

## **6.5 Asera - Sandangpangan (81.5 km): Link No. 32**

### **6.5.1 Selection and Description of Route Location (Link No. 32)**

#### **(1) Asera -Tinobu (34.0 km)**

##### **1) Location of Existing Road**

The existing road section between Molawe (Sta.229 km) and Tinobu (Sta.236 km) is located in relatively rolling areas along the coastal topography. The Molawe - Asera section is located inland. In this section, the 5 km portion of Sta.224 km to 219 km and the 1km portion between Sta.207.5 km and 208.5 km are in mountainous areas, while other portions run through gentle hilly area.

##### **2) Existing Road Conditions**

The entire road section is the gravel or dirt road without any drainage facilities or measures to protect the surface of slopes. The alignment is generally satisfactory except for that in the mountainous areas.

##### **3) Land Use**

The narrow coastal flatland in which copra and cacao are raised is an extent of 1 km or less wide. The inland portion, 1 km from the road along the coast, is designated to be limited production forest (HPT). The 3 km section near Sta.201 km of the existing road runs through limited production forest (HTP). The Asera area is a large-scale migration area. The settlers raise cacao in the hilly areas.

##### **4) Possibility of Development**

The Asera area of Sta.216 km (Andowia) to 203.5 km is migration area. Around this area, undeveloped lands suitable for paddy field are distributed. Development of these areas is expected when the road is developed and improved.

##### **5) Components of Construction Work**

A proposed road alignment is shown in Appendix A-6.1 and the following major works are needed for the construction:

- Improvement of road alignment
- Widening of roadway;
- Pavement;
- Bridges;
- Drainage; and
- Slope protection.

## **(2) Tinobu - Sandangpangan (47.5 km)**

### **1) Location of Existing Road**

The road is located in a relatively rolling area along the coast.

### **2) Existing Road Conditions**

The entire section consists of either gravel or dirt roads, without drainage facilities or measures to protect the surface of the slopes. Except for a section through a village, the road alignment is satisfactory as a whole.

### **3) Land use**

The coastal land is relatively flat, but narrow, with a width of 1 km or less. Copra is cultivated in the coastal flatland. The inland portions 1 km from the road are designated to be limited production forest (HPT).

### **4) Possibility of development**

The alluvial plain around Pasiambu (Sta.260 km) and Lemobajo (Sta.249 km) can be developed for paddy field. The coast with sandy beaches and rocky reefs at Tanjun Taipa, which can be reached within one and half hours from Kendari city, can be developed for tourism. In the Toreo area (near Sta.242 km) in the vicinity of Tinobu, there are hot springs and unusual land forms created by calcium carbonate deposited by gushing hot springs. Development to utilize such resources can be expected.

### **4) Components of Construction Work**

A proposed road alignment is shown in Appendix A-6.1 and the following major works are needed for the construction.

- Improvement of road alignment;
- Widening of roadway;
- Pavement;
- Bridges; and
- Drainage.

## 6.5.2 Preliminary Engineering Design (Link No. 32)

### (1) Preliminary Engineering of Bridges

Application of types of bridge superstructures to link No. 32 is as described in section 6.2.2 (1).

Most existing bridges are wooden bridges or bailey bridges. Therefore, bridges except three existing steel truss bridges are to be newly constructed. For bridges to be retained, BR32-18 (Sta.227+535), BR32-24 (Sta.235+465) and BR32-49 (269+510) have only 6m wide without sidewalk but have enough durability. The width of 6m accommodates two-lane traffic.

For bridge foundations, most bridges on this route required pile foundations but spread footing was also recommended for bridges in mountainous area from Sta.217km to Sta.225km based on the results of soil investigation.

Depth of bearing layer based on boring data is about 4m below the ground surface. Spread footing was adopted though the height of substructure became higher in the same manner as link No. 22. Bridges in other areas of link No. 32 required pile foundations with 7 m to 17m pile length based on the soil conditions.

Quantities of bridge improvement on link No. 32 are summarized as shown in Table 6-5-1. Proposed bridge list of link No. 32 is given in Tables 6-5-2 (1) and (2).

**Table 6-5-1 Summary of Bridge Improvement Quantities of Link No. 32**

Classification		The Number of Bridge	Area (m <sup>2</sup> )
New Construction	Bridge length $\leq 50$ m	55	11,480
	Bridge length $> 50$ m	1	456
	Total	56	11,936
Retain Existing		3	630

*Source: Study Team*

### (2) Preliminary Engineering of Slope Protection Works

Slope protection works are constructed to protect the slopes from erosion or weathering by covering them with vegetation or structures and also to stabilize the slopes by means of drainage works or retaining structures. The following types of slope protection works are adopted for the feasibility route considering the terrain and geology, as shown in Table 6-5-3 and Table 6-5-4.

Required height of slope protection works for each link is Figure 6-5-1.

Table 6-5-2 (1) Proposed Bridge List of Link No.32 (1 of 2)

Bridge No.	Location		Length	Nos. of Span	Span Arrangement	Bridge Width (m)	Types of Super-structures	Sub-structures										Boring Data	
								Types of Foundations			Abutments			Piers					
	km	+ m	(m)	Nos.	ha(m)	Pile La(m)	Nos.	ha(m)	Pile La(m)	Nos.	Nos.	hp(m)	Pile/ 1 pier Lp(m)	Nos.	hp(m)	Pile/ 1 pier Lp(m)	Nos.		
																		FIX	
BR 32 - 1	203	+ 800	20.0	1	1 @ 20.0	9.6	RC-T	Spread	1	6	-	1	6	-	-	-	-	-	13
BR 32 - 2	205	+ 720	60.0	3	3 @ 20.0	7.6	RC-T	Pile	-	-	2	10	12	18	1	16	12	25	12
BR 32 - 3	206	+ 455	30.0	1	1 @ 30.0	7.6	PC-I	Pile	1	10	22	1	10	12	22	-	-	-	12
BR 32 - 4	207	+ 360	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	12	1	6	12	18	-	-	-	12
BR 32 - 5	207	+ 760	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	12	1	6	12	18	-	-	-	12
BR 32 - 6	210	+ 590	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	12	1	6	12	18	-	-	-	12
BR 32 - 7A	212	+ 570	20.0	1	1 @ 20.0	9.6	PC-I	Pile	1	6	17	1	6	17	18	-	-	-	10,11
BR 32 - 7B	213	+ 585	30.0	1	1 @ 30.0	9.6	PC-I	Pile	1	6	17	1	6	17	22	-	-	-	10,11
BR 32 - 8	214	+ 700	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	17	1	6	17	18	-	-	-	10,11
BR 32 - 9	215	+ 20	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	17	1	6	17	18	-	-	-	10,11
BR 32 - 10	216	+ 100	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	17	1	6	17	18	-	-	-	10,11
BR 32 - 11	217	+ 380	20.0	1	1 @ 20.0	9.6	RC-T	Spread	1	6	-	1	8	-	-	-	-	-	9
BR 32 - 12	218	+ 920	20.0	1	1 @ 20.0	7.6	RC-T	Spread	1	10	-	1	6	-	-	-	-	-	9
BR 32 - 13	220	+ 335	30.0	1	1 @ 30.0	7.6	PC-I	Spread	1	6	-	1	10	-	-	-	-	-	9
BR 32 - 14	220	+ 860	20.0	1	1 @ 20.0	7.6	RC-T	Spread	1	6	-	1	6	-	-	-	-	-	9
BR 32 - 15	221	+ 405	30.0	1	1 @ 30.0	7.6	PC-I	Spread	1	6	-	1	8	-	-	-	-	-	8
BR 32 - 16	225	+ 115	30.0	1	1 @ 30.0	7.6	PC-I	Spread	1	8	15	22	1	8	15	22	-	-	6,7
BR 32 - 17	226	+ 335	30.0	1	1 @ 30.0	9.6	PC-I	Pile	1	6	7	22	1	6	7	22	-	-	6,7
BR 32 - 18	227	+ 535	30.0	1	1 @ 30.0	6.0	Steel Truss	Pile	-	-	-	-	-	-	-	-	-	-	6,7
BR 32 - 19	229	+ 640	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	7	18	1	6	7	18	-	-	6,7
BR 32 - 20	230	+ 550	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	7	18	1	6	7	18	-	-	6,7
BR 32 - 21	230	+ 750	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	7	18	1	6	7	18	-	-	6,7
BR 32 - 22	232	+ 800	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	7	18	1	6	7	18	-	-	6,7
BR 32 - 23	233	+ 350	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	7	18	1	6	7	18	-	-	6,7
BR 32 - 24	235	+ 465	30.0	1	1 @ 30.0	6.0	Steel Truss	Pile	-	-	-	-	-	-	-	-	-	-	5
BR 32 - 25	236	+ 680	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	8	11	16	1	8	11	16	-	-	5
BR 32 - 26	236	+ 930	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	8	11	16	1	8	11	16	-	-	5
BR 32 - 27	237	+ 660	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	11	16	1	6	11	16	-	-	5
BR 32 - 28	239	+ 120	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	11	16	1	6	11	16	-	-	5
BR 32 - 29	239	+ 890	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	11	16	1	6	11	16	-	-	5
BR 32 - 30	240	+ 400	40.0	2	2 @ 20.0	9.6	RC-T	Pile	-	-	-	2	8	-	-	12	11	20	5
BR 32 - 31	241	+ 170	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	8	11	16	1	8	11	16	-	-	5
BR 32 - 32	243	+ 20	20.0	1	1 @ 20.0	9.6	RC-T	Pile	1	6	13	18	1	8	13	18	-	-	3,4

Table 6-5-2 (2) Proposed Bridge List of Link No.32 (2 of 2)

Bridge No.	Location		Length (m)	Nos. of Span	Span Arrangement	Bridge Width (m)	Types of Super-structures	Sub-structures										Boring Data				
								Abutments					Piers									
	km	m	Types of Foundations	FIX		MOVE			FIX-FIX		MOVE-FIX											
				Nos.	ha(m)	Pile La(m)	Nos.	ha(m)	Pile La(m)	Nos.	hp(m)	Nos.	Pile/1 pier Lp(m)	Nos.	hp(m)	Nos.	Pile/1 pier Lp(m)	Nos.				
BR 32 - 33	243	+ 365	30.0	1	1 @ 30.0	9.6	PC-I	1	6	13	22	1	6	13	22	-	-	-	-	-	-	3.4
BR 32 - 34	246	+ 50	20.0	1	1 @ 20.0	7.6	RC-T	1	6	13	18	1	6	13	18	-	-	-	-	-	-	3.4
BR 32 - 35	246	+ 230	20.0	1	1 @ 20.0	7.6	RC-T	1	6	13	18	1	6	13	18	-	-	-	-	-	-	3.4
BR 32 - 36	248	+ 480	20.0	1	1 @ 20.0	9.6	RC-T	1	6	13	18	1	6	13	18	-	-	-	-	-	-	3.4
BR 32 - 37	248	+ 670	20.0	1	1 @ 20.0	9.6	RC-T	1	6	13	18	1	6	13	18	-	-	-	-	-	-	3.4
BR 32 - 38	249	+ 345	30.0	1	1 @ 30.0	7.6	PC-I	1	6	13	22	1	6	13	22	-	-	-	-	-	-	3.4
BR 32 - 39	250	+ 715	30.0	1	1 @ 30.0	7.6	PC-I	1	6	13	22	1	6	13	22	-	-	-	-	-	-	3.4
BR 32 - 40	251	+ 520	20.0	1	1 @ 20.0	9.6	RC-T	1	6	13	18	1	6	13	18	-	-	-	-	-	-	1.2
BR 32 - 41	254	+ 50	30.0	1	1 @ 30.0	9.6	PC-I	1	6	15	20	1	6	15	20	-	-	-	-	-	-	1.2
BR 32 - 42	255	+ 270	30.0	1	1 @ 30.0	9.6	PC-I	1	6	17	20	1	6	17	20	-	-	-	-	-	-	1.2
BR 32 - 43	256	+ 390	20.0	1	1 @ 20.0	9.6	RC-T	1	8	17	16	1	8	17	16	-	-	-	-	-	-	1.2
BR 32 - 44	262	+ 685	30.0	1	1 @ 30.0	7.6	PC-I	1	6	17	20	1	6	17	20	-	-	-	-	-	-	1.2
BR 32 - 45	263	+ 385	30.0	1	1 @ 30.0	7.6	PC-I	1	10	17	20	1	10	17	20	-	-	-	-	-	-	1.2
BR 32 - 46	263	+ 630	20.0	1	1 @ 20.0	7.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 47	263	+ 820	20.0	1	1 @ 20.0	7.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 48	264	+ 920	20.0	1	1 @ 20.0	9.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 49	269	+ 510	45.0	1	1 @ 45.0	6.0	Steel Truss	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 50	274	+ 590	20.0	1	1 @ 20.0	7.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 51	274	+ 580	20.0	1	1 @ 20.0	7.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 52	275	+ 430	20.0	1	1 @ 20.0	7.6	RC-T	1	8	17	16	1	8	17	16	-	-	-	-	-	-	1.2
BR 32 - 53	279	+ 80	20.0	1	1 @ 20.0	7.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 54	279	+ 225	30.0	1	1 @ 30.0	7.6	PC-I	1	8	17	20	1	8	17	20	-	-	-	-	-	-	1.2
BR 32 - 55	279	+ 425	30.0	1	1 @ 30.0	7.6	PC-I	1	8	17	20	1	8	17	20	-	-	-	-	-	-	1.2
BR 32 - 56	279	+ 810	20.0	1	1 @ 20.0	9.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2
BR 32 - 57	280	+ 915	30.0	1	1 @ 30.0	9.6	PC-I	1	6	17	20	1	6	17	20	-	-	-	-	-	-	1.2
BR 32 - 58	282	+ 260	20.0	1	1 @ 20.0	9.6	RC-T	1	8	17	16	1	8	17	16	-	-	-	-	-	-	1.2
BR 32 - 59	282	+ 950	20.0	1	1 @ 20.0	9.6	RC-T	1	6	17	16	1	6	17	16	-	-	-	-	-	-	1.2

**Table 6-5-3 Adopted Slope Protection Type (Cutting Slope)**

Station(km)	Geology	Slope Protection Type
202.6-203.6	Diluvium	Sprayed Concrete Cribwork
203.6-205.1	Alluvium	Sprayed Concrete Cribwork
205.1-206.1	Ultra Basic Rock	Shotcrete
206.1-208.1	Alluvium	Sprayed Concrete Cribwork
208.1-211.1	Ultra Basic Rock	Shotcrete
211.1-213.6	Alluvium	Sprayed Concrete Cribwork
213.6-215.6	Alluvium	Sprayed Concrete Cribwork
215.6-229.1	Tokala Formation	Shotcrete
229.1-238.6	Ultra Basic Rock	Shotcrete
238.6-239.6	Tokala Formation	Shotcrete
239.6-242.1	Alluvium	Sprayed Concrete Cribwork
242.1-258.1	Tokala Formation	Shotcrete
258.1-259.1	Alluvium	Sprayed Concrete Cribwork
259.1-260.1	Tokala Formation	Shotcrete
260.1-261.1	Alluvium	Sprayed Concrete Cribwork
261.1-281.6	Tokala Formation	Shotcrete
281.6-283.4	Alluvium	Sprayed Concrete Cribwork

Source: Study Team

**Table 6-5-4 Quantities of Slope Protection**

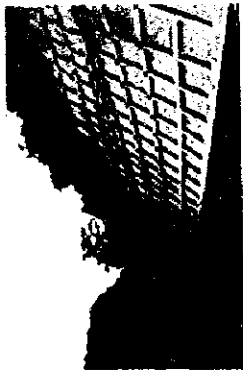
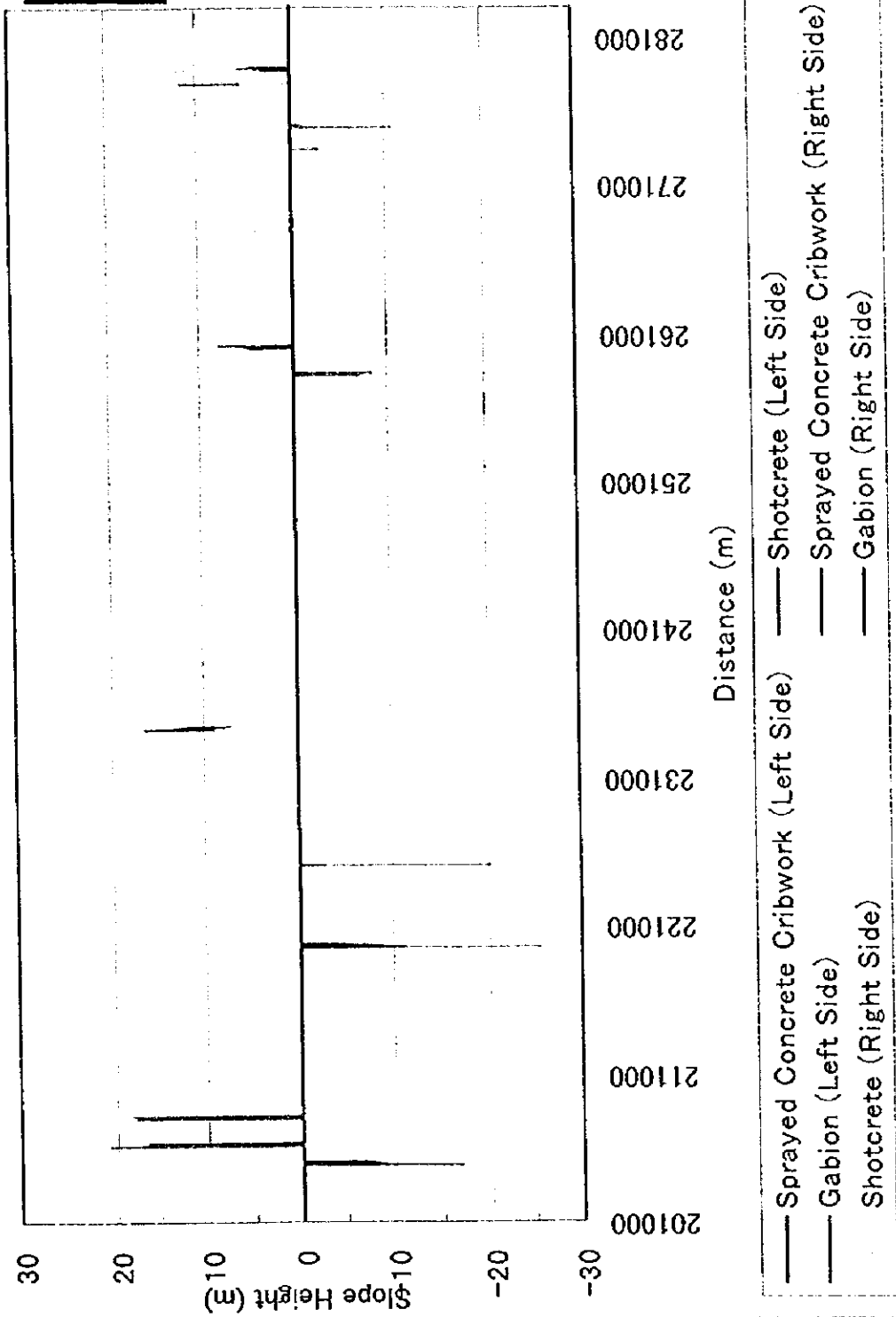
	Cut		Fill
	Sprayed Concrete Cribwork(m <sup>2</sup> )	Shotcrete (m <sup>2</sup> )	Mat Gabion (m <sup>2</sup> )
Quantity	9,509	10,068	7,374

Source: Study Team

### (3) Cost Estimation

#### 1) Estimated Project Cost

Cost items consist of preparation works, pavement, earth work, drainage, bridge, slope protection and safety facilities works. The cost for engineering service was estimated at 20% of the total construction cost consisting of direct and indirect cost. A contingency has been included in 10 % of the total of construction and engineering cost. The ratio of major item costs to the total cost is shown in Figure 6-5-2 and Table 6-5-5 shows estimated cost.



Sprayed Concrete Cribwork Type

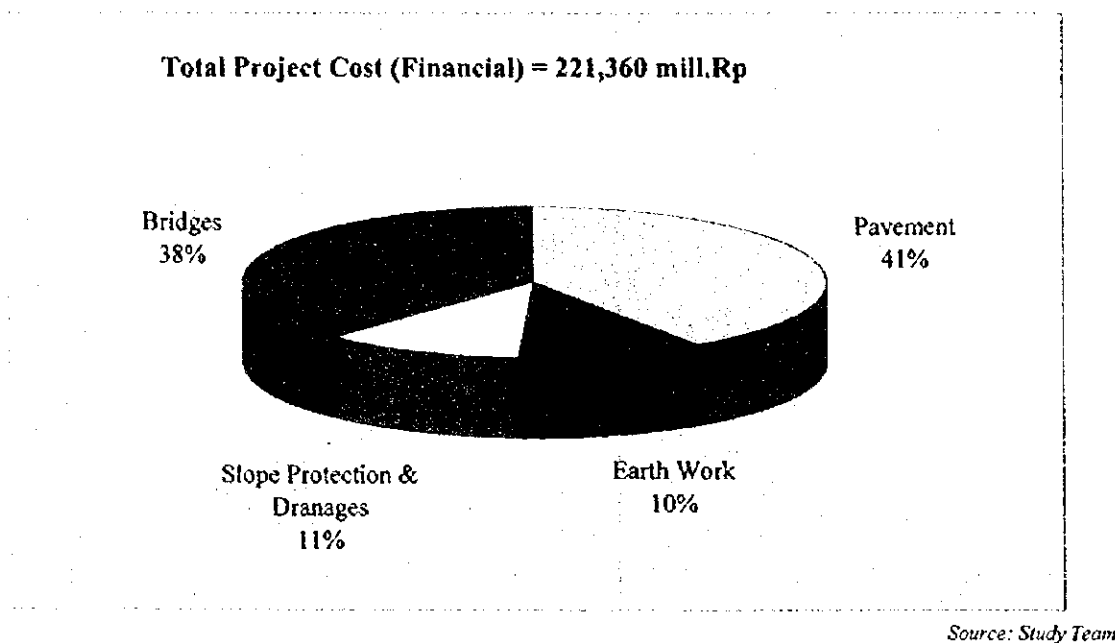


Shotcrete Type

Figure 6-5-1 Location and Height Slope Protection for Link No.32

## 2) Implementation Plan

As shown in Figure 6-5-3, the construction period is 5 years consisting of one year for preparation of project for fund raising plan, 1.5 years for detailed design of the roads and 2.5 years for construction. Also, the investment plan was set in accordance with the construction plan.



**Figure 6-5-2 Construction Cost Ratio for Link No.32**

## (4) Economic Analysis

### 1) Economic Project Costs

The economic investment costs were estimated in constant 1998 prices. The financial investment costs in terms of market price include the component of taxes. The economic costs for economic analysis were obtained by subtracting the portion of transfer payment such as taxes from financial costs. Implementation is scheduled over four years from 2000 to 2003. The phased financial and economic investment costs (initial investment) are summarized in Table 6-5-6.



**Table 6-5-5 Total Construction Cost For Asera - Tondowatu Road (Link No.32)**

Rate : 11SS = 10600Rp = 140Yen

Item	Unit	Quantity	Unit Price		Total Price		Financial Total (Mill. Rp)	Financial Total (Mill. Yen)
			Foreign (US\$)	Financial (Rp)	Local Financial (Rp)	Local Economic (Rp)		
<b>1. Preparation Works</b>								
Cleaning and Grubbing	m <sup>2</sup>	713,255	0.25	1,867	1,331,647,832	1,497,123,085	3,071	
<b>2. Pavement</b>								
New Road Asphalt Concrete = Sub base (Type A)	m	21,700	39.40	436,896	857,150	9,489,648,200	18,566	
Widening Road Asphalt Concrete = Sub base (Type A)	m	59,751	20.99	234,564	1,254,173	14,015,433,564	27,310	
Transport for Pavement Material (L=20km)	m <sup>3</sup>	81,978	2.57	19,133	210,332	1,568,477,689	3,798	
Sub-2					2,321,656	25,064,554,453	49,674	
<b>3. Earth Work</b>								
Excavation (Common)	m <sup>3</sup>	346,292	0.92	7,407	318,589	2,564,984,844	5,942	
Excavation (Sound Rock)	m <sup>3</sup>	26,204	4.12	33,605	107,960	880,385,420	2,025	
Disposal soil (L=3km)	m <sup>3</sup>	143,101	1.30	8,610	171,721	1,232,097,544	3,052	
Sub-3					598,270	4,677,667,408	11,019	
<b>4. Drainage</b>								
Pipe Culvert (D=100cm)	m	2,480	44.35	634,758	199,988	1,574,199,840	2,740	
Pipe Culvert (D=60cm)	m	1,629	15.28	202,287	24,891	330,344,079	594	
Box Culvert (B=3.0m, H=2.0m)	m	360	325.89	3,064,762	117,320	1,103,314,320	2,347	
U-ditch (L=50cm)	m	33,380	2.85	69,850	98,133	2,331,893,000	3,340	
Sub-4					347,333	5,339,451,239	9,021	
<b>5. Slope Protection</b>								
Sprayed Concrete Embankment	m <sup>2</sup>	9,509	14.68	127,197	139,592	1,209,516,273	2,689	
Stone Masonry	m <sup>2</sup>	10,065	11.82	101,590	119,004	1,020,794,520	2,282	
Mat Gabion	m <sup>2</sup>	7,374	6.91	116,286	0	0	0	
Sodding	m <sup>2</sup>	0	9.20	72,584	67,841	535,234,416	1,284	
Sub-5					328,437	2,765,545,209	6,226	
<b>6. Tunnel</b>								
No		0	3,500.00	22,400,000	0	0	0	
<b>7. Bridges</b>								
No		56			2,662,300	23,658,014,389	51,878	
<b>8. Safety Facilities Works</b>								
Guard Railing	m	17,360	11.39	168,012	196,168	2,916,688,320	4,996	
Traffic Sign	each	272	27.98	426,548	7,597	115,809,204	196	
Line Marking	m	81,451	0.42	4,231	34,209	546,619,181	707	
Sub-5					237,974	3,377,116,705	5,900	
<b>9. Mobilization &amp; Temporality Works (20% of Total Cost)</b>								
No		0			1,290,462	13,678,898,960	27,338	
<b>10. Sub-Total</b>								
m <sup>2</sup>		176,000	0.00	20,000	7,948,480	79,892,896,594	164,147	
houses		2	0.00	15,000,000	0	30,000,000	3,520	
<b>11. Land Acquisition</b>								
<b>12. Compensation</b>								
m <sup>2</sup>		0	0.00	15,000,000	0	30,000,000	3,520	
<b>13. Engineering Cost (20% of 10+11+12)</b>								
<b>14. Contingency (10% of 10+11+12+13)</b>								
<b>Grand Total Cost (10+11+12+13+14)</b>					10,831,628	106,544,803,555	221,360	

Item	Unit	Quantity	Year						Total
			1999	2000	2001	2002	2003		
1. Preparation of Project									
2. Survey and Design	km	81.45							
3. Construction									
Earth Work	m3	372,496							
Slope Protection	m2								
Tunnel	m	0.0							
Bridges	No	56							
Pavement	km	81.45							
Foreign (US\$)			522,075	1,695,780	3,707,066	4,906,707	10,831,628		
Local Financial Cost (Rp)			5,641,829,325	17,631,653,701	33,591,618,125	49,679,402,404	106,544,503,555		
Local Economic Cost (Rp)			4,903,963,460	16,337,878,074	28,073,809,305	43,437,904,511	92,753,555,350		
Total Financial Cost (Mill. Rp)			11,176	35,607	72,887	101,690	221,360		
Total Economic Cost (Mill. Rp)			10,458	34,313	67,369	95,449	207,569		

Figure 6-5-3 Implementation Schedule For Asera - Tondowatu Road (Link No.32)

**Table 6-5-6 Phased Initial Investment Costs in 1998 Prices  
(F/S - Link No. 32)**

(Million Rp.)		
Year	Financial Prices	Economic Prices
2000	11,176	10,438
2001	35,607	34,313
2002	72,887	67,369
2003	101,690	95,449
Total	221,360	207,569

Source: Study Team

The maintenance cost of the proposed road follows the engineering study results of the cost estimates. Besides, the maintenance cost of the proposed road in the case of “without the improvement of the proposed road” was treated as a negative cost.

## 2) Economic Benefits

Benefits are classified into two types, one is the direct benefit and the other is the indirect benefit or intangible benefit.

The direct benefits which would be realized from the implementation of the Project are defined as the savings in travel costs, composed of the vehicle operating cost and vehicle time cost when comparing the “with” and “without” project conditions.

The benefit of vehicle operating costs was estimated as a difference of vehicle operating costs between “with” Project” case and “without” Project” case. The vehicle operating cost was derived from the obtained daily vehicle-kilometers and the unit vehicle operating cost by vehicle type. In addition, a promotion of traffic safety and a saving in accident costs were anticipated.

In this economic analysis, the above-mentioned direct benefits, e.g. the saving in vehicle operating cost was computed as a quantified benefit. The calculation of direct benefits were made for the planning year of 2003 and 2018.

As a result, the saving in vehicle operating cost is summarized as shown in Table 6-5-7.

**Table 6-5-7 Estimated Economic Benefits  
(F/S - Link No. 32)**

(Million Rp. at 1998 price)	
Year	Benefit of Saving in VOC
2004	62,679
2018	131,004

Source: Study Team

### 3) Economic Cost-Benefit Analysis

The analysis follows the conventional discounted cash flow method in determining the economic internal rate of return (EIRR), the net present value (NPV) and the benefit cost ratio (B/C). (NPV and B/C are calculated at a discount rate of 15 percent.) The project life is assumed to be 20 years after the completion of the construction.

The benefits in the intermediate years were interpolated and those beyond 2018 were assumed to be fixed. The total economic project costs and benefits streams are presented in Table 6-5-8. The efficiency measures were calculated and the results are as follows:

Efficiency Measures	F/S - Link No. 32
EIRR	30.4%
NPV (Million Rp.)	163,407
B/C	2.48

Source: Study Team

These results indicate that implementation of the project (road improvement of link No. 32) is economically feasible.

**Table 6-5-8 Economic Analysis for F/S of Link No. 32**

		(Million Rp.)						
Year	Benefits		Total	Costs		Total	Maint. Cost (Without)	Net Cash Flow
	VOC Saving			Invest Costs	Maint. Cost (With)			
1	1999			0	0	0	0	0
2	2000			10,438	148	10,586	148	-10,438
3	2001			34,313	148	34,461	148	-34,313
4	2002			67,369	148	67,517	148	-67,369
5	2003	0	0	95,449	148	95,597	148	-95,449
6	2004	62,679	62,679	0	148	148	10,243	72,774
7	2005	67,560	67,560	0	148	148	148	67,560
8	2006	72,440	72,440	0	148	148	148	72,440
9	2007	77,320	77,320	0	148	148	148	77,320
10	2008	82,201	82,201	0	148	148	148	82,201
11	2009	87,081	87,081	0	148	148	10,243	97,176
12	2010	91,961	91,961	0	15,337	15,337	148	76,772
13	2011	96,842	96,842	0	148	148	148	96,842
14	2012	101,722	101,722	0	148	148	10,243	111,817
15	2013	106,602	106,602	0	148	148	148	106,602
16	2014	111,483	111,483	0	148	148	148	111,483
17	2015	116,363	116,363	0	148	148	10,243	126,458
18	2016	121,243	121,243	0	148	148	148	121,243
19	2017	126,124	126,124	0	15,337	15,337	148	110,935
20	2018	131,004	131,004	0	148	148	10,243	141,099
21	2019	131,004	131,004	0	148	148	148	131,004
22	2020	131,004	131,004	0	148	148	148	131,004
23	2021	131,004	131,004	0	148	148	10,243	141,099
24	2022	131,004	131,004	0	148	148	148	131,004
25	2023	131,004	131,004	0	148	148	148	131,004
				207,569	33,930	241,499	64,122	

Source: Study Team

Assuming that the benefits and cost stream might alter  $\pm 10\%$ ,  $\pm 20\%$ , the effect on the EIRR was tested and the results are summarized in Table 6-5-9. In the most severe case of -20% benefit and +20% cost, the value of EIRR is 22.6%.

**Table 6-5-9 EIRR by Altered Benefit and Cost (F/S - Link No 32)**

Cost	Benefit		
	Base	-10%	-20%
Base	30.4%	28.2%	25.8%
+10%	28.4%	26.3%	24.1%
+20%	26.6%	24.6%	22.6%

*Source: Study Team*

## 6.6 Uekuli – Tompira (114.1 km): Link No. 15

See Appendix A6.2.

## 6.7 Alternative Road Facilities Study

### 6.7.1 Alternative Facilities for Link No.16 from Sta.42km to Sta.49km

The coastline of the southern part of Bungku is located on a wide coral reef. Precipitous limestone ridge runs very close to the coast, forming a cliff. Between the ridges, precipitous channels flow into the cove. The existing road is a gravel road about 3 meters wide, and their vertical and horizontal alignments on the low standard level. The following two plans were studied for road improvement:



**Table 6-7-1 Comparison of Route Alternatives**

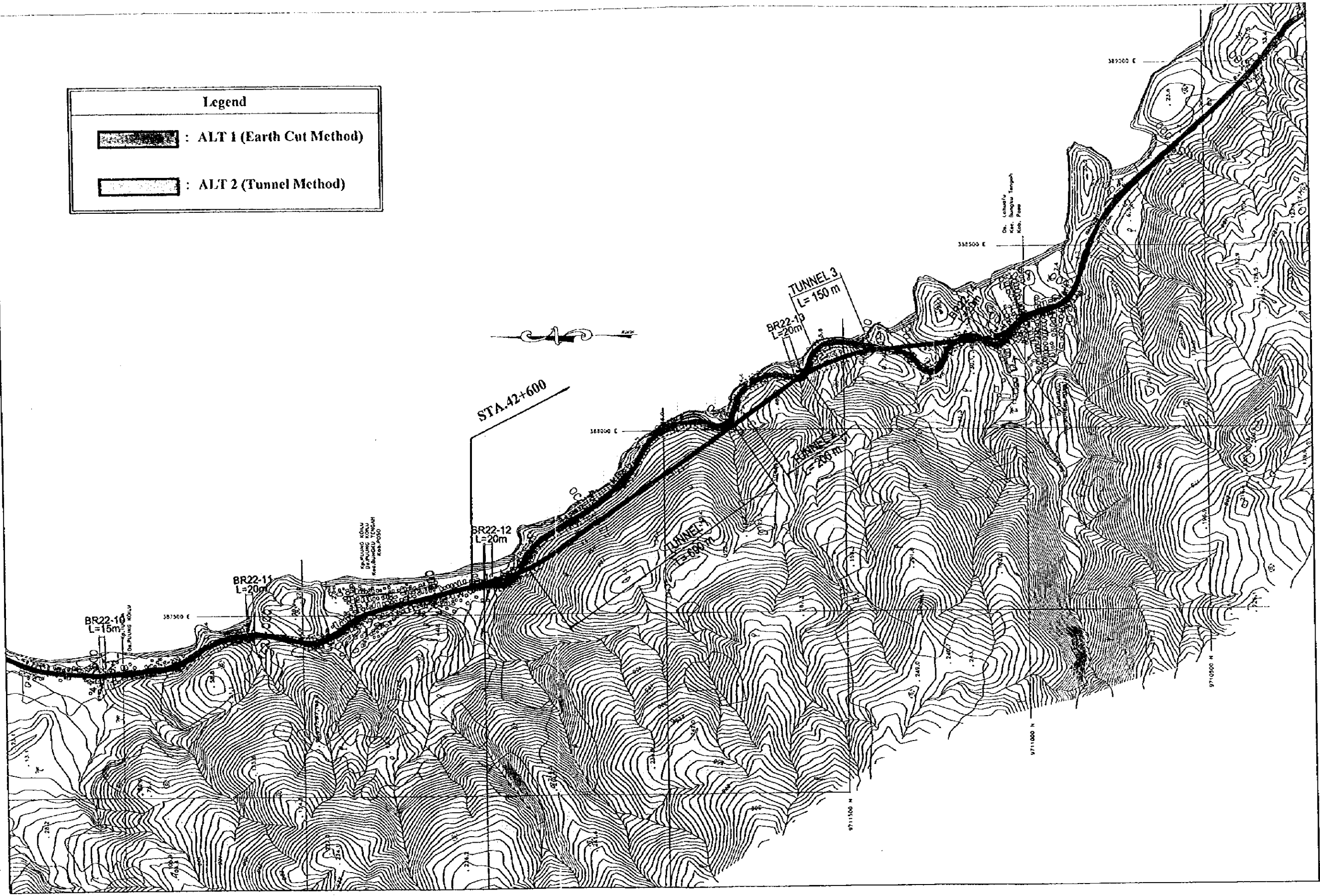
	Alternative 1	Alternative 2
Structures for Road	Earth cut with high slope protection	Tunnel and bridges
Road Length	Sta. 42+600 ~ 49+300 = 6.700 km	Sta. 42+600 ~ 49+100 = 6.500 km
Road Location	- The route runs along slopes of cliff	- The route is planned on raised coral reef. - Coves are connected with short tunnels to avoid the cutting of steep cliffs.
Horizontal Alignment	Low standard is adopted due to the land shape.	Comparatively high standard can be adopted for shore line route.
Slope Protection	Proposed road requires slope protections of maximum 40 m high even adopting lowest standard of 30 km/h for road improvement.	-----
Marine Route	-----	Shore protection for embankment against high tide is required
Construction	All the works can be done on ground.	The construction is apt to be complicated since the works are done from both on-shore and offshore.
Environmental Impact	Countermeasure is required to avoid disturbing surrounding aesthetic view by extremely high slopes.	Countermeasure is required to protect the coral reef.
Construction Cost	85 billion Rp.	97 billion Rp.

*Source: Study Team*

Based on the comparison described above, Alternative 2 was adopted considering the minimum environmental effect and simplicity of construction and two alternatives are shown in Figures 6-7-1 and 6-7-2.



Legend	
	: ALT 1 (Earth Cut Method)
	: ALT 2 (Tunnel Method)



PROJECT: ROAD NETWORK STUDY  
IN CENTRAL AND SOUTH-EAST SULAWESI

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
DIRECTORATE GENERAL OF HIGHWAYS (BINA MARGA)  
MINISTRY OF PUBLIC WORKS

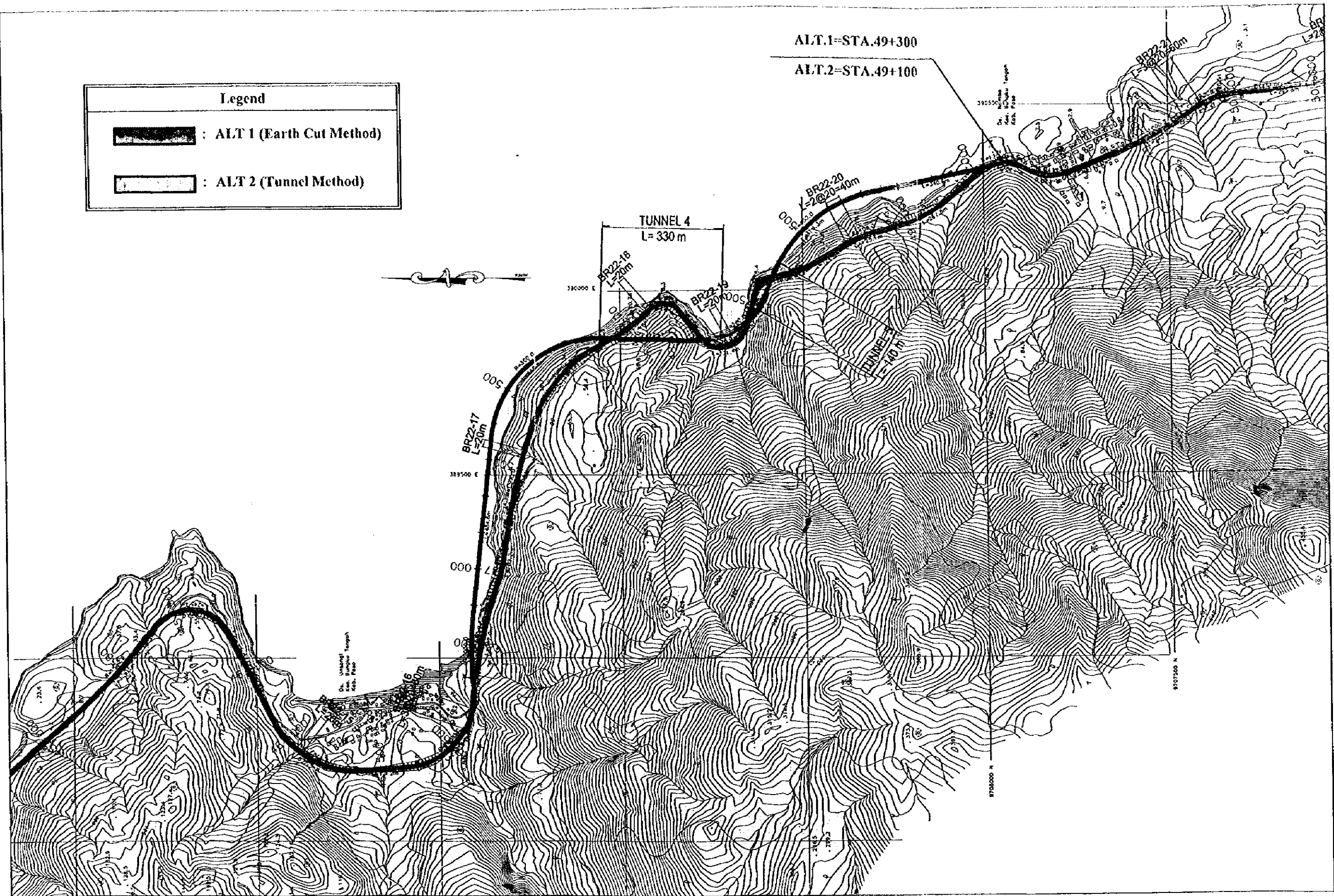
PACIFIC CONSULTANTS INTERNATIONAL  
YACHIYO ENGINEERING Co., Ltd.

Figure 6-7-1 Plan for Comparison of Route  
Alternatives (41+500 - 45+500)

SCALE:  
1: 10000

SHEET NO.





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IN CENTRAL AND SOUTH-EAST SULAWESI

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YACHIYO ENGINEERING Co., Ltd.

Figure 6-7-2 Plan for Comparison of Route  
Alternatives (45+500 - 50+000)

SCALE:  
1:10000

SHEET NO.



### 6.7.2 Alternative Facilities for Link No. 22 from Sta.138 km to Sta.142 km

The mountainous area near the border of the province is a typical karst topography, with gigantic hollow limestone portions and hilly terrain located in an complicated manner. The existing road was constructed with no available topographical map, crossing precipitous hollow portions (depth 30 m or more) and hilly terrain. Accordingly, the curve radius employed in the horizontal alignment of this road is sharp, and the vertical gradient is 20% at some sections. The geology of the area along the road consists of hard limestone and improvement of the vertical alignment extremely difficult. For the route selection, therefore, a new road was proposed based on a newly prepared topographic map (1:5,000). The proposed road has the new horizontal alignment detouring around the precipitous hollow portions and hilly terrain.

### 6.7.3 Alternative Facilities for Bridge Type

During bridge planning, bridge length and span length are generally determined in consideration of following factors.

- crossing conditions (river, valley, road, railway)
- crossing criteria (navigation clearance)
- road alignments (vertical and horizontal)

Some arrangements of piers could be determined based on the above conditions and criteria. However, the arrangement of piers should be determined by comparison when has no restrictions.

BR 22-29 bridge was proposed at station 55km +530m.

A bridge length of BR 22-29 requires 120m due to the width of river named the Baholaungsangi River, however, the topography of river bed is relatively flat. Arrangement of piers, therefore, has little restriction. That means many types of span arrangement are possible. Cost of superstructure generally becomes more costly as the bridge span is longer. On the other hand, total cost of substructure becomes more inexpensive due to reduction of the number of piers.

For the selection of bridge type of BR 22-29, following three types of the superstructure were studied.

- |  |             |                       |
|--|-------------|-----------------------|
| (a) Alternative 1: short span (6*20m=120m) : | RC T-girder | 2 abutments & 4 piers |
| (b) Alternative 2: middle span (3*40m=120m): | PC I-girder | 2 abutments & 2 piers |
| (c) Alternative 3: long span (2*60m=120m):   | Steel Truss | 2 abutments & 1 piers |

The comparison of the above three alternatives is shown in Table 6-7-2.

As a result, three spans of prestressed concrete I-girder, which is the most economical, was applied to the superstructure for the BR 22-29 bridge.

Table 6-7-2 Comparison of Bridge Alternatives for BR 22-29

Alternative	Alternative 1	Alternative 2	Alternative 3																																																																
SIDE VIEW																																																																			
Bridge Length	120m	120m	120m																																																																
Superstructures	RC T-Girder L=20m	PC I-Girder L=40m	Steel Truss L=60m																																																																
Span Arrangement	6@20=120	3@40=120	2@60=120																																																																
Substructures	<table border="1"> <thead> <tr> <th>Bearing Condition</th> <th>H (m)</th> <th>Pile Length (m)</th> <th>n</th> </tr> </thead> <tbody> <tr><td>A1</td><td>M</td><td>10.0</td><td>23</td></tr> <tr><td>P1</td><td>F.F</td><td>12.0</td><td>23</td></tr> <tr><td>P2</td><td>M.F</td><td>12.0</td><td>23</td></tr> <tr><td>P3</td><td>M.F</td><td>12.0</td><td>23</td></tr> <tr><td>P4</td><td>M.F</td><td>12.0</td><td>23</td></tr> <tr><td>P5</td><td>M.F</td><td>12.0</td><td>23</td></tr> <tr><td>A2</td><td>M</td><td>10.0</td><td>23</td></tr> </tbody> </table>	Bearing Condition	H (m)	Pile Length (m)	n	A1	M	10.0	23	P1	F.F	12.0	23	P2	M.F	12.0	23	P3	M.F	12.0	23	P4	M.F	12.0	23	P5	M.F	12.0	23	A2	M	10.0	23	<table border="1"> <thead> <tr> <th>Bearing Condition</th> <th>H (m)</th> <th>Pile Length (m)</th> <th>n</th> </tr> </thead> <tbody> <tr><td>A1</td><td>M</td><td>10.0</td><td>23</td></tr> <tr><td>P1</td><td>F.F</td><td>12.0</td><td>23</td></tr> <tr><td>P2</td><td>M.F</td><td>12.0</td><td>23</td></tr> </tbody> </table>	Bearing Condition	H (m)	Pile Length (m)	n	A1	M	10.0	23	P1	F.F	12.0	23	P2	M.F	12.0	23	<table border="1"> <thead> <tr> <th>Bearing Condition</th> <th>H (m)</th> <th>Pile Length (m)</th> <th>n</th> </tr> </thead> <tbody> <tr><td>A1</td><td>M</td><td>10.0</td><td>23</td></tr> <tr><td>P1</td><td>F.F</td><td>12.0</td><td>23</td></tr> <tr><td>A2</td><td>M</td><td>10.0</td><td>23</td></tr> </tbody> </table>	Bearing Condition	H (m)	Pile Length (m)	n	A1	M	10.0	23	P1	F.F	12.0	23	A2	M	10.0	23
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Features	<ul style="list-style-type: none"> <li>- Degree of obstruction in the river is the highest.</li> <li>- Feeling of passenger is not comfortable due to many bridge expansion joints.</li> <li>- Maintenance cost for the bridge becomes higher due to many expansion joints.</li> </ul>	<ul style="list-style-type: none"> <li>- Degree of obstruction in the river is middle.</li> <li>- Feeling of passenger is relatively good due to less bridge expansion joints than Alternative 1.</li> <li>- Maintenance cost of this Alternative is the cheapest because of concrete structure and less expansion joints.</li> </ul>	<ul style="list-style-type: none"> <li>- Degree of obstruction in the river is the lowest.</li> <li>- Feeling of passenger is not so good due to large deflection of stiffness girder.</li> <li>- Maintenance cost for this type will become higher due to necessity of painting for prevention of rust and erosion.</li> </ul>																																																																
Construction Cost (Million Rp.)	<table border="1"> <tbody> <tr><td>Superstructures</td><td>2,634</td></tr> <tr><td>Substructures</td><td>8,470</td></tr> <tr><td><b>TOTAL</b></td><td><b>11,104</b></td></tr> </tbody> </table> <p>( 1.16 )</p>	Superstructures	2,634	Substructures	8,470	<b>TOTAL</b>	<b>11,104</b>	<table border="1"> <tbody> <tr><td>Superstructures</td><td>4,146</td></tr> <tr><td>Substructures</td><td>5,441</td></tr> <tr><td><b>TOTAL</b></td><td><b>9,587</b></td></tr> </tbody> </table> <p>( 1.00 )</p>	Superstructures	4,146	Substructures	5,441	<b>TOTAL</b>	<b>9,587</b>	<table border="1"> <tbody> <tr><td>Superstructures</td><td>7,560</td></tr> <tr><td>Substructures</td><td>4,005</td></tr> <tr><td><b>TOTAL</b></td><td><b>11,565</b></td></tr> </tbody> </table> <p>( 1.21 )</p>	Superstructures	7,560	Substructures	4,005	<b>TOTAL</b>	<b>11,565</b>																																														
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#### 6.7.4 Alternative Facilities for Application of Tunnel

Sta.62 km to near Sta.66 km of link No. 15 passes along the coastal line through steep cliffs and gorges. Considering the continuity of alignment for this route, it is advantageous to design along the coastal line, but there is the necessity for high embankments and high cut slope.

High embankments are not generally suitable for coastal areas in terms of maintenance. And also, high cut slopes in limestone is not recommended because of the stability and cost of the slope during and after construction

Therefore, tunnels were proposed to avoid these problems. However, long tunnels are not recommended in terms of user psychology, traffic safety, and the potential for secondary disasters following traffic accidents. Also, with short tunnels the need to provide maintenance systems such as ventilation, lighting and fire fighting facilities are minimized as long tunnels need such facilities. Consequently, short tunnels, which will be less than 500m and at most 1000m in length was proposed for this study. Considering to these conditions, four tunnels were required along the coastal line as given in Table 6-7-3.

**Table 6-7-3 List of Tunnel**

Tunnel No	Location of Tunnel (km from Uekuli)	Tunnel Length
No. 1 Tunnel	62k380~63k120	740m
No. 2 Tunnel	63k270~63k730	460m
No. 3 Tunnel	63k800~64k090	290m
No. 4 Tunnel	65k240~65k740	500m

*Source: Study Team*

Tunnel entrances are at an acute angle to the contour lines of the hillside. Therefore, slope stability and traffic safety should be taken into consideration for design and construction of the tunnel entrances.

## **Chapter 7**

### **Environmental Study**

## CHAPTER 7 ENVIRONMENTAL STUDY

### 7.1 Introduction

#### 7.1.1 Study Objectives

The objectives of the environmental impact assessment (EIA) study for Trans-Sulawesi East Road are:

- To understand the present condition of the environment in the project area
- To identify the particular activities of the project which may induce significant impact on the environment
- To predict the environmental impacts and evaluate their magnitudes
- To propose countermeasures to mitigate of the envisaged negative impacts
- To formulate plans for environmental management and monitoring

#### 7.1.2 Scope of Works

##### (1) Objected Road Links

The roads of the feasibility study (F/S), which are selected in the pre-feasibility study (Pre-F/S) stage of this study, comprise five (5) road links; three (3) links from Central Sulawesi and two (2) links from Southeast Sulawesi. Table 7-1-1 shows the road links for F/S study area.

**Table 7-1-1 Road Links for Feasibility Study Area**

Road Link No.	Location		Road Length (km)
	Road Section	Province	
16	Umpanga – Bungku	Central Sulawesi	35.8
22	Bungku – Provincial border	Central Sulawesi	110.7
33	Provincial border – Asera	Southeast Sulawesi	55.5
32	Asera -- Sandanpangan	Southeast Sulawesi	81.5
15	Uekuli – Tompira	Central Sulawesi	110.7
Total Road Length (km)			397.6

*Source: Study Team*

##### (2) Project Activities

The EIA study covers all the project activities involved in the implementation of the Trans-Sulawesi East Road in Central and Southeast Sulawesi. In general, the project consists of three stages, namely pre-construction, construction and post-construction. The project activities at each stage can be summarized:

1) Pre-construction stage:

- Sectional and longitudinal survey, terrestrial mapping
- Inventory of land, houses and other properties, traffic and public facilities in the project area
- Land acquisition and compensation
- Resettlement of inhabitants

2) Construction stage:

a) Preparation work

- Mobilization of labor
- Introduction of construction machinery and equipment
- Preparation of access road
- Construction of site office/base camp

b) Construction work

- Land clearing and stripping
- Transport of machinery and construction materials
- Earth works (excavation and filling)
- Road, bridge and tunnel construction
- Surplus soil disposal

3) Post-construction stage:

- Road operation
- Road maintenance

### (3) Environmental Elements

The environmental elements to be considered for the Environmental Impact Assessment (EIA) study are shown in Table 7-1-2, by using an environmental examination matrix. The vertical axis consists of rows of environmental elements grouped in three categories: i.e. social environment, natural environment and environment pollution, and the horizontal axis consisting of columns of project activities; i.e. pre-construction stage, construction stage and post-construction stage. As a result, a significant negative impact is identified on environmental element *Hazard (Risk)*, and possible negative impact is envisaged on eleven environmental elements, while, a possible positive impact is identified on environmental element *Economic Activities*, from some project activities.

Regarding to the environmental pollution elements, taking into consideration of the contents of the project and its scale; i.e., lower traffic volume in the study area, no toxic substances produced, no groundwater pumping, etc., no significant negative impacts are anticipated from any of the project activities, except noise and vibration. Noise and vibration arise especially during the construction stage by the use of construction devices and vehicles. Therefore, noise



and vibration as an environmental pollution were considered in the EIA to be conducted for the project.

Environmental elements were identified by the result of a scoping assessment conducted in the master plan and pre-feasibility study stage as items on which significant or possible negative/positive impacts are envisaged. The result of a scoping assessment on the F/S road links is summarized in Table 7-1-3, and detailed description of scoping results for each F/S road links are shown in Article 7.2.4 of this report.

**Table 7-1-2 Environmental Examination Matrix**

Major Facilities/Activities		Road / Roadside Facilities / Road Construction				
		Overall Evaluation	Pre-Construction Stage	Construction stage	Post-Construction stage	
Environmental Elements						
Social Environment	1	Resettlement	X	X		X
	2	Economic Activity	X(+)	X(+)		X(+)
	3	Traffic and Public Facility				
	4	Split of Communities				
	5	Cultural Property	X	X		
	6	Nature Reserves	X	X	X	X
	7	Public Health Condition				
	8	Waste	X		X	
	9	Hazards (Risk)	XX	XX	XX	
Natural Environment	10	Topography and Geology	X		X	
	11	Soil Erosion	X		X	X
	12	Groundwater	X		X	X
	13	Hydrological Situation	X		X	
	14	Coastal Zone	X		X	
	15	Fauna and Flora	X	X	X	X
	16	Meteorology				
Pollution	17	Landscape				
	18	Air Pollution				
	19	Water Pollution				
	20	Soil Contamination				
	21	Noise and Vibration	X		X	
	22	Land Subsidence				
	23	Offensive Odor				

Source: Study Team

- Note
- XX: The environmental elements to which special attention has to be paid. They might cause serious negative impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.
  - X: The environmental elements which may have a possible negative impact depending on the scale of the project and site conditions.
  - X(+): The environmental elements which may have a possible positive impact.
  - No mark: The environmental items requiring to impact assessment since the anticipated impacts are, in general, not significant.

**Table 7-1-3 Summary of Scoping Results for F/S Road Links**

No	Environmental Item/Factor	Link No.16	Link No.22	Link No.32	Link No.33	Link No.15	Overall Evaluation
<b>A. Social Environment</b>							
1.	Resettlement	B	B	B	B	B	B
2.	Economic Activities	B	B	B	B	B	B
3.	Traffic/Public Facilities	D	D	D	D	D	D
4.	Split of Communities	D	D	D	D	D	D
5.	Cultural Property	D	D	D	D	B	B
6.	Water Rights and Rights of Common	D	B	D	D	D	B
7.	Public Health Condition	D	D	D	D	D	D
8.	Waste	D	B	D	B	B	B
9.	Hazards (Risk)	D	B	D	B	A	A
<b>B. Natural Environment</b>							
1.	Topography and Geology	D	D	D	D	B	B
2.	Soil Erosion	D	B	D	B	B	B
3.	Groundwater	D	D	D	D	B	B
4.	Hydrological Situation	B	B	B	B	B	B
5.	Coastal Zone	B	B	B	B	B	B
6.	Fauna and Flora	B	B	B	B	B	B
7.	Meteorology	D	D	D	D	D	D
8.	Landscape	D	D	D	D	D	D
<b>C. Pollution</b>							
1.	Air Pollution	D	D	D	D	D	D
2.	Water Pollution	D	D	D	D	D	D
3.	Soil Contamination	D	D	D	D	D	D
4.	Noise and Vibration	B	B	B	B	B	B
5.	Land Subsidence	D	D	D	D	D	D
6.	Offensive Odor	D	D	D	D	D	D

Source: "JICA Environmental Guidelines"

Note : Evaluation categories:

A: Serious impact is expected.

B: Some impact is expected.

C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses).

D: No impact is expected.

## 7.2 Present Environmental Conditions

### 7.2.1 General Description

#### (1) Central Sulawesi

Central Sulawesi is the most forested and least populated province in Sulawesi, with a land area of nearly 6.4 million hectares. Even with a population of approximately 1.3 million and a growth rate of 3.5 % (including transmigrates), population density of the province is only 22 persons per km<sup>2</sup>. Forests cover 64 % of the land and over 95 % of the province's income are derived from timber exports, mainly ebony. The human population is concentrated around the coast and/or large lakes and few people inhabit the mountainous areas.

Central Sulawesi remains one of most culturally diverse provinces in Indonesia. Government publications list 12 different ethnic groups and 24 distinct languages for the province, while, the biodiversity can be observed in the forest and coastal areas of the province.

The provincial capital, the coastal town of Palu, lies in the driest place in Indonesia with only 300mm up to 800 mm rain per year. The province is divided into four kabupatens - Banggai, Buaol, Tolitoli, Donggala and Poso.

Project roads of this feasibility study (F/S) in Central Sulawesi, link Nos.15, 16 and 22, are located in kabupaten Poso. Northern part of link No.15, i.e. road section Uekuli-Tondoyondo, and southern part of link No.22, i.e. road section Betebete-Provincial Border, are located in the mountainous area, while the remainder are mainly situated along the sea-shore line. The project sites are shown in the environmental map of Figures 7-2-1 to 7-2-3.

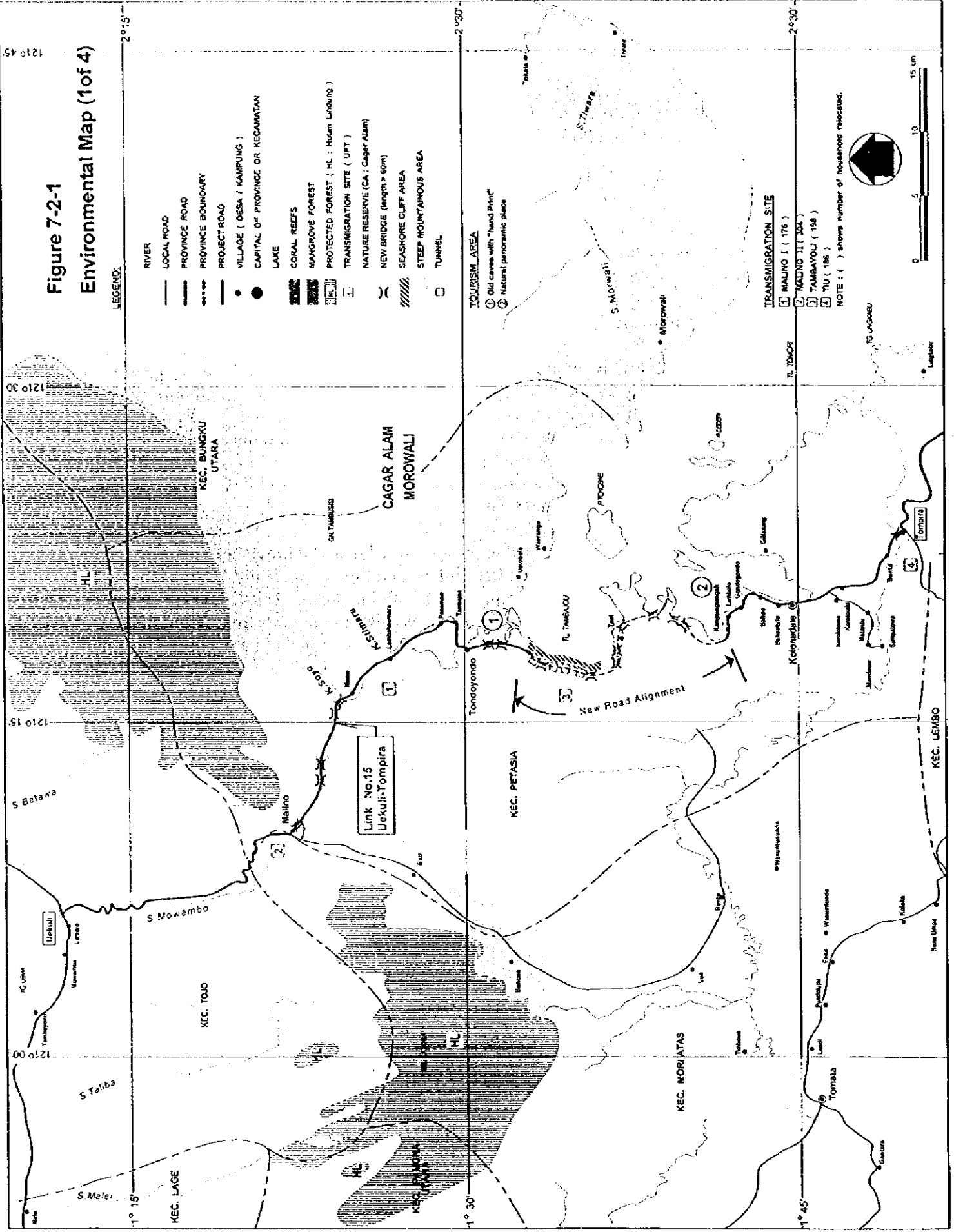
## **(2) Southeast Sulawesi**

Southeast Sulawesi is a low-lying province including wetlands, with a land area of nearly 3.8 million hectares including the offshore islands of Buton, Muna, etc. Its population is 1.22 million. The province is still the remotest and least developed area among the four provinces in Sulawesi. The northern part of the peninsula of Southeast Sulawesi province is mountainous. Mt. Mekongga, the highest place, is 2,790 m above sea-level. The southern plains are covered in the west with forest, and in the east with grass fields, including *Savannah*, while low lying area around Aopa is mostly wet/swamp-land.

The provincial capital, Kendari, is located at the eastern edge of the province. The province is divided into four kabupatens - Buton, Kendari, Kolaka and Muna. Ethnically, the inhabitants of the province can be divided into two main groups - the mainland Tokali and the offshore islanders of Muna and Buton islands. Bugis and Makassarese immigrants from South Sulawesi province have settled along the coasts, and more recent arrivals include transmigration from Java, Bali and Lombok.

Project roads in Southeast Sulawesi, link Nos.32 and 33, are located in kabupaten Kendari. Southern part of the project road is located along the sea-shore line which faced to the Bone Sea and Banda Sea, while northern part is situated in inland areas including hills and/or mountain. The project sites are shown in the environmental map of Figures 7-2-3 and 7-2-4.

**Figure 7-2-1  
Environmental Map (1 of 4)**



**LEGEND:**

- RIVER
- LOCAL ROAD
- PROVINCE ROAD
- PROVINCE BOUNDARY
- PROJECT ROAD
- VILLAGE ( DESA / KAMPUNG )
- CAPITAL OF PROVINCE OR KECAMATAN
- LAKE
- CORAL REEFS
- MANGROVE FOREST
- PROTECTED FOREST ( HL : Hutan Lindung )
- TRANSMIGRATION SITE ( IPT )
- NATURE RESERVE ( CA : Cagar Alam )
- NEW BRIDGE ( length > 50m )
- SEASHORE CLIFF AREA
- STEEP MOUNTAINOUS AREA
- TUNNEL

**TOURISM AREA**

- ① Old caves with "hand Print"
- ② Natural panoramic place

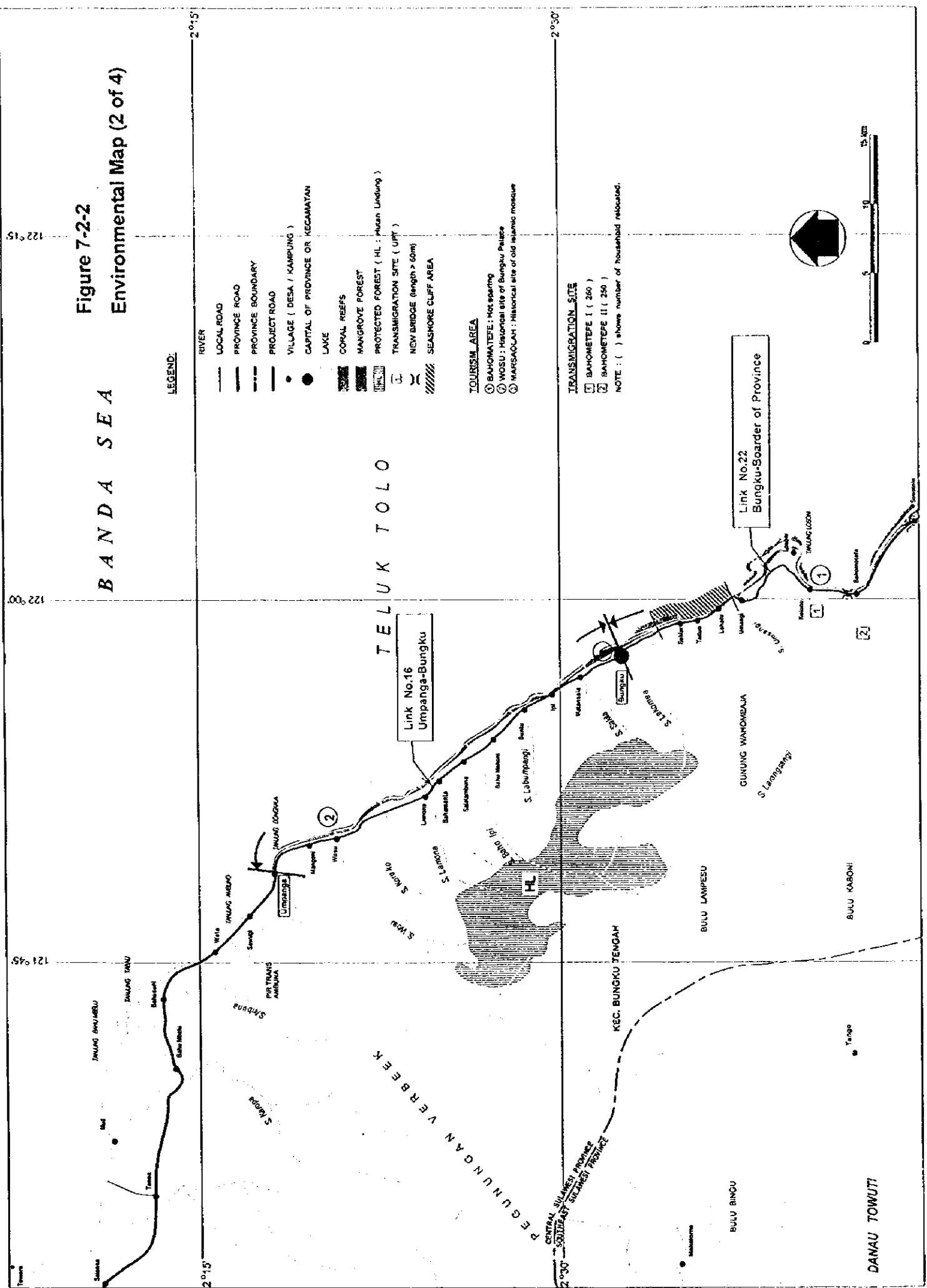
**TRANSMIGRATION SITE**

- ① MALINO I ( 176 )
- ② MALINO II ( 203 )
- ③ TAMBAJOU I ( 158 )
- ④ TU ( 186 )

NOTE : ( ) shows number of households relocated.



**Figure 7-2-2  
Environmental Map (2 of 4)**



BANDA SEA

TELUK TOLO

Link No.16  
Umpanga-Bungku

Link No.22  
Bungku-Boarder of Province

**LEGEND:**

- RIVER
- LOCAL ROAD
- PROVINCE ROAD
- PROVINCE BOUNDARY
- PROJECT ROAD
- VILLAGE ( DESA / KAMPUNG )
- CAPITAL OF PROVINCE OR KECAMATAN
- LAKE
- CORAL REEFS
- MANGROVE FOREST
- PROTECTED FOREST ( HL : Hutan Lindung )
- TRANSMIGRATION SITE ( UPT )
- NEW BRIDGE (length > 50m)
- SEASHORE CLIFF AREA
- TOURISM AREA
- BAHOMATEFE : Hot spring
- WOSU : Historical site of Bungku Palace
- MARSAOLAH : Historical site of old Islamic mosque

**TRANSMIGRATION SITE**

- 1 BAHOMETEFE I ( 260 )
- 2 BAHOMETEFE II ( 250 )

NOTE : ( ) shows number of household relocated.



EGUNGAN VERBEK

KEC. BUNGU TENGAH

BULU LAMPESU

GUNUNG WAKONAJA

BULU KABONI

DANAU TOWUTI

121°45'

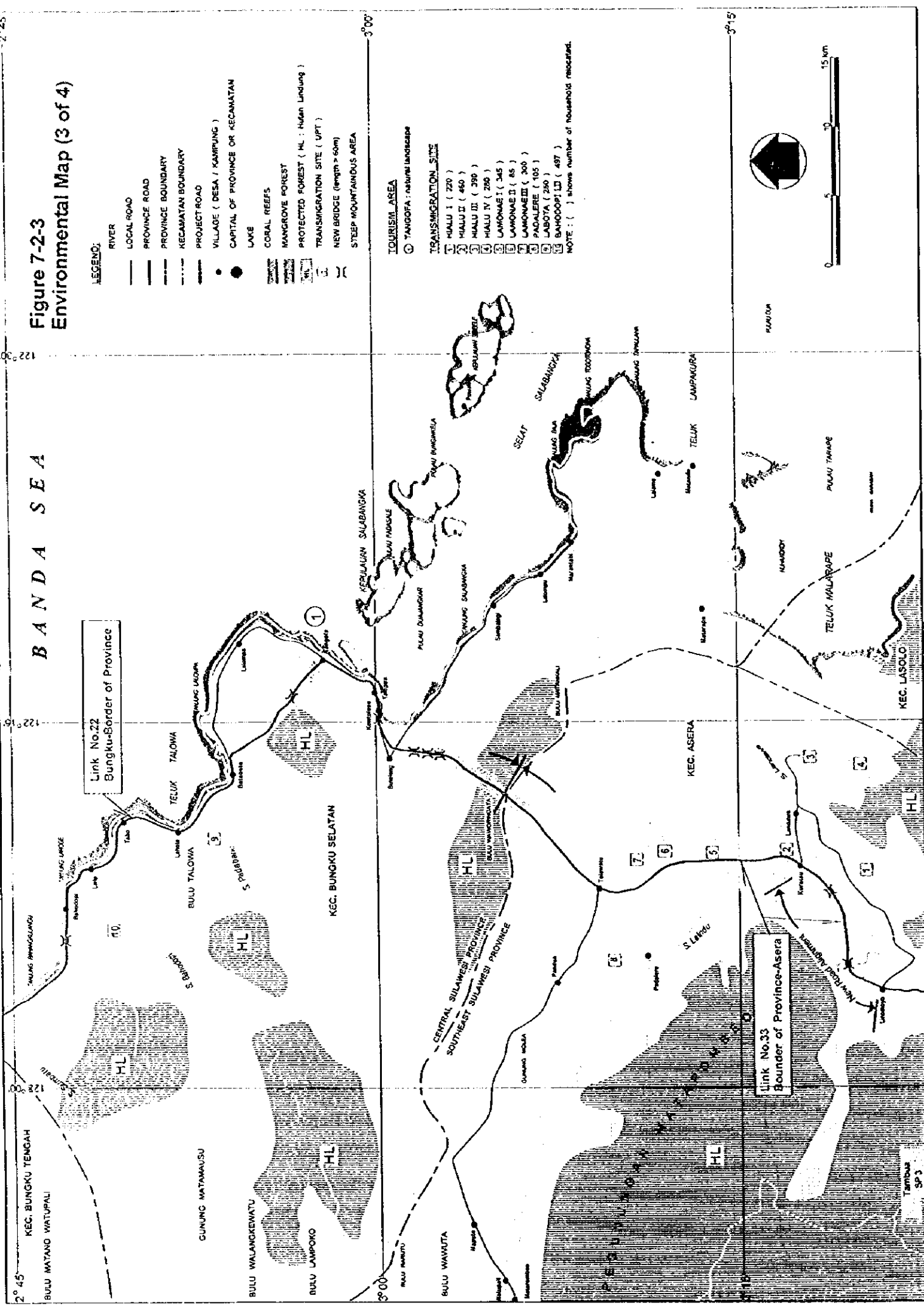
122°00'

122°15'

2°15'

2°30'

Figure 7-2-3  
Environmental Map (3 of 4)



LEGEND:

- RIVER
- LOCAL ROAD
- PROVINCE ROAD
- PROVINCE BOUNDARY
- KECAMATAN BOUNDARY
- PROJECT ROAD
- VILLAGE ( DESA / KAMPUNG )
- CAPITAL OF PROVINCE OR KECAMATAN
- LAKE
- CORAL REEFS
- MANGROVE FOREST
- PROTECTED FOREST ( HL : Hutan Lindung )
- TRANSMIGRATION SITE ( UPT )
- NEW BRIDGE (length > 60m)
- STEEP MOUNTAINOUS AREA

TOURISM AREA

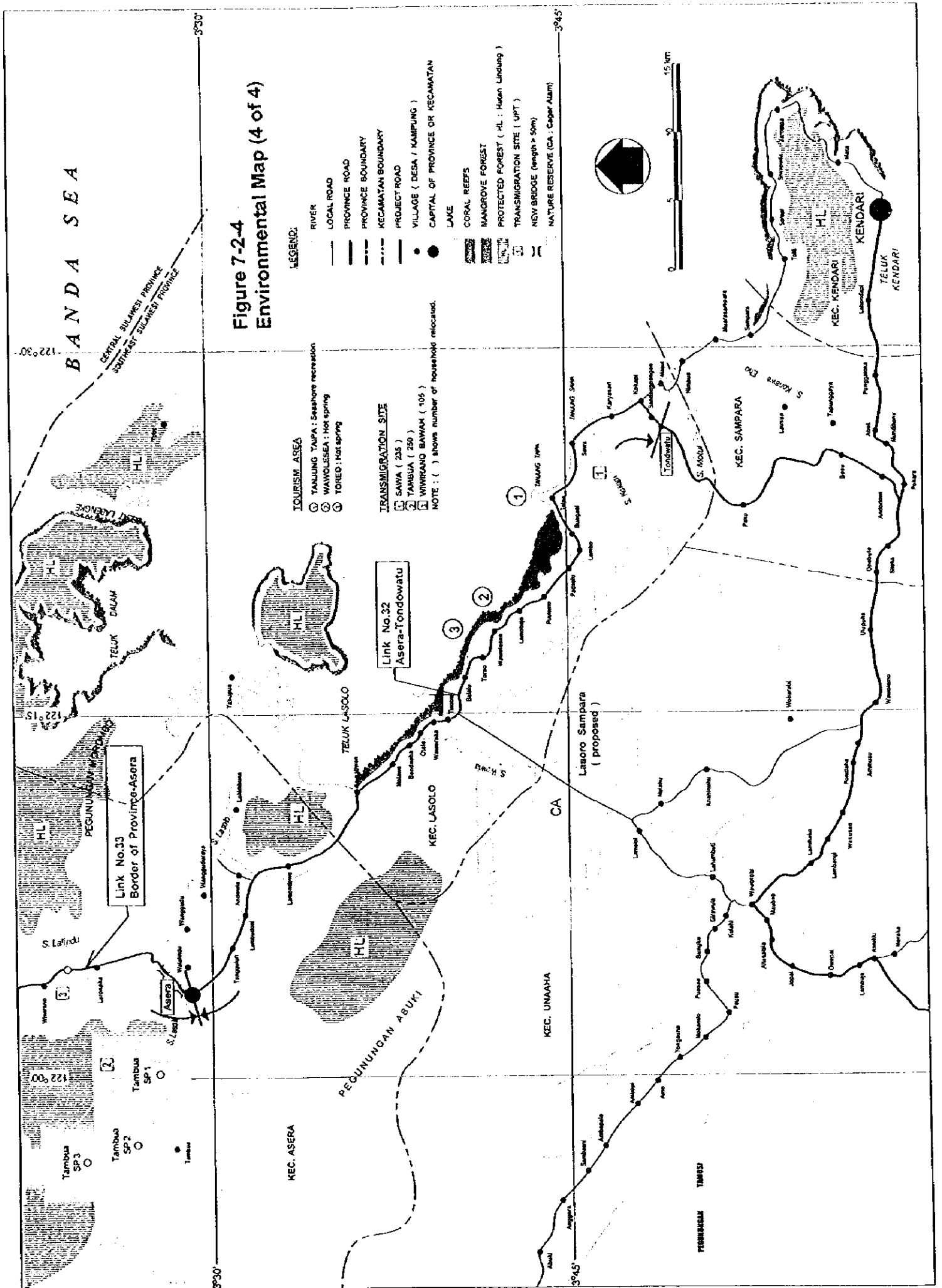
① TANGOPA : natural landscape

TRANSMIGRATION SITE

- 1 HIALU I ( 220 )
- 2 HIALU II ( 450 )
- 3 HIALU III ( 390 )
- 4 HIALU IV ( 285 )
- 5 LAMONAE I ( 345 )
- 6 LAMONAE II ( 85 )
- 7 LAMONAE III ( 300 )
- 8 PADALERE ( 105 )
- 9 LABOTA ( 290 )
- 10 BAHODOP III ( 487 )

NOTE : { } shows number of household relocated.





**Figure 7-2-4  
Environmental Map (4 of 4)**

**LEGEND:**

- RIVER
- LOCAL ROAD
- PROVINCE BOUNDARY
- PROVINCE BOUNDARY
- KECAMATAN BOUNDARY
- PROJECT ROAD
- VILLAGE (DESA / KAMPUNG)
- CAPITAL OF PROVINCE OR KECAMATAN
- LAKE
- CORAL REEFS
- MANGROVE FOREST
- PROTECTED FOREST (HL : Hutan Lindung)
- TRANSMIGRATION SITE (UPT)
- NEW BRIDGE (panjang > 50m)
- NATURE RESERVE (CA : Cagar Alam)

**TOURISM AREA**

- ⊙ TAMUNG TAIPA : Seashore recreation
- ⊙ WAWOLESEA : Hot spring
- ⊙ TORED : Hot spring

**TRANSMIGRATION SITE**

- 1 SAWA ( 235 )
- 2 TAMBUA ( 250 )
- 3 WIMIRANO BAWAH ( 105 )

NOTE : ( ) shows number of household relocated.



## 7.2.2 Umpanga – Bungku (Link No. 16)

### (1) Natural Environment

#### 1) Meteorology

As is typical in Indonesia, Central Sulawesi is located in the tropical zone. Therefore, rainfall intensity of this region is rather high. There are two seasons in Indonesia; that is, the wet season between December to May and the dry season between June to November.

The monthly rainfall data, between year 1990 to 1996, and the monthly temperature data, between 1992 to 1996, taken from Meteorological Station in Kasiguncu, kabupaten Poso, is shown in Table 7-2-1 and Table 7-2-2, respectively.

**Table 7-2-1 Monthly Rainfall**

Month/ Year	1	2	3	4	5	6	7	8	9	10	11	12	Total (mm)
1990	387	81	183	276	293	280	188	76	170	214	144	348	2,640
1991	298	75	236	252	233	124	109	131	90	55	105	381	2,089
1992	150	171	257	322	158	309	59	216	70	157	265	170	2,304
1993	168	115	165	223	232	268	117	41	111	56	160	145	1,801
1994	273	65	11	211	274	212	107	47	50	83	135	239	1,707
1995	366	231	342	575	473	229	135	115	325	463	140	127	3,521
1996	181	488	131	242	128	339	222	197	52	219	107	111	2,417
Average	260	175	189	300	256	252	134	118	124	178	151	217	2,354

Source : Meteorological Station in Kasiguncu, Kabupaten Poso, 1997

**Table 7-2-2 Monthly Temperature**

Month/ Year	1	2	3	4	5	6	7	8	9	10	11	12	(Unit : °C)
1992	26.0	25.6	25.6	26.2	26.7	26.0	25.8	26.2	26.4	26.4	26.4	26.7	26.7
1993	26.4	26.2	26.2	26.2	26.6	26.2	26.2	25.7	25.4	26.4	26.5	26.3	26.3
1994	25.9	26.3	26.3	26.8	27.0	26.7	26.0	26.3	26.5	26.4	25.8	26.3	26.3
1995	26.2	25.9	24.4	25.5	26.7	26.0	25.8	25.8	26.3	26.2	26.4	25.6	25.6
1996	25.7	26.6	27.0	27.0	27.0	26.6	26.2	23.3	26.4	25.6	26.6	26.0	26.0
Average	26.0	26.1	25.9	26.3	26.8	26.3	25.8	25.9	26.2	26.2	26.3	26.2	26.2

Source : Meteorological Station in Kasiguncu, Kabupaten Poso, 1997

#### 2) Topography

The topographic feature of the road section Umpanga - Bungku is flat, in general. The topographic feature of the project road link No.16 is summarised as shown in Table 7-2-3.



**Table 7-2-3 Topography Feature of Link No.16**

No.	Road Section	Road (Km)	0 - 8% (flat)		9 - 25% (irregular)		> 25 % (hilly)	
			Km	%	Km	%	Km	%
1.	Umpanga – Wosu	8.5	8.5	100	-	-	-	-
2.	Wosu – Bungku	27.3	26.4	97	0.9	3	-	-

Source: Study Team

**3) Geology**

The details of the geological features of the study area have already been described in Chapter 4 of this report.

**4) Hydrological Situation**

In the rainy season, some rivers occasionally flood and affect the smooth traffic of the existing road sections, while, the high tides also cause of the rivers to overflow and affect. Characteristics of rivers and streams flowing through the study area of link No.16 are given in Table 7-2-4.

**Table 7-2-4 River Characteristics**

No	River Name	Catchment Area (Km <sup>2</sup> )	Length (Km)	Width (m)	Average Flow (m <sup>3</sup> /sec)	Flowing Pattern of River	River Water Usage
<b>Umpanga – Wosu</b>							
1	S. Wosu	88.3	26	10	3.7	Perennial *	Domestic
<b>Wosu – Bungku</b>							
1	S. Bahoearekoreko	48.9	12.1	7	1.9	Perennial	Domestic
2	S. Lanona	57.4	13.6	7	2.3	Perennial *	Domestic
3	S. Bahomolea/Kontro B.	51.3	13.0	7	2.2	Perennial	Domestic
4	S. Pamonaan	63.2	12.1	3	2.7	Perennial	Domestic
5	S. Ipi	144.0	26.9	12	6.1	Perennial *	Domestic

Source: Study Team

Note, \* : flood in rainy season

**5) Natural Hazard (Earthquake)**

Earthquakes have been observed frequently in Sulawesi. Table 7-2-5 shows the number of earthquakes occurring in Central Sulawesi between the years 1993 and 1995. Earthquakes with the magnitude of more than four are less than 20% in number, and more than 80% are small ones of which are not able to be felt by the human body.

**Table 7-2-5 Earthquakes in Central Sulawesi**

Year/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993	359	158	170	150	180	204	147	116	155	80	610	397
1994	370	218	283	254	297	314	359	320	344	539	348	470
1995	322	574	403	633	1184	788	365	505	340	358	442	353
Average	350	317	285	346	554	435	290	314	280	326	467	407

Source: Mining Office in Palu

## 6) Coastal Area

The study area of link No.16 is mainly located along the coastal region, and typical biodiversity of the coastal area can be observed in this region. The identified species inhabiting the coastal area are shown in Table 7-2-6. The habitat of mangrove and coral reefs in the study area is given in Figure 7-2-2.

**Table 7-2-6 Species Inhabiting in Coastal Area**

Mangrove Species	Coral Reef Species	Fish Species in Coral Reefs
<i>Avicenia alba</i> , <i>Avicenia marina</i> , <i>Avicenia officinalis</i> , <i>Campostenion philippinense</i> , <i>Rhizophora apiculata</i> , <i>Rhizophora mucronata</i> , <i>Sonneratia</i> , <i>Nipah (Nipa fruticans)</i> , <i>Waru laut (Hibiscus tiliaceus)</i>	<i>Favia spp</i> , <i>Labophyllia spp</i> , <i>Porites spp</i> , <i>Plastygira spp</i> , <i>Azphthera spp</i> , <i>Astreopora</i> , Karang batu ( <i>Scleractina</i> ), Lolak ( <i>Trochus niloticus</i> ), Karang mutiara ( <i>Pinctada spp</i> ), Kimah ( <i>Tridacna</i> ). Rumput laut <i>Euchema spinosa</i> dan <i>Gracilari</i> .	Kuda laut belang ( <i>Hippocampus kuda</i> ), Paling berbintang ( <i>Echidna nebulosa</i> ), Tambra laut garisbiru ( <i>Symphoricichthys spilurus</i> ), Ikan belang putih ( <i>Dascyllus trimaculatus</i> ), Ikan karang bendera ( <i>Heniochus acuminatus</i> ), Ikan badut jingga ( <i>Amphiprion ocellaris</i> ), Ikan karang bermata dua ( <i>Coradion melanopus</i> ), Ikan katak ( <i>Arotron areostaticus</i> ), paling berekor hitam ( <i>Moringua bicolor</i> ), Ikan todak lorek hitam ( <i>Hemirhamphus far</i> ), Ikan pipih bentuk lidah ( <i>Tetrasomus gibbosus</i> ), Ikan kakatua merah-lembanyung ( <i>Scarops rubroviolaceus</i> ).

Source: Study Team

## 7) Flora and Fauna

### a. Flora

Based on the Decree of Minister of Agriculture No. 54/Kpts/Um/2/1972, the Decree of Minister of Forestry No. 261/Kpts.IV/1990 and the Government Act No. 5 of 1990, the species as the members of the lowland and highland forest ecosystem which belong to the endemic and protected species are as follows;

- Lowland species: *Cratoxylon celebicus*, *Ficus varegata pterospermum celebicus*, *Vitex quinata*, Palm kipas (*Livistoma rotunatifolia*), Palm raksasa (*Pigafettafilaris*), etc.
- Highland species: *Agathis damara*, *Phyllacladus hypophyllus*, *Dracrycarpus spp*, *Vaccinium*, *Salmanila malabrica*, Pohon kuku alam (*Pericopsis mooniana*), *Garuga Floribunda*, Kedondong (*Spondias pinnata*), Benuang (*Octomeles sumatrana*), Rambutan Hutan (*Nephelium mutabile*), Durian (*Durio spp*), Manggis (*Garcinia hombroniana*), Keruing (*Dipterocarpus merginata*), etc.

The forest observed in kabupaten Poso, including the study area of link No.16, is classified in Table 7-2-7.

**Table 7-2-7 Forest Classification in Kabupaten Poso**

No	Classification	Area (ha)	Ratio (%)
1	Limited production forest (IPT)	755,776	35.0
2	Convertible production forest (HPK)	55,066	2.6
3	Ordinary production forest (TGHK or RTRW)	178,505	8.3
4	Nature sanctuary and recreation forest	373,320	17.3
5	Protected forest (HL)	795,980	36.9
Total		2,158,647	100.0

Source: Study Team

Plantations of crops are common in this region, that is; coconut (*Cocos nucifera*), cocoa (*Cacao sp.*), coffee (*Coffea spp.*), jambu mede (cashew: *Anacardium occidentale*), Jati (*Tectona grandis*) and mango (*mangifera spp.*), while, the palm-oil plantations also exist.

**b. Fauna**

The endemic and protected fauna observed in the study area are as follows;

- Birds: Burung Maleo (*Macrocephalon maleo*), Gagang bayem (*Himantopus himantopus*), Burung Elang (*Spizaetus lanceolatus*), Burung Raja udang paruh hitam (*Pelagopsis melanorphyscha*).
- Insects: Belalang pemakan paku (*Karyndia gracilipes*).
- Mamalias: Musang raksasa (*Macrogalidia musschenbroekii*), Kelelawar pemakan serangga (*Minipteris schreibersii*), Hipposideros diadema, Rhinolopus arcvatus, Megalerma spasma, Babyrousa (*Babyrousa*), Kucing bakau (*Felis spp.*)

**8) Conservation Area**

Forest reserve (HL: Hutan Lindung) is located in the western side of the study area, however, the project road of link No.16 does not cross the reserve area. Location of the forest reserve is shown in Figure 7-2-2.

**(2) Social Environment**

**1) Demography**

The study area is located at Kecamatan Bungku Tenga, kabupaten Poso. The demographic data of villages (Desa) located at the study area is shown in Table 7-2-8.

**Table 7-2-8 Demographic Data of the Study Area (Link No.16)**

No.	Name of Kecamatan / Desa (village)	Area (km <sup>2</sup> )	Population	Number of House-hold (HH)	Population Density (person/Km <sup>2</sup> )
Kecamatan Bungku Tengah		--	38,835	8,109	--
1	Umpanga	80.0	282	57	3
2	Loro Benu	34.0	619	105	18
3	Wosu	175.0	1,190	240	7
4	Hahoearekoreko	3.2	304	58	9
5	Lanona	4.1	454	77	11
6	Bahomante	4.1	623	104	16
7	Bahomoleo	4.7	473	79	10
8	Bahomohoni	11.0	163	39	1
9	Bente	11.0	719	141	6
10	Ipi	1.0	294	55	27
11	Bahoruru	6.0	767	138	12
12	Matonsala	4.0	321	67	7
13	Bungi	2.0	224	51	9
14	Matano	0.8	499	108	616
15	Lamberea	4.0	485	114	11

*Source : Kecamatan Bungku Tengah Dalam Angka 1995*

In accordance with the improvement of the project road alignment, some houses are relocated because of the project implementation. Detailed road alignment of link No.16 is shown in Volume VI of this report.

## 2) Economic Activities

Working population classified by the economic activities in the region of kabupaten Poso is shown in Table 7-2-9. Major economic activity in this region is the agriculture sector. While, agriculture sector can be classified in five activities, that is; food crops, plantation, forestry, cattle breeding and fishery.

**Table 7-2-9 Classification of Economic Activities in Kabupaten Poso**

No	Type of Job	Kabupaten Poso	
		Person	%
1	Agriculture	125,418	69.9
2	Industry	5,653	3.2
3	Mining and quarry	1,058	0.6
4	Construction	3,410	1.9
5	Trade	15,345	8.6
6	Communication	2,063	1.2
7	Finance	--	--
8	Service	23,708	13.2
9	Others	1,776	1.8
Total		179,477	100.0

Source: Kabupaten Poso dalam angka 1995

Agricultural activities in Kecamatan Bungku Tengah, kabupaten Poso, comprises of paddy, corn, cassava, peanuts, soybeans and mung beans. Table 7-2-10 shows the production of each crop. While, Table 7-2-11 shows the kinds and area of plantations in Kecamatan Bungku Tengah.

**Table 7-2-10 Agricultural Products in Kecamatan Bungku Tengah**

No	Food Crops	Production amount (ton/year)
1	Paddy	6,329
2	Corn	359
3	Cassava	21
4	Peanuts	40
5	Soy-beans	1,114
6	Mung-beans	46

Source : Kecamatan Bungku Tengah Dalam Angka tahun 1995

**Table 7-2-11 Area of Plantations in Kecamatan Bungku Tengah**

No.	Kinds of Plantation	Plantation Area ( ha )
1	Coconut	2,037
2	Coffee	87
3	Clove	255
4	Cocoa	956
5	Palm-oil	4,500

Source : Kecamatan Bungku Tengah Dalam Angka tahun 1995

The fishery activity is common in Kecamatan Bungku Tengah. Table 7-2-12 shows the detail of fishery activity in this region.

**Table 7-2-12 Fishery Activity In Kecamatan Bungku Tengah**

Year	Number of Fishermen	Fishery Production (ton)	Value (x10 <sup>3</sup> Rp.)
1992	334	763.3	457,980
1993	421	995.5	597,300
1994	360	998.7	599,220
1995	365	999.6	799,680

*Source: Study Team*

### **3) Transmigration**

Number of transmigrants relocated in kabupaten Poso during 1990/1991 - 1994/1995 are 6,091 households (equivalent to 22,968 people). Transmigration have come derived from various provinces of Sulawesi, West Java, Central Java, East Java and Bali. In the fiscal year of 1994/1995, 981 households (3,663 people) relocated to this region.

However, no transmigration sites exists along the project road link No.16.

### **4) Tourism**

The tourism spots located along Umpanga -- Bungku road section are "Wosu", as the historical site of Bungku Palace, and "Marsaolah", as the historical site of old Islamic mosque. The location of each tourism spot are shown in Figure 7-2-2.

The development of tourism in the study area is rather weak compared with other areas such as Bunaken, Toraja, Bali, etc., due to lack of transportation facilities (accessibility), accommodation facilities and professionals and investors in its management.

### **(3) Environmental Pollution**

There is almost no data available regarding to the environmental pollution; such as air pollution, water pollution, soil contamination, noise and vibration, land subsidence and offensive odor. However, taking into consideration the contents of the project and its scale; i.e., low traffic volume in the study area, no toxic substances produced, no groundwater pumping, etc., significant environmental pollution may not occur by any of the project activities, except noise and vibration during construction stage of the project.

### **(4) Scoping Assessment**

The result of scoping assessment of the road link No.16 is given in Table 7-2-13.

**Table 7-2-13 Scoping Result for Umpanga – Bungku (Link No. 16)**

No	Environmental Item/Factor	Evaluation	Reasons
<b>A. Social Environment</b>			
1.	Resettlement	B	Resettlement shall be taken into consideration due to improvement of the project road alignment
2.	Economic Activities	B(+)	Project scope is improvement of existing roads, therefore impacts on economic activities are small. Plus impacts on transmigrants are anticipated
3.	Traffic/Public Facilities	D	Project site is located at rural region
4.	Split of Communities	D	Notable impact regarding split communities not predicted
5.	Cultural Property	D	Cultural properties are few in the study area
6.	Water Rights and Rights of Common	D	Project road does not cross the nature and/or forest reserves
7.	Public Health Condition	D	No impact on public health conditions
8.	Waste	D	Large amount of surplus soil by cutting work are produced in the project
9.	Hazards (Risk)	D	No large scale hazards are predicted
<b>B. Natural Environment</b>			
1.	Topography and Geology	D	No large scale topographic change is carried out in the project
2.	Soil Erosion	D	Soil erosion may not occur by the project
3.	Groundwater	D	Large scale excavation is carried out in the project
4.	Hydrological Situation	B	Some impacts on river flow are anticipated by bridge construction
5.	Coastal Zone	B	Some project roads in the study area pass through the coastal zone
6.	Fauna and Flora	B	Protected/Endemic fauna and flora exist in the study area
7.	Meteorology	D	No meteorological impacts are predicted
8.	Landscape	D	Notable impact regarding landscape not predicted
<b>C. Pollution</b>			
1.	Air Pollution	D	Predicted traffic volume in the study area is small
2.	Water Pollution	D	Impacts on water bodies by construction works etc. is negligible
3.	Soil Contamination	D	Toxic substances are not handled by the project
4.	Noise and Vibration	B	Noise and vibration may occur by construction equipment during construction stage
5.	Land Subsidence	D	No ground water pumping is carried out in the project
6.	Offensive Odor	D	There is no factor of offensive odor in the project

Source: "JICA Environmental Guidelines"

Note : Evaluation categories:

- A: Serious negative impact is expected.
- B: Some negative impact is expected.
- B(+): Some positive impact is expected.
- C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses).
- D: No impact is expected.

### 7.2.3 Bungku – Border of province (Link No. 22)

#### (I) Natural Environment

##### 1) Meteorology

The monthly rainfall data, between year 1990 to 1996, and the monthly temperature data, between 1992 to 1996, taken from Meteorological Station in Kasiguncu, kabupaten Poso, is given in Table 7-2-14 and Table 7-2-15, respectively.

**Table 7-12-14 Monthly Rainfall**

Month/ Year	1	2	3	4	5	6	7	8	9	10	11	12	Total (mm)
1990	387	81	183	276	293	280	188	76	170	214	144	348	2,640
1991	298	75	236	252	233	124	109	131	90	55	105	381	2,089
1992	150	171	257	322	158	309	59	216	70	157	265	170	2,304
1993	168	115	165	223	232	268	117	41	111	56	160	145	1,801
1994	273	65	11	211	274	212	107	47	50	83	135	239	1,707
1995	366	231	342	575	473	229	135	115	325	463	140	127	3,521
1996	181	488	131	242	128	339	222	197	52	219	107	111	2,417
Average	260	175	189	300	256	252	134	118	124	178	151	217	2,354

Source : Meteorological Station in Kasiguncu, Kabupaten Poso, 1997

**Table 7-2-15 Monthly Temperature**

Month/ Year	1	2	3	4	5	6	7	8	9	10	11	12	(Unit : °C)
1992	26.0	25.6	25.6	26.2	26.7	26.0	25.8	26.2	26.4	26.4	26.4	26.7	26.7
1993	26.4	26.2	26.2	26.2	26.6	26.2	26.2	25.7	25.4	26.4	26.5	26.3	26.3
1994	25.9	26.3	26.3	26.8	27.0	26.7	26.0	26.3	26.5	26.4	25.8	26.3	26.3
1995	26.2	25.9	24.4	25.5	26.7	26.0	25.8	25.8	26.3	26.2	26.4	25.6	25.6
1996	25.7	26.6	27.0	27.0	27.0	26.6	26.2	23.3	26.4	25.6	26.6	26.0	26.0
Average	26.0	26.1	25.9	26.3	26.8	26.3	25.8	25.9	26.2	26.2	26.3	26.2	26.2

Source : Meteorological Station in Kasiguncu, Kabupaten Poso, 1997

##### 2) Topography

The topographic feature of the road section Bungku – Provincial border is variety. Steep slopes exist on the road section between Betebete and Tangofa, and near the Province border. The topographic feature of the project road link No.22 is summarised as shown in Table 7-2-16.



**Table 7-2-16 Topography Feature of Link No.22**

No.	Road Section	Road (Km)	0 - 8% (flat)		9 - 25% (undulating)		> 25 % (hilly)	
			Km	%	Km	%	Km	%
1	Bungku - Bahodopi	41.9	29.7	70.9	9.8	23.4	2.4	5.7
2	Bahodopi – Betebete	21.8	20.1	92.2	1.7	7.8	--	--
3	Betebete – Tangofa	16.3	1.4	9.6	11.3	69.3	3.5	21.5
4	Tangofa – Province Border	30.7	8.9	29.0	16.8	54.7	5.0	16.3

Source: Study Team

Note: Road section Betebete-Tangofa(I) is the coastal road, and Betebete-Tangofa(II) is the short cut road.

### 3) Geology

The details of geological features of the study area have already been described in Chapter 4 of this report.

### 4) Hydrological Situation

In the rainy season, some rivers flood and affect the traffic on the existing road section, while, the high tide also cause the rivers to overflow. Characteristics of rivers and streams flowing through the study area of link No.22 are given in Table 7-2-17.

**Table 7-2-17 River Characteristics**

No	River Name	Catchment Area (Km <sup>2</sup> )	Length (Km)	Width (m)	Average Flow (m <sup>3</sup> /sec)	Flowing Pattern of River	River Water Usage
1	S. Sakita	64.7	13.7	4	2.7	Perennial	Domestic
2	S. Lakome	28.6	4.4	4	1.2	Intermittent	Domestic
3	S. Kololama	17.1	4.1	3	0.7	Intermittent	Domestic
4	S. Unsongi	30.8	10.7	5	1.3	Perennial	Domestic
5	S. Larangsangi	283.0	31.4	13	12.0	Perennial *	Domestic, Irrigation
6	S. Petula	10.0	4.9	4	0.4	Intermittent	Domestic
7	S. Siumbatu	242.0	17.1	8	10.2	Perennial *	Domestic, Irrigation
8	S. Nula	15.6	4.1	5	0.7	Perennial	Domestic
9	S. Ngolango	23.9	5.6	5	1.0	Perennial	Domestic
10	S. Bahodopi	241.0	25.8	12	10.2	Perennial *	Domestic, Irrigation
11	S. Kampi	18.5	4.7	4	--	Perennial	Domestic
12	S. Watubobotol	21.4	6.3	4	--	Perennial	Domestic
13	S. Tinala	67.2	14.1	6	2.6	Perennial	Domestic, Irrigation

Source: Study Team

Notes, \* : flood in rainy season

### 5) Natural Hazard (Earthquake)

Earthquakes are observed frequently in Sulawesi as described in Table 7-2-5.

## 6) Coastal Area

The study area of link No.22 is mainly located along the coastal region, and typical biodiversity of the coastal area can be observed in this region. The identified species inhabiting the coastal area are shown in Table 7-2-18. The habitat of mangrove and coral reefs in the study area is shown in Figures 7-2-2 and 7-2-3.

**Table 7-2-18 Species Inhabiting in Coastal Area**

Mangrove Species	Coral Reef Species	Fish Species in Coral Reefs
<i>Avicenia alba</i> , <i>Avicenia marina</i> , <i>Avicenia officinalis</i> , <i>Campostenion philippinense</i> , <i>Rhizophora apiculata</i> , <i>Rhizophora mucronata</i> , <i>Sonneratia</i> , Nipah ( <i>Nipa fruticans</i> ), Waru laut ( <i>Hibiscus tiliaceus</i> )	<i>Favia spp.</i> , <i>Labophyllia spp.</i> , <i>Porites spp.</i> , <i>Plastygira spp.</i> , <i>Azophythera spp.</i> , Astreopora, Karang batu ( <i>Scleractina</i> ), Lolak ( <i>Trochus niloticus</i> ), Karang mutiara ( <i>Pinctada spp.</i> ), Kimah ( <i>Tridacna</i> ). Rumput laut <i>Euchema spinosa</i> dan <i>Gracilari</i> .	Kuda laut belang ( <i>Hippocampus kuda</i> ), Paling berbintang ( <i>Echidna nebulosa</i> ), Tambra laut garisbiru ( <i>Symphoricthys spilurus</i> ), Ikan belang putih ( <i>Dascyllus trimaculatus</i> ), Ikan karang bendera ( <i>Heniochus acuminatus</i> ), Ikan badut jingga ( <i>Amphiprion ocellaris</i> ), Ikan karang bermata dua ( <i>Coradion melanopus</i> ), Ikan katak ( <i>Arotron areostaticus</i> ), paling berekor hitam ( <i>Moringua bicolor</i> ), Ikan todak lorek hitam ( <i>Hemirhamphus far</i> ), Ikan pipih bentuk lidah ( <i>Tetrasomus gibbosus</i> ), Ikan kakatua merah-lembanyung ( <i>Scarops rubroviolaceus</i> ).

Source: Study Team

## 7) Flora and Fauna

### a. Flora

Based on the Decree of Minister of Agriculture No. 54/Kpts/Um/2/1972, the Decree of Minister of Forestry No. 261/Kpts.IV/1990 and the Government Act No. 5 of 1990, the members of the lowland and highland forest ecosystem which belong to the endemic and protected species are:

- Lowland species: *Cratoxylon celebicus*, *Ficus varegata pterospermum calebicus*, *Vitex quinata*, Palm kipas (*Livistoma rotunatifolia*), Palm raksasa (*Pigafettafilaris*), etc.
- Highland species: *Agathis damara*, *Phyllacladus hypophyllus*, *Dracrycarpus spp.*, *Vaccinium*, *Salmanila malabrica*, Pohon kuku alam (*Pericopsis mooniana*), *Garuga Floribunda*, Kedondong (*Spondias pinnata*), Benuang (*Octomeles sumatrana*), Rambutan Hutan (*Nephelium mutabile*), Durian (*Durio spp.*), Manggis (*Garcinia hombroniana*), Keruing (*Dipterocarpus merginata*), etc.

The forest observed in kabupaten Poso, including the study area of link No.22, is classified as shown in Table 7-2-19.

**Table 7-2-19 Forest Classification in Kabupaten Poso**

No	Forest Classification	Area (ha)	Ratio (%)
1	Limited production forest (HPT)	755,776	35.0
2	Convertible production forest (HPK)	55,066	2.6
3	Ordinary production forest (TGHK or RTRW)	178,505	8.3
4	Nature sanctuary and recreation forest	373,320	17.3
5	Protection forest (III.)	795,980	36.9
Total		2,158,647	100.0

Source: Study Team

The crop plantations are common in this region, that is; coconut (*Cocos nucifera*), cocoa (*Cacao sp.*), coffee (*Coffea spp.*), jambu mede (cashew: *Anacardium occidentale*), Jati (*Tectona grandis*) and mango (*mangifera spp.*), while, the palm-oil plantation also exist.

#### b. Fauna

The endemic and protected fauna observed in the study area are as follows;

- Birds: Burung Maleo (*Macrocephalon maleo*), Gagang bayem (*Himantopus himantopus*), Burung Elang (*Spizaetus lanceolatus*), Burung Raja udang paruh hitam (*Pelagopsis melanorphyscha*).
- Insects: Belalang pemakan paku (*Karyndia gracilipes*).
- Mamalias: Musang raksasa (*Macrogalidia musschenbroekii*), Kelelawar pemakan serangga (*Minipteris schreibersii*), Hipposideros diadema, Rhinolopus arcvatus, Megalcerma spasma, Babyrousa (*Babyrousa*), Kucing bakau (*Felis spp.*)

#### 8) Conservation Area

Forest reserves (HL: Hutan Lindung) are located in the study area. The project road link No.22 cross the forest reserve at near the provincial border. Location of the forest reserve is shown in Figure 7-2-3.

#### (2) Social Environment

##### 1) Demography

The study area is located at Kecamatan Bungku Tengah and Kecamatan Bungku Selatan, kabupaten Poso. The demographic data of villages (Desa) located at the study area is given in Table 7-2-20.

**Table 7-2-20 Demographic Data of the Study Area (Link No.22)**

No.	Name of Kecamatan / Desa (village)	Area (km <sup>2</sup> )	Population	Number of House-hold (HH)	Population Density (person/Km <sup>2</sup> )
Kecamatan Bungku Tengah		--	38,835	8,109	--
1	Totoiso	0.1	265	64	2,650
2	Mendui	0.3	250	42	893
3	Tofuti	13	437	73	37
4	Bahontobungku	21	418	81	20
5	Puungkoilo	15	896	174	60
6	Lahuatu	20	565	121	28
7	Unsongi	47	544	87	16
8	Nambo	52	576	97	11
9	Laroure	18	560	118	31
10	Kolono	38	672	139	18
11	Bahomoachi	68	431	94	6
12	Bahomotefe	23	664	101	29
Sub-total		315.4	6,278	1,191	19.9
Kecamatan Bungku Selatan		--	20,107	4,409	--
1	UPT Lele	10.3	246	86	24
2	Dampala	68.2	133	49	3
3	Siumbatu	63.3	394	104	6
4	Lalampu	80.3	232	83	3
5	Bahodopi	61.7	339	99	5
6	Keurea	152.9	193	61	1
7	Fatutia	193.8	273	73	14
8	Labota	162.2	287	83	2
9	Padabaho	23.7	174	41	7
10	Bete Bete	52.8	349	102	7
11	Puungkeu	29.5	153	41	5
12	Tangofa	118.7	406	121	3
13	One Ete	39.5	152	50	4
14	Tanda Oleo	171.2	239	70	1
15	Lateu	105.7	840	239	8
16	Torete	16.6	473	107	28
17	Buleleng	59.4	524	102	9
Sub-total		1,409.8	5,407	1,511	3.8

Source : Kecamatan Bungku Tengah and Selatan Dalam Angka 1996

In accordance with the improvement of the project road alignment, some houses need to be relocated under the project implementation. Detailed road alignment of link No.22 is given in Volume VI of this report.

## 2) Economic Activities

Working population classified by the economic activities of the region of kabupaten Poso is given in Table 7-2-21. Major economic activity in this region is the agriculture sector. While, agriculture sector can be classified in five activities, i.e.; food crops, plantation, forestry, cattle breeding and fishery.

**Table 7-2-21 Classification of Economic Activities in Kabupaten Poso**

No	Type of Job	Kabupaten Poso	
		Person	%
1	Agriculture	125,418	69.9
2	Industry	5,653	3.2
3	Mining and quarry	1,058	0.6
4	Construction	3,410	1.9
5	Trade	15,345	8.6
6	Communication	2,063	1.2
7	Finance	--	--
8	Service	23,708	13.2
9	Others	1,776	1.8
Total		179,477	100.0

Source: Kabupaten Poso dalam angka 1995

Agricultural activities in Kecamatan Bungku Tengah and Selatan, kabupaten Poso, comprise paddy, corn, cassava, peanuts, soy-beans and mung-beans. Table 7-2-22 gives the production of each crop. While, Table 7-2-23 gives kinds and area of plantations in Kecamatan Bungku Tengah and Selatan.

**Table 7-2-22 Agricultural Products in Kecamatan Bungku Tengah and Selatan**

No	Food Crops	Production amount (ton/year)	
		Kec. Bungku Tengah	Kec. Bungku Selatan
1	Paddy	6,329	334
2	Corn	359	443
3	Cassava	21	1,006
4	Peanuts	40	26
5	Soy-beans	1,114	13
6	Mung-beans	46	184

Source : Kecamatan Bungku Tengah Dalam Angka 1995

**Table 7-2-23 Plantations in Kecamatan Bungku Tengah and Selatan**

No.	Kinds of Plantation	Plantation Area ( ha )	
		Kec. Bungku Tengah	Kec. Bungku Selatan
1	Coconut	2,037	2,679
2	Coffee	87	74
3	Clove	255	79
4	Cocoa	956	348
5	Palm-oil	4,500	--

Source : Kecamatan Bungku Tengah and Selatan Dalam Angka 1995

The fishery activity is common in Kecamatan Bungku Tengah and Selatan. Table 7-2-24 gives the details of fishery activities in this region. (Data in Kecamatan Bungku Selatan did not available.)

**Table 7-2-24 Fishery Activity in Kecamatan Bungku Tengah**

Year	Number of Fishermen	Fishery Production (ton)	Value ( x10 <sup>3</sup> Rp. )
1992	334	763.3	457,980
1993	421	995.5	597,300
1994	360	998.7	599,220
1995	365	999.6	799,680

Source : Kecamatan Bungku Tengah and Selatan Dalam Angka 1995

### 3) Transmigration

The number of transmigration relocated in kabupaten Poso since 1990/1991 - 1994/1995 are 6,091 households (equivalent to 22,968 people). Transmigrants have arrived from various provinces of Sulawesi, West Java, Central Java, East Java and Bali. In the fiscal year of 1994/1995, 981 households (3,663 people) have relocated to this region.

Along the project road link No.22, six (6) transmigration sites, that is; UPT Bahodopi I/II, Labota, PIR Trans Ambuna, Bahometefe I and Bahometefe, are located. Table 7-2-25 gives the details of each transmigration, and the locations are shown in Figures 7-2-2 and 7-2-3.

**Table 7-2-25 Transmigration in the Study Area**

No	Name	Location (Desa)	Year	Area (Ha)	Household	Population	Origin (relocated from)
1	Bahodopi I	Bahodopi	1992	1,190	387	1,534	NTB, Local
2	Bahodopi II	Bahodopi	1992	370	110	443	NTB, Local
3	Labota	Labota	1993	278	86	250	Jateng, NTB, Local
4	PIR Trans Ambuna	Ambuna	1996	1,110	350	1,416	Local
5	Bahometefe I	Bahometefe	1991	790	250	915	Jabar, Jateng, Bali, Local
6	Bahometefe	Bahometefe	1991	794	250	1,031	Jabar, Jateng, Bali, Local

*Source: Study Team*

### 4) Tourism

The tourism spots located along Bungku -- Provincial border road section are "Bahometefe", as the natural landscape, "Kolone", as the culture spot for Masteantina, in Kecamatan Bungku Tengah, and "Tangofa", as the natural landscape, in Kecamatan Bungku Selatan. The location of each tourism place is shown in Figures 7-2-2 and 7-2-3.

The development of tourism in the study area is rather weak compared with other areas such as Bunaken, Toraja, Bali, etc., due to lack of transportation facilities (accessibility), accommodation facilities and professionals and investors in its management.

#### (4) Environmental Pollution

There is almost no data available regarding the present environmental pollution; such as air pollution, water pollution, soil contamination, noise and vibration, land subsidence and offensive odor. However, taking into consideration the contents of the project and its scale; i.e., lower traffic volume in the study area, no toxic substances produced, no groundwater pumping, etc., significant environmental pollution might not be caused by any project activities, except for noise and vibration during construction.

#### (4) Scoping Assessment

The result of scoping assessment of the road link No.22 is given in Table 7-2-26.

**Table 7-2-26 Scoping Result for Bungku – Provincial border (Link No. 22)**

No	Environmental Item/Factor	Evaluation	Reasons
<b>A. Social Environment</b>			
1.	Resettlement	B	Resettlement shall be taken into consideration due to improvement of the project road alignment
2.	Economic Activities	B (+)	Project scope is improvement of existing roads, therefore impacts on economic activities are small. Plus impacts on transmigrants are anticipated
3.	Traffic/Public Facilities	D	Project site is located at rural region
4.	Split of Communities	D	Notable impact regarding split communities not predicted
5.	Cultural Property	D	Cultural properties are few in the study area
6.	Water Rights and Rights of Common	B	Project road cross the forest reserves
7.	Public Health Condition	D	No impact on public health conditions
8.	Waste	B	Some amount of surplus soil by cutting work are produced
9.	Hazards (Risk)	B	Some part of project road is located in the seashore cliff and mountainous area, therefore a potentially hazardous area, especially landslides and/or cave-in
<b>B. Natural Environment</b>			
1.	Topography and Geology	D	No large scale topographic change is carried out in the project
2.	Soil Erosion	B	Soil erosion may occur during construction stage, due to earth works, etc., mainly in seashore cliff and mountainous area
3.	Groundwater	D	Large scale excavation are not carried out in the project
4.	Hydrological Situation	B	Some impacts on river flow are anticipated by bridge construction
5.	Coastal Zone	B	Some project roads in the study area pass through the coastal zone
6.	Fauna and Flora	B	Protected/Endemic fauna and flora exist in the study area.
7.	Meteorology	D	No meteorological impacts are predicted
8.	Landscape	D	Notable impact regarding landscape not predicted
<b>C. Pollution</b>			
1.	Air Pollution	D	Predicted traffic volume in the study area is small
2.	Water Pollution	D	Impacts on water bodies by construction works etc. is negligible
3.	Soil Contamination	D	Toxic substances are not handled by the project
4.	Noise and Vibration	B	Noise and vibration may occur by construction equipment during construction stage
5.	Land Subsidence	D	No ground water pumping is carried out in the project
6.	Offensive Odor	D	There is no factor of offensive odor in the project

Source: "JICA Environmental Guidelines"

Note : Evaluation categories:

- A: Serious negative impact is expected.
- B: Some negative impact is expected.
- B(+): Some positive impact is expected.
- C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses).
- D: No impact is expected.

## 7.2.4 Provincial border - Asera (Link No. 33)

### (I) Natural Environment

#### 1) Meteorology

The monthly rainfall data, between year 1990 to 1996, and the monthly temperature data, between 1992 to 1995, taken from Meteorological Station in Kendari Airport, kabupaten Kendari, is shown in Table 7-2-27 and Table 7-2-28, respectively.

**Table 7-2-27 Monthly Rainfall**

Year/ Month	1	2	3	4	5	6	7	8	9	10	11	12	Total (mm)
1990	194	128	170	185	218	32	42	27	0	10	0	376	1,378
1991	218	143	113	141	331	132	35	0	93	78	16	291	1,589
1992	509	212	441	392	392	192	89	2	2	0	130	238	2,596
1993	447	157	403	458	252	83	15	28	0	6	15	90	1,952
1994	394	253	290	94	217	276	241	52	43	38	122	149	2,169
1995	231	162	137	199	185	370	78	2	8	23	48	355	1,798
1996	95	69	379	277	343	133	67	67	0	22	11	374	1,837
Average	348	187	322	291	323	203	95	30	24	29	40	312	1,902

Source : Meteorological Station in Kendari Airport 1995

**Table 7-2-28 Monthly Temperature**

(Unit : °C)

Year/ Month	1	2	3	4	5	6	7	8	9	10	11	12
1992	25.9	25.9	25.7	26.0	26.3	26.0	25.8	26.1	26.3	26.4	26.4	26.6
1993	26.0	26.2	25.9	26.3	26.1	26.0	25.7	26.3	26.5	2.62	2.65	2.63
1994	25.9	26.1	26.1	25.8	26.0	26.2	25.9	26.0	26.1	26.0	26.1	26.1
1995	25.8	26.1	25.9	26.0	26.0	25.9	25.9	26.1	25.8	26.2	26.1	26.5
Average	25.9	26.0	25.9	26.0	26.1	26.0	25.8	26.1	26.2	26.2	26.3	26.4

Source : Meteorological Station in Kendari Airport 1995

#### 2) Topography

The topographic feature of the road section Asera - Kuratao is flat, in general. The road section of Kuratao - Provincial border is located at the valley of Lasolo and Lalindu river and its topographic feature is wavy. In the area near the provincial border, steep slopes of more than 25% gradient can be found. The topographic feature of the project road link No.33 is summarised as given in Table 7-2-29.



**Table 7-2-29 Topographic Feature of Link No.33**

No.	Road Section	Road (Km)	0 -- 8% (flat)		9 - 25% (undulating)		> 25% (hilly)	
			Km	%	Km	%	Km	%
1.	Asera - Kuratao	28.3	1.0	3.5	27.3	96.5	--	--
2.	Kuratao -- Provincial border	27.2	16.9	62.1	10.3	37.9	--	--

Source: Study Team

### 3) Geology

The details of geological features of the study area have already been described in Chapter 4 of this report.

### 4) Hydrological Situations

Some of the major rivers in Southeast Sulawesi, that is, Sungai Lasolo and Sungai La Lindu, cross the project road link No.33. Some rivers tend to overflow in rainy season. Characteristics of major rivers flowing through the study area are given in Table 7-2-30.

**Table 7-2-30 River Characteristics**

No	River Names	Catchment Area (Km <sup>2</sup> )	Length (Km)	Width (m)	Average Flow (m <sup>3</sup> /sec)	Flowing Type	Water Usage
1	S. Lasolo	880.6	52.6	79-80	44.2	Perennial *	Domestic, Irrigation
2	S. La Lindu	572.2	40.0	50-70	36.4	Perennial *	Domestic, Irrigation
3	S. Landawe	97.0	23.2	8-12	3.8	Perennial	Domestic

Source: Study Team

Notes, \* : flood in rainy season

### 5) Flora and Fauna

#### a. Flora

Based on the Decree of Minister of Agriculture No. 54/Kpts/Um/2/1972, the Decree of Minister of Forestry No. 261/Kpts.IV/1990 and the Government Act No. 5 of 1990, the members of the lowland and highland forest ecosystem which belong to the endemic and protected species are:

- Lowland species: *Cratoxylon celebicus*, *Ficus varegata pterospermum celebicus*, *Vitex quinata*, Palm kipas (*Livistoma rotunajfolia*), Palm raksasa (*Pigafettafilaris*), etc.
- Highland species: *Agathis damara*, *Phyllacladus hypophyllus*, *Dracrycarpus spp*, *Vaccinium*, *Salmanila malabrica*, Pohon kuku alam (*Pericopsis mooniana*), *Garuga Floribunda*, *Kedondong (Spondias pinnata)*, *Benuang (Octomeles sumatrana)*, *Rambutan Hutan (Nephelium mutabile)*, *Durian (Durio spp)*, *Manggis (Garcinia hombroniana)*, *Keruing (Dipterocarpus merginata)*, etc.

The forest observed in kabupaten Kendari, including the study area of link No.33, is shown in Table 7-2-31.

**Table 7-2-31 Forest Classification in Kabupaten Kendari**

No	Forest Classification	Area (ha)	Ratio (%)
1	Production forest (HPK: Hutan Produksi on Konversi)	577,666	44.9
2	Industry forest	441,100	34.3
3	Ordinary production forest (HPT: Hutan Produksi Terbatas)	47,000	3.7
4	Nature sanctuary forest (HL: Hutan Lindung)	10,797	0.1
5	Nature Conservation Rawa Aopa & Watumokai (CA: Cagar Alam)	72,023	5.6
6	Recreation forest	50,000	3.9
Total		1,287,486	100.0

Source: Study Team

b. Fauna

The endemic and protected faunas observed in the study area are as follows;

- Birds: Burung Maleo (*Macrocephalon maleo*), Gagang bayem (*Himantopus himantopus*), Burung Elang (*Spizaetus lanceolatus*), Burung Raja udang paruh hitam (*Pelagopsis melanophyscha*), Rangkong (*Rhyticeros cassidix*), Nuri (*Eos hitrio*), Kakatua putih (*Cacatua alba*), Ayam hutan (*Gallus galus*).
- Insects: Belalang pemakan paku (*Karyndia gracilipes*).
- Mamalias: Anoa (*Bubalus guarlesi*), Musang raksasa (*Macrogalidia musschenbroekii*), Kelelawar pemakan serangga (*Miniopteris schreibersii*), Hipposideros diadema, Rhinolopus arcvatus, Megalerna spasma, Babyrousa (*Babyrousa*), Kucing bakau (*Felis spp.*), Ruasa (*Cervus timorensis*).
- Primates: Owa-owa (*Hylobater spp*), Monyet Sulawesi (*Macaca tonkeana*), Lutung (*Presbytis cristata*).

The detail of fauna species inhabiting the tropical forest, in general, are given in the Table 7-2-32.

Table 7-2-32 Fauna Species in Tropical Forest

No.	Local/Indonesian Name	Scientific Name	Status
<b>Mammals</b>			
1	Cerurut hutan	<i>Crosidura lea</i>	
2	Kelelawar peniak an scrangga	<i>Miniopsis schereibersii</i>	
3	Codot		
4	Kalong	<i>Roucelthus spp</i>	
5	Tikus hutan	<i>Pteropus sp.</i>	
6	Tikus pohon	<i>Paruronyx dominator</i>	
7	Bajing moncong	<i>Margaretanys parvus</i>	
8	-	<i>Hyoscicurus heinrichi</i>	
9	-	<i>Megalerna soasma</i>	Protected
10	Rusa	<i>Rhinolopus arcvatus</i>	Protected
11	Babirusa	<i>Babyrousa babyrussa</i>	Protected
12	Kuskus	<i>Polanger sp.</i>	Protected
13	Anoa	<i>Bubalus sp</i>	Protected
14	Kucing hutan	<i>Felis sp</i>	Protected
15	Musang raksasa	<i>Macrogulidia mussachenbroeckii</i>	Protected
16	Luwak	<i>Paradoxurus hermaphroditus</i>	
17	Kuda		
18	Sapi	<i>Equus sp.</i>	
19	Kerbau	<i>Bubalus spp.</i>	
<b>Primates</b>			
1	Owa-owa	<i>Hylobates spp</i>	Protected
2	Monyet sulawesi	<i>Macaca tonkeana</i>	Protected
3	Kera ekor panjang	<i>Macaca fascicularis</i>	Protected
4	Monyet	<i>Macaca maura</i>	Protected
5	Lutung	<i>Presbytis cristata</i>	
<b>Birds</b>			
1	Kakatua putih	<i>Cacatu alba</i>	Protected
2	Nuri	<i>Eos hiurio</i>	Protected
3	Ayam hutan	<i>Gallus gallus</i>	Protected
4	Gagak	<i>Corvus sp.</i>	
5	Terkukur	<i>Geopelia srriala</i>	
6	Alap-alap ekor bercak	<i>Accipiter trinotatus</i>	Protected
7	Alap-alap perut merah	<i>Accipiter rhodogaster</i>	
8	Elang	<i>Spizaetus lanceolatus</i>	Protected
9	Srigunting	<i>Dicrurus hottentotus</i>	
10	Walet	<i>Collocalia spp</i>	Protected
11	Burung hantu	<i>Tito alba</i>	
12	Burung rangkong	<i>Rhyticeros cassidix</i>	Protected
13	Pengisap madu	<i>Myza celebensis</i>	
14	Betet raket bercak	<i>Prioniturus flexicans</i>	
15	Srindit	<i>Loriculus sp</i>	
16	Burung maleo	<i>Macrocephalon maleo</i>	Protected/ Endemic
17	Puyuh		
18	Kucica	<i>Catoptera turdaedes</i>	
19	Bentet kukuk putih	<i>Cocarina schistacea</i>	
20	Bubut	<i>Ceotropus celebensis</i>	
21	Anis punggung merah	<i>Zoothera erythronata</i>	
22	Prenjak kenting	<i>Phylloscopus sarasinorum</i>	
23	Burung cabe	<i>Dicaeum aurealimbatum</i>	
24	Burung kacamata	<i>Zosterop anomala</i>	
<b>Reptils</b>			
1	Kadal	<i>Bungarus fasciatus</i>	
2	Cecak	<i>Hemidactylus frenatus</i>	
3	Ular sanca	<i>Phyton molurus</i>	Protected
4	Ular gilig	<i>Cylindrophis melanotus</i>	Protected
5	Riawak	<i>Varanus salvator</i>	Protected
<b>Amphibia</b>			
1	Katak	<i>Rhana cancrivora</i>	

Source : Pengamatan lapang dan wawancara, 1998

## 6) Conservation Area

No nature reserves, including forest reserve, is designated in the study area of link No.33.

### (2) Social Environment

#### 1) Demography

The study area is located in Kecamatan Asera with its capital city of Andowia, kabupaten Kendari. Most of the study area contains existing and/or planned transmigration sites. The demographic data of the study area is given in Table 7-2-33.

**Table 7-2-33 Demographic Data of the Study Area (Link No.33)**

No.	Name of Kecamatan / Desa (village)	Area (km <sup>2</sup> )	Population (Person)			Household (HH)	Population Density (Person/Km <sup>2</sup> )
			Male	Female	Total		
Kecamatan Asera		2,077	7,768	6824	14,592	2,751	7
1	Desa Asera	118	1,046	800	1,846	340	15
2	Desa Walalindu	110	288	267	555	113	5
3	Desa Wanggudu	67	330	279	609	103	9
4	Desa Laroonah	150	254	249	503	84	3
5	Desa Wiwirano	115	513	450	963	146	8
6	Desa Linomoyo	200	265	249	514	105	2
7	Desa Padalere	145	216	130	346	65	2
Kab. Kendari		16,480	201,213	195,465	396,678	80,700	24

Source : Kec. Asera Dalam Angka 1995, and Kabupaten Kendari Dalam Angka 1995

The number of houses located along Provincial border - Asera road section is estimated to be approximately 950 units. Most of the houses, including school, religious facilities, hospital, etc., are situated about 6 to 12 meters or more away from both sides of the existing road edge. In accordance with the construction of new road and improvement of existing road alignment, some houses are relocated as a result of project implementation. Detailed road alignment of link No.33 is shown in Volume VI of this report.

The number of houses, which are located in the villages in the study area, classified by the housing structure, that is; permanent, semi-permanent and wooden, is given in Table 7-2-34.

**Table 7-2-34 Number of Houses in the Study Area and Conditions**

No.	Kecamatan / Desa	Number of Houses (Unit) with Housing Conditions			
		Permanent	Semi-Permanent	Wood/Bamboo	Total
Kecamatan Asera		117	165	2,469	2,751
1	Desa Asera	4	19	317	340
2	Desa Walalindu	6	10	97	113
3	Desa Wanggudu	7	5	91	103
4	Desa Laroonah	4	--	80	84
5	Desa Wiwirano	7	12	127	146
6	Desa Linomoyo	--	--	105	105
7	Desa Padalere	--	--	65	65
Total		28	46	882	956

Source : Kecamatan Asera dan Kecamatan Lasalo Dalam Angka 1995

Generally in Southeast Sulawesi, land acquisition caused by the project implementation has been carried out in conformity with the existing regulations, which are Presidential Decree No.55, 1993 and Regulation of the Minister of Agrarian Affairs No. 1, 1994, by the local regional administration of Panitia Pengadaan Tanah bagi Pelaksanaan Pembangunan untuk kepentingan Umum coordinated by Pemerintah Daerah TK.II in association with the project and related agencies.

## 2) Economic Activities

Working population classified by economic activity in the region of Kecamatan Asera, kabupaten Kendari, is given in Table 7-2-35. Major economic activity in this region is the agriculture sector and most of which is carried out by transmigrants. The agriculture sector can be classified into five activities, i.e.; food crops, plantation, forestry, cattle breeding and fishery. Agricultural products in Kecamatan Asera are given in Table 7-2-36.

**Table 7-2-35 Classification of Economic Activities in Kecamatan Asera**

No	Economic Activities	Kecamatan Asera	
		Person	%
1	Agriculture	4,871	53.3
2	Industry	--	--
3	Mining	--	--
4	Construction	35	0.4
5	Trade	182	2.0
6	Transportation	124	1.4
7	PNS/ABRI	440	4.8
8	Finance	119	1.3
9	Service	--	--
10	Others	3,386	37.1
Total		9,137	100.0

Source: PDRB Kabupaten Kendari in 1995

**Table 7-2-36 Agricultural Products in Kecamatan Asera**

No.	Types of crops	Kecamatan Asera		
		Area (ha)	Production (ton)	Average (ton/ha)
1	Rice-field paddy	447	1,118	2.5
2	Dry-land paddy	202	505	2.5
3	Corn	8	52	1.5
4	Cassava	8	60	7.5
5	Sweet potato	-	-	-
6	Peanuts	53	106	2.0
7	Soy-beans	34	41	1.2
8	Mung—beans	87	218	2.5
9	Coconut	868	34	0.03
10	Cashew	1,710	135	0.07
11	Cocoa	2,396	146	26.2
12	Coffee	286	7,488	-

Source : Kecamatan Asera Dalam Angka, 1995

### 3) Transmigration

Number of transmigrants relocated in kabupaten Kendari during 1979/1980 - 1995/1996 is 24,001 (equivalent to 100,551 people). Transmigrants have arrived from various provinces of Sulawesi, West Java, Central Java, East Java and Bali. In the fiscal year of 1996/1997, 1,633 households (5,735 people) have relocated to this region.

Along Provincial border - Asera road section, ten (10) transmigration sites, that is; Tambua I, Wiwirano Bawah, Hialu I/II/III/IV, Lamona I/II/III and Padalere, are located. While, some other transmigration sites are planned to be constructed in the near future. Table 7-2-37 gives the detail of each transmigration, and the locations are shown in Figures 7-2-3 and 7-2-4.

**Table 7-2-37 Transmigration in the Study Area**

No	Name	Location (Desa)	Year	Area (Ha)	Household	Population	Origin
1	Tambua I	Asera	95/96	450	200	894	Jatim, Local
2	Wiwirano Bawah	Wiwirano	97/98	236	105	416	Jateng, NTB, Local
3	Hialu I	Hialu	94/95	158	70	280	Local
			95/96	338	150	586	Jabat, Bali, NTT, Local
4	Hialu II	Hialu	94/95	675	300	1,252	Bali, Local
			95/96	360	160	588	Bali, Local
5	Hialu III	Hialu	95/96	273	121	430	Jatim, NTB, Local
			96/97	605	269	1,076	Jatim, NTB, Local
6	Hialu IV	Hialu	95/96	254	113	426	Bali, NTT, Local
			96/97	376	167	668	Bali, NTT, Local
7	Lamona I	Lamona	95/96	776	345	1,380	Bali, Local
8	Lamona II	Lamona	95/96	191	85	319	Bali, Local
9	Lamona III	Lamona	95/96	157	70	294	NTB, Local
			96/97	518	230	920	Bali, Jatim
8	Padalere	Padalere	97/98	236	105	377	Jatim, Bali, Local

Source : Kamwil Department Transmigrasi dan PPH Sulawesi Tenggara, 1997

### 4) Tourism

No designated tourism area exists in the study area of link No.33.

### (3) Environmental Pollution

There is almost no data available regarding the environmental pollution; such as air pollution, water pollution, soil contamination, noise and vibration, land subsidence and offensive odor. However, taking into consideration the project; i.e., low traffic volumes in the study area, no toxic substances produced, no groundwater pumping, etc., significant environmental pollution might not be occurred by the project activities, except noise and vibration during construction.

### (4) Scoping Assessment

The result of scoping assessment of the road link No.33 is given in Table 7-2-38.

**Table 7-2-38 Scoping Result for Provincial border -- Asera (Link No. 33)**

No	Environmental Item/Factor	Evaluation	Reasons
<b>A. Social Environment</b>			
1.	Resettlement	D	Resettlement shall be taken into consideration due to construction of new roads and improvement of existing road alignment
2.	Economic Activities	B (+)	Project scope is improvement of existing roads, therefore impacts on economic activities are small. Plus impacts on transmigrants are anticipated
3.	Traffic/Public Facilities	D	Project site is located at rural region
4.	Split of Communities	D	Notable impact regarding split communities not predicted
5.	Cultural Property	D	Cultural properties are few in the study area
6.	Water Rights and Rights of Common	D	Project road does not cross the nature and/or forest reserves
7.	Public Health Condition	D	No impact on public health conditions
8.	Waste	B	Some amount of surplus soil by cutting work are produced in the project
9.	Hazards (Risk)	B	Landslides and/or flood are predicted in the study area
<b>B. Natural Environment</b>			
1.	Topography and Geology	D	No large scale topographic change is carried out in the project
2.	Soil Erosion	B	Soil erosion may occur during the construction stage, due to earth work, etc. mainly in mountainous area
3.	Groundwater	D	Large scale excavation are not carried out in the project
4.	Hydrological Situation	B	Some impacts on river flow are anticipated by bridge construction
5.	Coastal Zone	B	Some part of project roads pass through the coastal zone
6.	Fauna and Flora	B	Protected/Endemic fauna and flora exist in the study area. Forest reserves exist in the study area
7.	Meteorology	D	No meteorological impacts are predicted
8.	Landscape	D	Notable impact regarding landscape not predicted
<b>C. Pollution</b>			
1.	Air Pollution	D	Predicted traffic volume in the study area is small
2.	Water Pollution	D	Impacts on water bodies by construction works etc. is negligible
3.	Soil Contamination	D	Toxic substances are not handled by the project
4.	Noise and Vibration	B	Noise and vibration may occur by construction equipment during construction stage
5.	Land Subsidence	D	No ground water pumping is carried out in the project
6.	Offensive Odor	D	There is no factor of offensive odor in the project

Source: "JICA Environmental Guidelines"

Note : Evaluation categories:

- A: Serious negative impact is expected.
- B: Some negative impact is expected.
- B(+): Some positive impact is expected.
- C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses).
- D: No impact is expected.