION & MAINTENANCE EQUIPMENT	990	-	990
SPARE PARTS	75	18	93
WORKSHOP/LABORATORY/SURVEY EQUIPMENT	52	-	52
TOTAL	1,694	2,158	3,852

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, and ownership cost for existing 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 20 links with the total length of 178 km which is 42% of the 425 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 : WAJO

REASON FOR SELECTION	ROAD LINK NO
Feasible	
- Primary	2,3,19,20,22,26,27,39,44,69, 73,74,83,
- Secondary	76
Engineering Point of View	1,7,9,11,16,25
Basic Human Needs	-

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

Six key road links which are located at the strategic point to complete the local road network consisting of feasible road links or connect Kecamatan capitals are selected from the engineering points of view.

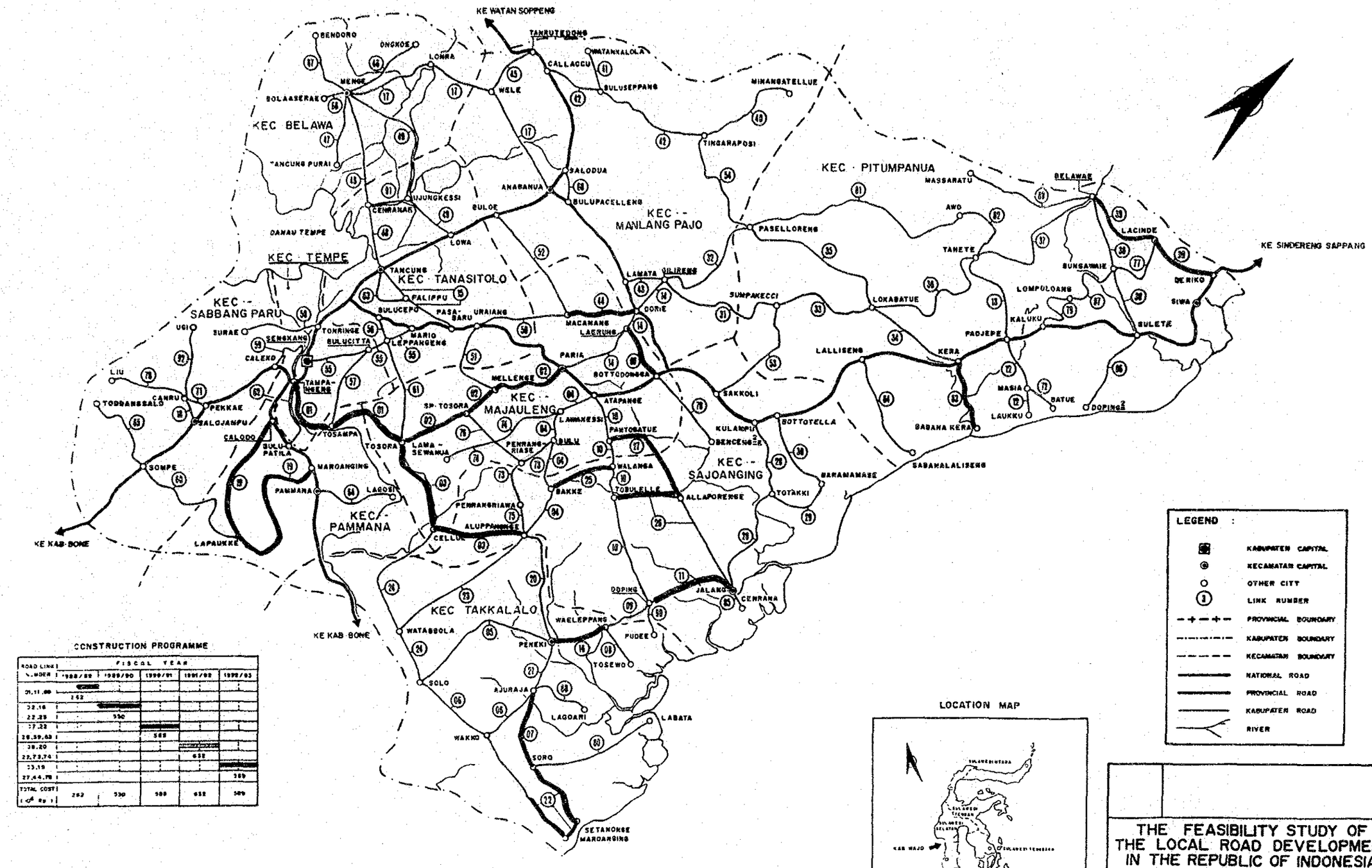
The order of proceeding with the improvement of the proposed road links are decided as shown in Table 6-1-4.

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

PROV : SULAWESI SELATAN KAB : WAJO

YEAR	LINK NO	( ) : rate
1988	1, 11, 69	
1989	2, 16, 22 (40%), 25	
1990	7, 22 (20%), 26, 39, 83	
1991	9, 20, 22 (40%), 73, 74	
1992	3, 19, 27, 44, 76	

KAB · WAJO



CONSTRUCTION PROGRAMME

ROAD LINK NUMBER	FISCAL YEAR 1988/89	1989/90	1990/91	1991/92	1992/93
01,11,60	262				
02,16		530			
22,25			588		
17,22				652	
28,39,63					589
38,20					
22,73,74					
23,19					
27,44,78					
TOTAL COST (10⁶ Rp)	262	530	588	652	589

SCALE :
0 5 10 15 Km

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

LOCATION MAP

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

TITLE : CONSTRUCTION PROGRAMME

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

(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 (1) ROAD LINKS TO BE MAINTAINED

PROV : SULAWESI SELATAN KAB : WAJO

(1000Rp)

LINK NO	LENGTH (Km)	BA (%)	SD (%)	RU (%)	RB (%)	ASPHAL (Km)	GRAVEL (Km)	EARTH (Km)	TN NO	AREA (m2)	RC NO	AREA (m2)	BRIDGE COST	LOCAL COST	FOREIGN COST	TOTAL COST
1	11	92.5	0.7	6.8	0.0	0	11	0	0	0.00	0	0.00	0	3,404	1,050	4,454
2	14	80.4	16.9	2.7	0.0	0	14	0	0	0.00	4	155.25	1,008	4,976	1,701	6,677
3	14	91.4	0.4	6.8	1.4	0	14	0	2	264.00	0	0.00	3,025	6,693	2,001	8,694
4	15	87.5	5.9	6.6	0.0	0	15	0	0	0.00	0	0.00	0	4,642	1,432	6,074
6	11	93.8	0.9	5.3	0.0	0	11	0	0	0.00	5	93.00	604	3,789	1,268	5,057
7	5	62.8	16.0	21.2	0.0	0	3	2	0	0.00	2	45.00	292	1,543	482	2,025
8	3	96.0	4.0	0.0	0.0	0	3	0	0	0.00	0	0.00	0	928	286	1,214
11	7	93.0	4.4	2.6	0.0	5	2	0	0	0.00	2	88.00	571	3,290	1,107	4,397
12	5	87.6	0.2	12.2	0.0	0	5	0	0	0.00	1	22.50	146	1,641	530	2,171
13	8	99.0	1.0	0.0	0.0	0	8	0	0	0.00	5	189.00	1,227	3,259	1,708	4,467
14	11	97.8	2.2	0.0	0.0	0	11	0	0	0.00	4	184.50	1,198	4,167	1,483	5,652
15	6	95.2	0.3	4.5	0.0	0	6	0	0	0.00	0	0.00	0	1,857	573	2,430
16	4	93.0	0.0	4.5	2.5	0	4	0	0	0.00	3	126.00	818	1,760	678	2,438
20	8	99.8	0.4	4.9	0.0	0	8	0	0	0.00	0	0.00	0	2,476	764	3,240
21	5	78.8	18.8	2.4	0.0	0	5	0	0	0.00	2	148.00	961	2,161	823	2,986
22	17	77.9	17.2	4.9	0.0	0	0	17	0	0.00	4	90.00	584	4,016	980	4,996
25	4	99.0	1.0	0.0	0.0	0	0	4	0	0.00	0	0.00	0	857	181	1,038
26	11	79.5	15.0	5.5	0.0	0	0	11	0	0.00	1	20.00	130	2,440	544	2,984
27	10	83.2	12.8	4.0	0.0	0	0	10	0	0.00	2	72.00	468	2,441	621	3,062
28	16	76.8	15.8	7.5	0.0	0	15	1	0	0.00	1	40.50	263	5,024	1,572	6,596
30	6	92.8	2.2	5.0	0.6	0	6	0	0	0.00	0	0.00	0	1,857	573	2,430
32	10	92.5	7.0	0.5	0.0	0	10	0	0	0.00	2	177.30	1,151	3,829	1,371	5,200
38	11	68.6	20.2	11.2	0.0	0	8	3	0	0.00	0	0.00	0	3,118	899	4,017
42	12	96.3	3.4	0.3	0.0	0	12	0	0	0.00	4	157.50	1,023	4,366	1,515	5,881
44	8	52.3	21.5	21.3	5.0	0	3	5	0	0.00	1	31.50	205	2,130	586	2,716

Table 6-1-5 (2) ROAD LINKS TO BE MAINTAINED

PROV : SULAWESI SELATAN KAB : WAJO

(1000Rp)

LINK NO	LENGTH (Ka)	BA (%)	SD (%)	RU (%)	RB (%)	ASPHAL (Ka)	GRAVEL (Ka)	EARTH (Ka)	TN NO	AREA (m2)	RC NO	AREA (m2)	BRIDGE COST	LOCAL COST	FOREIGN COST	TOTAL COST
46	8	87.9	3.4	8.8	0.0	8	0	0	0	0.00	2	99.00	643	4,101	1,367	5,468
51	4	72.5	20.0	6.3	1.3	0	0	4	0	0.00	0	0.00	0	857	181	1,038
52	8	99.0	1.0	0.0	0.0	0	8	0	0	0.00	0	0.00	0	2,476	764	3,240
54	8	95.0	5.0	0.0	0.0	0	4	4	0	0.00	0	0.00	0	2,095	563	2,658
55	9	98.4	0.6	1.0	0.0	0	9	0	0	0.00	3	76.50	497	3,102	1,039	4,141
56	3	99.0	1.0	0.0	0.0	0	2	1	0	0.00	0	0.00	0	833	236	1,069
57	7	91.6	6.3	2.1	0.0	0	4	3	1	22.50	0	0.00	258	2,082	574	2,656
58	5	91.2	2.8	6.0	0.0	0	4	1	0	0.00	0	0.00	0	1,452	427	1,879
59	5	97.2	0.8	2.0	0.0	0	5	0	0	0.00	1	22.50	146	1,641	530	2,171
63	5	90.4	8.6	1.0	0.0	0	5	0	0	0.00	0	0.00	0	1,547	477	2,024
64	6	60.0	20.0	20.0	0.0	0	2	4	0	0.00	0	0.00	0	1,476	372	1,848
66	3	99.0	1.0	0.0	0.0	0	0	3	0	0.00	0	0.00	0	643	136	779
67	6	85.2	0.5	14.3	0.0	0	6	0	0	0.00	2	45.00	292	2,043	678	2,721
68	2	99.0	1.0	0.0	0.0	0	2	0	0	0.00	0	0.00	0	619	191	810
69	4	47.5	25.0	27.5	0.0	0	0	4	0	0.00	0	0.00	0	857	181	1,038
71	1	99.0	1.0	0.0	0.0	0	1	0	0	0.00	0	0.00	0	309	95	404
73	8	0.0	99.0	1.0	0.0	0	0	8	0	0.00	1	22.50	146	1,807	415	2,222
74	11	59.1	25.5	15.5	0.0	0	0	11	1	45.00	0	0.00	516	2,759	611	3,370
78	8	62.4	2.3	35.4	0.0	0	8	0	0	0.00	1	31.50	205	2,696	838	3,444
83	3	50.0	13.3	36.7	0.0	0	0	3	0	0.00	0	0.00	0	643	136	779
85	2	99.0	1.0	0.0	0.0	0	2	0	1	125.00	0	0.00	1,432	1,737	506	2,243
90	2	99.0	1.0	0.0	0.0	0	2	0	0	0.00	0	0.00	0	619	191	810
92	4	79.3	15.3	5.5	0.0	0	4	0	0	0.00	1	45.00	292	1,424	487	1,911
SUM	354					13	242	99	5	436.50	54	1982.05	18,102	114,394	35,225	149,619

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 Wajo 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 2,627 x 10^6 and maintenance cost is Rp 716 x 10^6 which is approximately 21% of the total expenditure.

Table 6-1-6 (1) CONSTRUCTION AND MAITENANCE COST

(CONSTRUCTION)

PROV : SULAWESI SELATAN KAB : WAJO

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	158,505	315,114	350,459	380,417	379,631	1,584,126	(60.3%)
Ownership Cost	2,839	5,630	6,586	7,102	7,843	30,000	(1.9%)
Operation Cost	74,376	144,904	158,666	177,125	192,615	747,686	(47.2%)
Material Cost	36,720	73,588	73,693	79,000	54,330	317,331	(20.0%)
Labour Cost	23,895	49,890	65,802	67,570	75,326	282,483	(17.8%)
Contingency	20,675	41,102	45,712	49,620	49,517	206,626	(13.0%)
FOREIGN CURRENCY :	104,061	236,546	238,869	252,974	210,061	1,042,511	(39.7%)
Ownership Cost	41,496	80,901	90,671	99,448	109,034	421,550	(40.4%)
Operation Cost	5,771	11,016	12,255	13,707	15,614	58,363	(5.6%)
Material Cost	43,221	113,775	104,786	106,822	59,014	426,618	(40.9%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	13,573	30,854	31,157	32,997	27,399	135,980	(13.0%)
TOTAL COST :	262,566	551,660	589,328	633,390	589,692	2,626,636	
Ownership Cost	44,335	86,531	97,257	106,550	116,877	451,550	(17.2%)
Operation Cost	80,147	155,920	170,921	190,832	208,229	806,049	(30.7%)
Material Cost	79,941	187,363	178,479	185,822	112,344	743,949	(28.3%)
Labour Cost	23,895	49,890	65,802	67,570	75,326	282,483	(10.8%)
Contingency	34,248	71,956	76,869	82,616	76,916	342,605	(13.0%)

(Contingency : 15%)

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

(MAINTENANCE)

PROV : SULAWESI SELATAN KAB : WAJO

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	55,281	112,736	117,738	125,342	134,209	545,306	(76.2%)
Ownership Cost	750	1,590	1,720	1,914	2,185	8,159	(1.5%)
Operation Cost	30,480	60,943	62,841	65,963	69,414	289,641	(53.1%)
Material Cost	1,610	3,530	3,883	4,466	4,733	18,222	(3.3%)
Labour Cost	22,441	46,673	49,294	52,999	57,877	229,284	(42.0%)
FOREIGN CURRENCY :	17,027	34,746	36,577	39,320	42,766	170,436	(23.8%)
Ownership Cost	14,634	29,276	30,275	31,945	33,814	139,944	(82.1%)
Operation Cost	1,704	3,413	3,526	3,729	3,973	16,345	(9.6%)
Material Cost	689	2,057	2,776	3,646	4,979	14,147	(8.3%)
Labour Cost	0	0	0	0	0	0	(0.0%)
TOTAL COST :	72,308	147,482	154,315	164,662	176,975	715,742	
Ownership Cost	15,384	30,866	31,995	33,859	35,999	148,103	(20.7%)
Operation Cost	32,184	64,356	66,367	69,692	73,387	305,986	(42.8%)
Material Cost	2,299	5,587	6,659	8,112	9,712	32,369	(4.5%)
Labour Cost	22,441	46,673	49,294	52,999	57,877	229,284	(32.0%)

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

(TOTAL)

PROV : SULAWESI SELATAN KAB : WAJO

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	213,786	427,850	468,197	505,759	513,840	2,129,432	(63.7%)
Ownership Cost	3,589	7,220	8,306	9,016	10,028	38,159	(1.8%)
Operation Cost	104,856	205,847	221,507	243,088	262,029	1,037,327	(48.7%)
Material Cost	38,330	77,118	77,576	83,466	59,063	335,553	(15.8%)
Labour Cost	46,336	96,563	115,096	120,569	133,203	511,767	(24.0%)
Contingency	20,675	41,102	45,712	49,620	49,517	206,626	(9.7%)
FOREIGN CURRENCY :	121,088	271,292	275,446	292,294	252,827	1,212,947	(36.3%)
Ownership Cost	56,130	110,177	120,946	131,393	142,848	561,494	(46.3%)
Operation Cost	7,475	14,429	15,781	17,836	19,587	74,708	(6.2%)
Material Cost	43,910	115,832	107,562	110,468	62,993	440,765	(36.3%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	13,573	30,854	31,157	32,997	27,399	135,980	(11.2%)
TOTAL COST :	334,874	699,142	743,643	798,052	766,667	3,342,378	
Ownership Cost	59,719	117,397	129,252	140,409	152,876	599,653	(17.9%)
Operation Cost	112,331	220,276	237,288	260,924	281,616	1,112,035	(33.3%)
Material Cost	82,240	192,950	185,138	193,934	122,056	776,318	(23.2%)
Labour Cost	46,336	96,563	115,096	120,569	133,203	511,767	(15.3%)
Contingency	34,248	71,956	76,869	82,616	76,916	342,605	(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 Wajo 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.

- 2-Steel Roller
- 1-Hand-guided Vibratory Roller
- 1-Asphalt Sprayer

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-Motor Grader 75 HP
- 1-Tire Roller 8-15 Ton
- 1-Dump Truck 3 Ton
- 1-Hand Guided Vibratory Roller 1000 Kg
- 1-Flat Bed Truck 3 Ton

b. Equipment for Bridge Maintenance

- 1-Flat Bed Truck with Grane 3 Ton

(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 equipmant 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 : WAJO

EQUIPMENT NAME	WORKABLE	EXISTING	(1988)	(1989)	(1990)	(1991)	(1992)
Bulldozer/Ripper	240	0	0.34	0.39	0.50	0.53	0.89
Swamp Bulldozer	240	0	0.05	0.05	0.02	0.03	0.00
Motor Grader	250	0	0.65	1.11	1.39	1.53	2.12
Hand-guide Vib. Roller	250	1	0.11	0.17	1.06	0.53	0.77
Tire Roller	240	0	0.51	1.14	0.88	1.03	0.44
Vibratory Roller (D&T)	250	0	0.47	0.86	1.07	1.19	1.57
Hydraulic Excavator; Wheel	240	0	0.23	0.19	0.07	0.08	0.02
Wheel Loader	250	0	0.80	1.59	1.70	1.96	2.19
Water Tank Truck	250	0	0.21	0.57	0.65	0.77	0.81
Dump Truck	250	0	6.01	12.10	13.61	15.58	17.68
Flat Bed Truck with Crane	250	0	0.06	0.13	0.68	0.32	0.46
Flat Bed Truck	250	0	0.62	1.36	1.34	1.35	0.75
Portable Crusher/Screening	250	0	0.17	0.43	0.38	0.46	0.37
Concrete Mixer	240	0	0.04	0.06	0.41	0.16	0.21
Water Pump	240	0	0.03	0.05	0.54	0.13	0.16
Concrete Vibrator	240	0	0.01	0.03	0.10	0.05	0.06
Asphalt Sprayer	240	1	0.51	1.14	0.88	1.03	0.44

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

Table 6-1-8 EQUIPMENT PURCHASE COST

PROV : SULAWESI SELATAN KAB : WAJO

(1000 Rp)

EQUIPMENT NAME	CLASS	CIF (JAKARTA)	PURCHASE NO.	PURCHASE COST
Bulldozer	90 HP	49,150	-	-
Bulldozer/Ripper	90 HP	53,000	1	53,000
Swamp Bulldozer	90 HP	52,850	-	-
Swamp Bulldozer	65 HP	40,500	-	-
Motor Grader	75 HP	47,800	3	143,400
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	2	62,140
Vibratory Roller (D&T)	4 ton	29,000	-	-
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	16	235,200
Dump Loader Truck	12 ton	56,300	-	-
Flat Bed Truck with Crane	3.0 ton	25,190	2	50,380
Flat Bed Truck	3.0 ton	11,275	3	33,825
Portable Crusher/Screening	30-40 t/h	188,000	1	188,000
Concrete Mixer	0.5 m3	18,000	1	18,000
Water Pump	200 l/min	630	1	630
Concrete Vibrator	3.3 HP	740	1	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	989,565
OWNERSHIP COST (FOREIGN)	532,856
EQUIPMENT COST SUPPLEMENTED	456,709

NOTE : OWNERSHIP COST (FOREIGN) for Existing Equipment

Hand-guide Vib. Roller	3,342
Vibratory Roller (D&T)	22,384
Asphalt Sprayer	2,912
TOTAL	28,638

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 : WAJO

ITEM	UNIT	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)
Site Clearance in Light Bush	m2	0.00	18900.00	15450.00	18900.00	0.00	53250.00
Subgrade Preparation	m2	43670.00	124240.00	234000.00	218000.00	325000.00	944910.00
Normal Fill	m3	0.00	0.00	0.00	0.00	0.00	0.00
Fill in Swamp	m3	2079.00	2070.00	555.00	1110.00	0.00	5814.00
Normal Excavation to Spoil	m3	256.00	445.20	1126.60	1556.20	1429.00	4813.00
Sub Base Course	m3	4338.20	14773.00	17800.80	21321.90	22202.80	80436.70
Base Course	m3	4760.00	11888.00	10944.00	13728.00	12880.00	54200.00
Shoulder	m2	115500.00	108400.00	146700.00	149400.00	298000.00	816000.00
Asphalt Patching	m2	57.00	0.00	0.00	0.00	0.00	57.00
Surface Dressing (Single)	m2	88000.00	16000.00	44000.00	48000.00	0.00	196000.00
Surface Dressing (Double)	m2	0.00	134600.00	80300.00	96600.00	56000.00	367500.00
Earth Drain	m	2360.00	13540.00	8640.00	21480.00	20540.00	66560.00
Earth Drain in Swamp (by machine)	m3	4200.00	3600.00	600.00	1200.00	0.00	9600.00
Pipe Culvert D80cm	m	24.00	169.20	449.60	233.20	298.00	1174.00
Masonry Culvert (80x80cm)	m	48.00	8.00	322.00	177.00	200.00	755.00
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	18.40	66.78	238.24	102.68	154.80	580.90
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	0.00	0.00	40.00	80.00	120.00
Superstructure (Timber;Span 8m;10T)	m2	0.00	0.00	0.00	0.00	28.00	28.00
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	18.00	0.00	0.00	18.00
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	0.00	0.00	1.00	0.00	1.00
Substructure (Abut;for Timber;10T)	NO	0.00	0.00	0.00	2.00	10.00	12.00
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	2.00	0.00	0.00	2.00
Demolition of Bridge (Timber->Timber)	m2	0.00	0.00	0.00	45.00	0.00	45.00
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	171.50	339.60	342.80	349.10	354.00	1557.00
Routine maintenance of earth road	Km	48.50	89.60	81.30	62.10	31.50	313.00
Routine maintenance of gravel road	Km	117.75	220.00	213.50	216.00	214.50	981.75
Routine maintenance of asphalt road	Km	5.25	30.00	48.00	71.00	108.00	262.25
Maintenance of Timber Bridge (New)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Maintenance of Concrete Bridge (New)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Maintenance of Timber Bridge (Exist)	m2	228.25	456.50	456.50	488.00	333.50	1962.75
Maintenance of Concrete Bridge (Exist)	m2	969.03	1823.43	1940.55	1952.80	2000.05	8685.85

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.

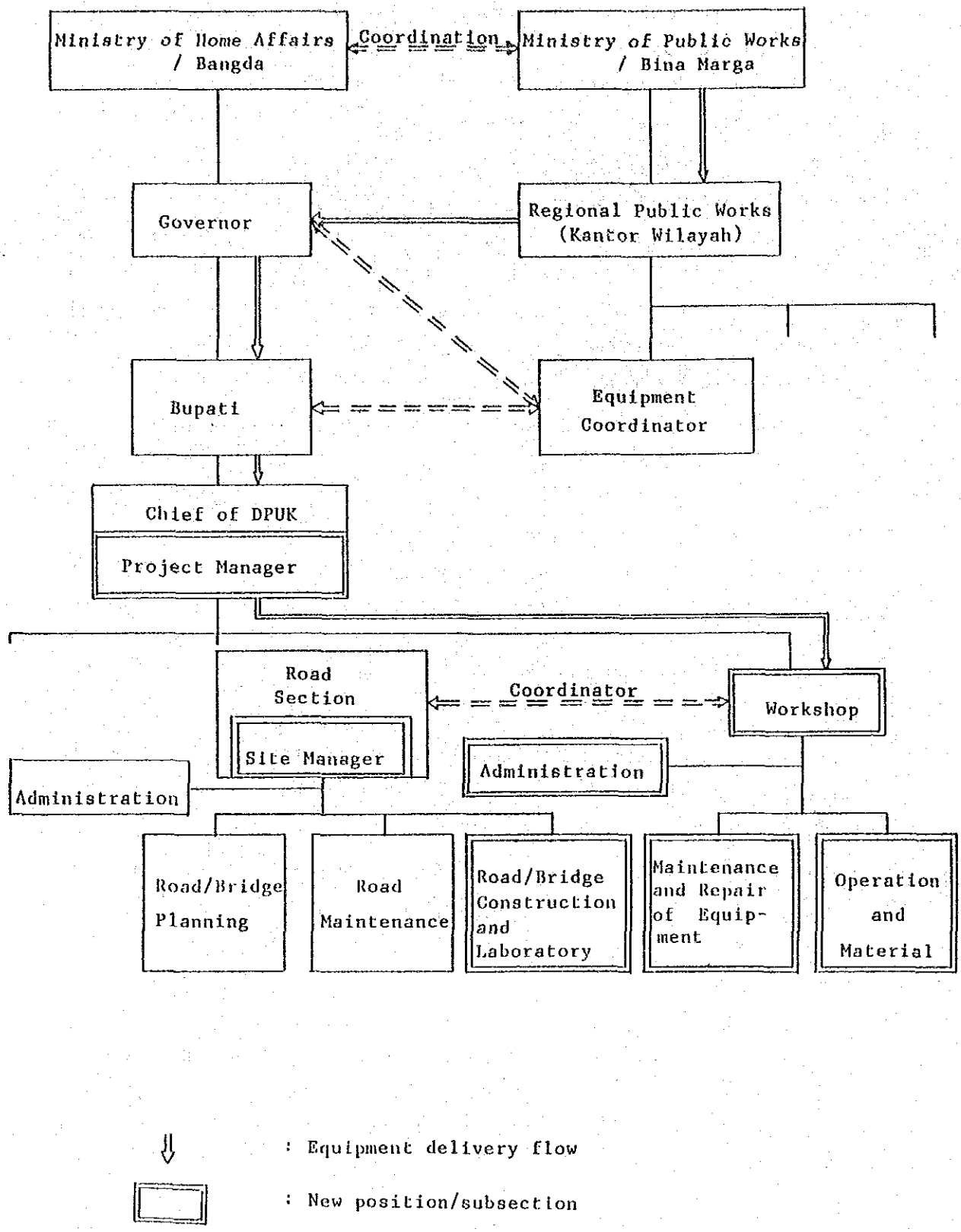
It is recommended that the workshop is newly organized to consist of three sub-sections, i.e. maintenance and repair of equipment, operation and materials, and administration to execute the main tasks described in Clause 3.5.

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