11.2.4 Vehicle Operation Cost Saving (1) Basic Concept

As mentioned in Table 11-2-1, transportation between San Borja and Trinidad during the rainy season depends on air transportation and water transportation; however, during dry season, vehicles can circulate along the whole road section between San Borja and Trinidad. After the completion of the road improvement project, vehicles will be able to circulate along the whole road during both seasons. Additionally, the 10.5 km section from Trinidad to the right bank of Mamoré river will be paved with asphalt.

Consequently, the difference in vehicle operation costs caused by alteration of the road surface conditions will be one of the benefits during dry season. On the other hand, during rainy season, the benefits will be measured as the difference between vehicle operation costs on the project road and transportation costs of alternative transportation modes. At the present, air transportation between San Borja and San Ignacio (138 km), and water transportation between San Ignacio and Trinidad (84 km) serve as alternative transportation means during the rainy season. Only this combination of transportation means is found in this road section. The cost of this combination of transportation means is adopted as the transportation costs during the rainy season in the "without case".

In order to calculate vehicle operation costs from the commencement of services in 2001 to 2020, future traffic volume must be forecasted. In this Study, an Origin-Destination (O-D) survey was conducted at three points on the project road, as indicated in Figure 11-2-1. Existing traffic volume and estimated future traffic volume are shown in Table 11-2-2.

- Future traffic volume of the project road was projected by estimating traffic based on the present traffic volume and converted traffic volume.
- Future traffic volume based on present traffic volume was estimated by a regression analysis based on the trinomial shifting average of traffic volume data from 1989 to 1995.
- Converted traffic volume was estimated by converting from air transportation to large truck transportation of beef and wheat transported between La Paz and Trinidad, which is estimated based on the analysis in the Phase-I study of the road improvement.

 Table 11-2-2
 Future Traffic Volume on the Project Road by Sections

			(San Dorla		(Unit : vehicles/day)				
Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large 1	fruck	Tot	al
1995	37	3	1 1	. 6	8	19	(0)	74	(0)
2001	77	6	2	13	17	39	(8)	154	(8)
2005	115	9	3	19	26	59	(9)	231	(9)
2010	192	15	5	31	42	98	(11)	383	(#1)
2015	318	25	8	52	69	163	(12)	635	(12)
2020	526	42	14	85	115	270	(14)	1,052	(14)

(San Borja - San Ignacio Section)

(San Ignacio - Puerto Varador Section	(San	Ignacio -	Puerto	Varador	Section	
---------------------------------------	------	-----------	--------	---------	---------	--

Үеаг	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large 1	ruck	Tota	41
1995	42	5	- 1	15	3	6	(0)	71	(0
2001	68	7		25	5	9	(8)	114	(8
2005	89	10		32	7	12	(9)	150	(9
2010	126	14	- 1	45	9	17	(11)	211	(11
2015	177	20		63	12	25	(12)	297	()2
2020	248	29	- 1	89	17	35	(14)	418	(14

(Puerto Varador - Trinidad Section)

		. `						(Unit : vehicles/day)				
Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large	Fruck	Tot	al			
1995	198	7	Т <u>-</u> Т	52	12	19	(0)	288	(0)			
2001	391	13	- 1	103	24	37	(8)	568	(8)			
2005	500	17		132	30	48	(9)	727	(9)			
2010	681	24		179	42	65	(11)	991	(11)			
2015	928	32		244	57	89	(12)	1,350	(12)			
2020	1,265	44	- 1	332	78	121	(14)	1,840	(14)			

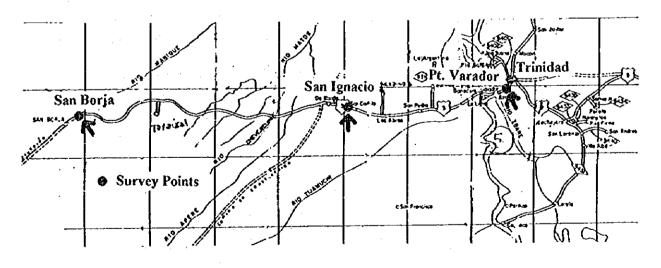


Figure 11-2-1 Traffic Survey Points

• Numbers in parenthesis in Table 11-2-2 shows the converted traffic volume calculated by converting air transportation of beef and wheat between La Paz and Trinidad into transportation by truck.

(2) Calculation Method for VOC Saving Benefits

Be =	$\{C_{wor} + C_{wod}\} - C_w$
C _w =	T[I]×VOC[I]×RD×365 days
C _{wor} =	T[I]×VOC{I]×RD×365 days×¾
C _{wod} =	$(T[I] \times VOC[I] \times RD \times 365 \text{ days} \times \frac{1}{4}) + (A \times TC_p[I] + B \times TC_c[I])$

where;

Be	: VOC saving benefits
Cw	: Vehicle operation cost in With-case
Cwor	: Vehicle operation cost in Without-case (rainy season)
Cwod	: Vehicle operation cost in Without-case (dry season)
T(I)	: Future traffic volume (vehicles per day)
VOC[1]	: Vehicle operation cost by vehicle type and by type of pavement (Refer to Table 11-2-3)
RD	: Running distance (Refer to Table 11-2-4)
Α	: Number of passengers transported by vehicle Average number of passengers by vehicle type multiplied by future traffic volume by vehicle type. (Refer to Tables 11-2-5 and 11-2-6)
TC _p [I]	: Passenger transportation costs. Passenger transportation costs between San Borja and Trinidad during the rainy season are shown in Table 11-2-7 with the site survey results.
В	 Cargo volume transported by vehicles between San Borja and Trinidad (Refer to Tables 11-2-8 and 11-2-9) B = T{I]×Participation of cargo vehicles×Average live load
TC _c [I]	: Cargo transportation costs Cargo transportation costs between San Borja and Trinidad during the

 Table 11-2-3
 Vehicle Operation Cost by Vehicle Type and Pavement Type

rainy season are shown in Table 11-2-10 with the results of site survey.

Type of Vehicle	Type of Pavement					
	Asphalt	Gravel	Earth			
Passenger car	. 0.2249	0.4934	0.6778			
Bus	0.2907	0.4648	0.5860			
Large bus	0.5423	0.9511	1.2091			
Small truck	0.3335	0.5095	0.6999			
Medium truck	0.4028	0.6768	0.8532			
Large truck	0.5186	0.8939	1.1363			

Note - 1. The above mentioned values are adopted from plain sections of the road project. 2. The value for earth was estimated by the proportion between the earth value against that of gravel value shown in the project plan from CONFIFAL CAIHUASI in 1987.

3. The figures in Asphalt and Gravel were provided by SNC. (Refer to Appendix)

Case	Type of Pavement	Distance	Section
Without project	Earth	221.0 km	San Borja - Trinidad
With project	Gravel	210.5 km	San Borja - Pto. Varador
	Asphalt	10.5 km	Pto, Varador - Trinidad

Table 11-2-4 Running Distance by Section

Table 11-2-5 Average Number of Passengers by Vehicle Type

Type of Vehicle	No. of Passengers
Passenger car	4.99
Bus	16.17
Large bus	25.55
Small truck	3.63
Medium truck	3.63
Large truck	6.39

*Figures were obtained by a survey conducted in this study

 Table 11-2-6
 Number of Passengers Transported by Vehicle Type (San Borja - San Ignacio Section)

 (Unit : rersons/day)

						(0101:1	ciscuscay
Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large Truck	Total
2001	384	97	51	47	61	249	889
2005	573	145	76	68	94	377	1,333
2010	958	242	127	112	152	626	2,217
2015	1,586	404	204	188	250	1,041	3,673
2020	2,624	679	357	308	417	1,725	6,110

(San Ignacio - Puerto Varador Section)

			(Unit : persons/day)				
Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large Truck	Total
2001	339	113		90	18	57	617
2005	444	161	-	116	25	76	822
2010	628	226	-	163	32	108	1,157
2015	883	323	-	228	43	159	1,636
2020	1,237	468	-	323	61	223	2,312

(Puerto Varador - Trinidad Section)

Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large Truck	Total
2001	1.951	210	<u> </u>	373	87	236	2,857
2005	2,495	274		479	108	306	3,662
2010	3,398	388	i - i	649	152	415	5,002
2015	4,630	517	· · · ·	885	206	568	6,806
2020	6.312	711	-	1,205	283	773	9,284

Note : * The figures don't include number of persons due to the converted traffic

 Table 11-2-7
 Passenger Transportation Costs

Section	Distance	Transportation Mode	Unit Cost
San Borja - San Ignacio	127 km	By airplane	US\$ 20.42
San Igoacio - Trinidad	84 km	By ship	US\$ 4.16

Source : Data was collected by the site survey

Table 11-2-8 Participation of Cargo

Participation (Share in %)		80 %
Average live load	Small truck	1.17 tons
	Medium truck	2.62 tons
	Large truck	3.71 tons

Source : Data was obtained from O-D survey in this study

		e a la francé de la composición de la c			(Unit: tons/day)
ſ	Year	Small Truck	Medium Truck	Large Truck	Total
ſ	2001	15	45	144	204
	2005	22	68	219	309
r	2010	36	110	364	510
Į	2015	61	181	605	390
- [2020	99	301	1.002	1.402

Table 11-2-9 Volume of Load Transported by Vehicle Type (San Borja - San Ignacio Section)

al-to an alling

			and the second	Unit: tons/e
Year	Small Truck	Medium Truck	Large Truck	Total
2001	29	13	33	75
2005	37	18	45	100
2010	53	24	63	140
2015	74	31	93	198
2020	104	45	130	279

	`		•	(Unit: tons/day
Year	Small Truck	Medium Truck	Large Truck	Total
2001	121	63	137	321
2005	154	79	178	411
2010	209	110	241	560
2015	285	149	330	764
2020	388	204	449	1,041

Note : Figures don't include converted traffic cargoes

Table 11-2-10 Cargo Transportation Costs

Section	Distance	Transportation Mode	Unit Cost
San Borja - San Ignacio	127 km	By airplane	US\$ 214.0
San Ignacio - Trinidad	84 km	By ship	US\$ 130.0

Source : Data was collected by the site survey

(3) Results of the Calculation of VOC Saving Benefits

The results of the calculation of benefits by the above-mentioned method are summarized in Table 11-2-11.

(Unit: Thousands of US\$)				
Year	Total VOC Saving			
2001	7,136			
2005	9,776			
2010	16,712			
2015	24,567			
2020	38,542			

Table 11-2-11 Total VOC Saving

11.2.5 Travel Time Saving

(1) Basic Concept

Travel time will be saved by the increase in running speed resulting from improvement of the road surface. In addition, the completion of the project will decrease to zero (0) the waiting time for ferry boats at the river crossing points, where ferry transportation is provided. Bridges will replace ferry transportation over the Maniqui, Cuberene, Apere, Tijamuchi and Ibare Rivers. During the rainy season, the waiting time saving at each point fluctuates depending on the situation of the ferry boats; however, in this Study, the establishment of travel speed was taken into account.

The benefit of travel time saving is calculated multiplying the total travel time saved by the personal travel time cost.

(2) Calculation Method for Travel Time Saving Benefits

Travel time saving benefits is calculated by using the following formula:

 $Be = \{T_{wor} + T_{wod}\} \times HC - T_w \times HC$ $T_w = T[I] \times (N-2) \times RD \times 1/V_w \times 365 \text{ days} \times HC$ $T_{wor} = T[I] \times (N-2) \times Tt \times 365 \text{ days} \times \frac{1}{4}$ $T_{wod} = T[I] \times (N-2) \times RD \times 1/V_{wo} \times 365 \text{ days} \times \frac{3}{4} \times HC$

where:

Be : Travel time saving benefits

Tw : Travel time cost in With-case

Twor : Travel time cost in Without-case (rainy season)

Twod : Travel time cost in Without-case (dry season)

T[I] : Future traffic volume by vehicle type (vehicles per day)

N :Average number of passengers indicated in Table 11-2-5.

This number of passengers includes the crew; however, for the calculation of travel time saving benefits, it must be deducted. From the results of the site investigation, an average of one person per car and two persons per other types of vehicles were considered as crew members.

RD : Distance indicated in Table 11-2-4.

- V_w : Travel speed by vehicle type in "with project" cases
- V_{wo} : Travel speed by vehicle type in "without project" cases. The travel speed was established as shown in Table 11-2-12 by the site investigation, taking into account the waiting time at the ferry transportation service points.
- HC : Time value

Time value is a conversion coefficient for evaluating time in a monetary point of view based on conditions shown in Table 11-2-13. Using these data, the average salary per capita per hour is calculated as follows:

$A \times B \times 12/(C \times F) \times 1/D \times 1/E$

Consequently, the time value in Bolivia was estimated in US\$0.1254 in 1995.

Tt : Travel time between San Borja and Trinidad during the rainy season. With the results of the site investigation, the following travel time between San Borja and Trinidad during the rainy season was obtained as shown in Table 11-2-13.

Table 11-2-12 Travel Speed

ype of Vehicle	1	Type of Pavement	t
	Asphalt	Gravel	Earth
Small	70	50	30
Medium	70	50	30
Large	70	50	30

Note : These figures was assumed by study team referring to data provided by SNC.

 Table 11-2-13
 Conversion Coefficient for Evaluating Time Value

	Items	Amount	Unit
4	Number of employees	585,854*	persons
B	Average salary	1,311*	Bs/month
C	Weekly working hours	44	hours
D	Total population of Bolivia	6,835*	1,000 persons
E	Exchange rate in 1995	4.7	Bs/US\$
F	Number of weeks/year	52	weeks

Note : * These values were estimated using 1992 data

 Table 11-2-14
 Travel Time during Rainy Season

Road Section	Travel Time	Transportation Mode
San Borja - San Ignacio	0.5 hours	By airplane
San Ignacio - Trinidad	6.0 hours	By ship

(3) Results of the Calculation of Travel Time Saving Benefits

The results of the calculation of benefits by the above-mentioned method are summarized in Table 11-2-15.

Year	Total Travel Time Benefits
2001	68
2005	89
2010	141
2015	200
2020	298

Table 11-2-15 Benefits of Travel Time Saving (Unit: Thousands of USS)

11.2.6 Transportation Cost Saving

(1) Basic Concept

At present, beef is transported from Trinidad to La Paz, and wheat is transported from La Paz to Trinidad by airplane. In the "without project" case, this expensive type of transportation will continue. On the other hand, in the "with project" case, 97 % of the all air transportation will be replaced by land transportation using trucks, due to the continuous circulation of traffic from Trinidad to La Paz throughout the year. Figure 11-2-2 schematically shows the relation between the travel distance along the road and the split of cargo transportation for road transportation. The difference in transportation costs resulting from the replacement of transportation means was counted as a benefit.

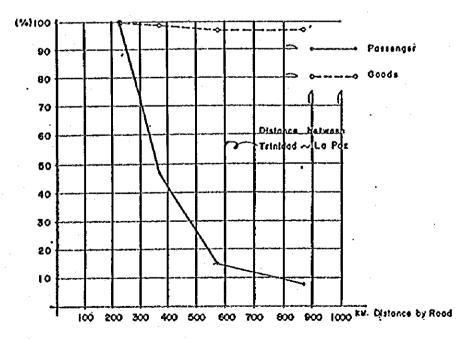


Figure 11-2-2 Share of Land Transport from/to La Paz

In the case of beef, "Análisis del Proceso de Comercialización de la Carne Bovina del Departamento del Beni con la Ciudad de La Paz" reports that the Provinces of Ballivian, Yacuma and Moxos in the Beni Department supply beef continuously to La Paz at a certain level.

This analysis estimates that 99,914 heads of cattle, which is equivalent to 14,142 tons of beef, were brought to the market of La Paz in 1992. In this report, the proportion of beef consumption supplied to La Paz by the Beni Department was also estimated as 69.5% of the total beef consumption of La Paz in 1992, while the past average rate was estimated as 65%. The influenced area of this road was estimated to be 34.5% in Phase 1 of the Study (1987); therefore, about 22% of the consumption of beef in La Paz is expected to be transported along the project road. Taking those figures into account, the beef volume transported from the influenced area to La Paz from 2001 to 2020 is estimated according to the estimated population growth rate in La Paz.

In the case of wheat, the volume of wheat to be transported to Trinidad was estimated based on the projection shown in the Phase I study report (1987) and the estimated population growth rate in Trinidad. The volume of beef and wheat to be transported between La Paz and Trinidad is estimated to be as shown in Tables 11-2-16 and 11-2-17.

		(Unit : tons)
Year	Population Growth Rate in La Paz Every 5 Years (%)	Estimated Volume of Beef to Be Transported to La Paz from the Influenced Area in Beni
2000	19.66	12,207
2005	18.10	14,416
2010	16.40	16,781
2015	15.41	19,366
2020	13.84	22,046

Table 11-2-16 Estimated Volume of Beef Transported to La Paz

Table 11-2-17	Estimated	Volume of	Wheat'	Trans	ported to	Trinidad

Үеаг	Population Growth Rate in La Paz Every 5 Years (%)	Estimated Volume of Wheat to Be Transporte to Trinidad from La Paz
2000	21.57	10,361
2005	19.86	12,418
2010	17.99	14,653
2015	16.90	17,129
2020	15.19	19,731

(2) Calculation Method of the Transportation Cost Saving-

Be = $TC_w - TC_{wo}$ $TC_w = (TV_b + TV_w) \times 1/D \times AC \times AT$

 $TC_{wo} = TV_b \times 0.97 \times 1/E \times VOC[I] \times F \times RD + TV_w \times 0.97 \times 1/G \times VOC[I] \times RD + (TV_b \times TV_w) \times 0.03 \times 1/D \times AC \times AT$

- where;
 - Be : Transportation cost Benefits
 - TC_w : Transportation costs in "with project" cases
 - Tcwo :: Transportation costs in "without project" cases
 - TV_b : Volume of transported beef
 - TV_w : Volume of transported wheat
 - D : Average freight of airplanes (Refer to Table 11-2-18)
 - AC : Unit cost of air transportation
 Unit cost of air transportation was obtained from the National Department of Roads in Trinidad, as shown in Table 11-2-19.
 - AT : Flight time required (3 hours)
 - E : Average load of a refrigerator car

After the completion of the project road, beef will be transported by land and refrigerated trucks will be needed. The results of on-site interviews with drivers of refrigerated trucks show that each vehicle can be expected to carry 10 tons.

VOC[1]: VOC unit

F

G

Of the VOC by vehicle type shown in Table 11-2-3, the VOC of large vehicles is applied to refrigerated trucks.

- : Conversion factor to determine the VOC of a refrigerated truck The VOC of a refrigerated truck is expected to be more expensive than that of an ordinary truck. Based on the results of interviews with executives of a private manufacture company of refrigerated trucks, the following conversion factors were chosen:
 - Refrigerated truck loaded with 10 ton of beef: 1.4
- RD : Transportation distance between La Paz and Trinidad (595 km.)
 - : Average live load of cargo vehicles

1.8 ton/vehicle and 4.5 ton/vehicle were adopted as the average live load for wheat and beef, respectively, based on the results of the site investigation.

 Table 11-2-18
 Average Load Transported by Airplane

Road Section	Product	Amount
La Paz - Trinidad	Wheat	1.8 ton/plane
Trinidad • La Paz	Beef	4.5 ton/plane

Source : These figures were obtained by site survey

		A D D D D
Road Section	Product	Value
La Paz - Trinidad	Wheat	US\$ 214.0
Trinidad - La Paz	Beef	US\$ 128.0
10000 - La raz	Contraction of the local division of the loc	Contractive

Таћја 11.2.19	Unit Cost of Air Transportation
Table 11-2-19	OUR COST OF VIT TTURPORT

Source : These figures were obtained from SNC in Trinidad

(3) Results of the Calculation of Transportation Cost Saving Benefits

The results of the transportation cost saving benefits calculation using the above-mentioned transportation modes are summarized in Table 11-2-20.

Year	Beef	Wheat	Total Saving
2001	1,344	1,404	2,748
2005	1,557	1,608	3,165
2010	1.841	1,877	3,718
2015	2.157	2.169	4,326
2013	2.491	2,475	4,966

Table 11-2-20 Transportation Cost Saving Benefits (Univ Thousands of USS)

11.2.7 Benefit of Income Generated by Development

(1) Basic Concept

After the completion of road improvement, access from Trinidad and San Ignacio to La Paz will be greatly improved and the volume of agricultural and forestal products such as rice, banana, yucca, wood, etc. transported into La Paz, the largest center of consumption in Bolivia, will increase. The volume of other agricultural products in Beni Department, such as cacao, fish and sugar cane are also expected to increase; however, they are not dealt with in this analysis because of a lack of detailed data or information.

(2) Estimation Method for the Calculation of Income Generated by Development

 $Be = K \times P \times X_j$

- Be : Benefits generated by development, representing producer's income resulting from a price increase in agricultural products.
- K : Volume of products transported to La Paz from the area affected by the project, as summarized in Table 11-2-21. This volume was estimated based on an analysis conducted in phase 1(1987) regarding the volume of banana, rice and yucca transported to La Paz from Trinidad. The volume was estimated according to the increase in population in La Paz, which is the main destination of products.

- P : Price of each product.
- Xj : Percentage of profits relative to consumer prices. The percentages adopted for banana, rice and yucca were 66%, 50% and 66%, respectively, based on the results of interviews in La Paz.

	· · · · · · · · · · · · · · · · · · ·		(Unit : tons/yea		
Year	Rice	Banana	Yucca		
2001	4,802	13,606	14,807		
2005	5,473	15,508	16,876		
2010	6,371	18,051	19,644		
2015	7,353	20,833	22,671		
2020	8,370	23,716	25,809		

Table 11-2-21 Volume of Products Transported to La Paz

(3) Results of Development Benefits

Table 11-2-22 shows the results of the estimated development benefits.

Үеаг	Agricultural Development Benefits
2001	784
2005	926
2010	1,048
2015	1,211
2020	1,382

Table 11-2-22 Results of Development Benefits (Unit: Thousands of US\$)

11.2.8 Ferry Cost Saving Benefits

Six main rivers (Maniqui, Cuberene, Apere, Tijamuchi, Mamoré and Ibare) and other small rivers cross the project road. At present, ferry transportation services are provided at the crossing points over four main rivers and over Los Puentes. After the completion of the project, all ferry services except the one for the Mamoré River will be closed. Road users will not have to pay a tariff in the "with project" case, except to cross the Mamoré River. This saving on ferry transportation costs is considered one of the benefits of the project. The tariff for each river's ferry transportation service is shown in Table 11-2-23. The estimated benefits of ferry transportation cost saving are shown in Table 11-2-24.

							(Unit :	Bs.)
Case	Type of Vehicle	Maniqui*	Cuberene	Apere	Tijamuchi	Los Puentes	Mamoré	lbare*
	Passenger car	5	5	5	5	10	25	. 5
Without	Wagon	7.5	7.5	7.5	10	20	25	7.5
project	Bus, truck	20	20	18	20	30	80	20
	Trailer	25	25	25	30	40	80	25
With	Small	0	0	0	0	0	20	0
project	Medium	0	0	0	0	0	20	0
	Large	0	0	0	0	0	80	0

Table 11-2-23 Ferry Transportation Service Tariffs

Note :* The bridges over the Maniqui and Ibare Rivers will be completed in 1995. For this evaluation, their tariffs were established on the same level as other places.

Source : The figures shown above were obtained through interviews at each ferry point.

					(Unit: Thousands of US\$)		
Year	Maniqui	Cuberene	Apere	Tijamuchi	Los Puentes	Mamoré	Ibare
2001	51	51	51	56	56	0	373
2005	69	69	69	75	75	0	503
2010	99	99	99	107	107	0	718
2015	131	131	131	141	141	0	946
2020	176	176	176	191	191	0	1,282

 Table 11-2-24
 Ferry Transportation Cost Saving Benefits

11.2.9 Maintenance Cost Saving

Gravel road maintenance costs are lower than maintenance costs for earth roads. However, extra maintenance costs will be incurred for inundated sections, where a few maintenance works have been carried out up to this time, during the rainy season. Therefore, in this Study, the difference in maintenance cost between mud roads and gravel roads is not counted as a benefit. However, for the section from Puerto Varador to Trinidad, which will be paved with asphalt, maintenance cost saving can be taken into account. Maintenance cost saving of the Puerto Varador-Trinidad section was estimated according to figures obtained during the Feasibility Study of the Pavement Project of the Access Road from Trinidad to Puerto Varador ("Proyecto de Pavimentación de la Vía de Acceso de Trinidad al Puerto Varador") carried out by CORDEBENI in 1993. Annual maintenance cost saving is converted using consumer price increase rates, which are shown in Table 11-2-25.

Table 11-2-25 Annual Maintenance Cost Saving

			(Unit: Thousands of USS)
Year	With Project Case	Without Project Case	Maintenance Cost Saving
1994~2013	76,620	275,036	198,416
1995~2020			215,331

Economic project costs for the economic evaluation were calculated by deducting taxes from the project costs estimated in Section 11.1. For the evaluation, the construction costs of seven bridges, which have been already completed or will be completed by IDB or USAID, were included as project costs. Annual economic costs during the construction period are shown in Table 11-2-26.

	Financial		Economical Costs	
Year	Costs	Economical Costs	Construction Costs of 7 Bridges	Total
1997	10,696	8,350	5,436	13,786
1998	17,555	13,672	-	13,672
1999	18,535	14,439	-	14,439
2000	11,277	8,832	-	8,832

Table 11-2-26 Economical Costs

11.2.11 Economic Evaluation Results

The evaluation results by evaluation indicator are as follows:

- IRR : 22.32 %
- NPV : US\$53,018,334.-
- B/C : 2.35

The above-mentioned evaluation results indicate that the project is feasible.

11.2.12 Sensibility Analysis

A sensibility analysis was conducted for the fluctuation of total costs, from 10% to 30%, and total benefit, from -10% to -30%. The results of this analysis are shown in Table 11-2-27.

Furthermore, in the worst case of a 30% cost increase and a 30% benefit reduction, IRR remains 14.51%, which means that the project is still feasible enough to execute. This means that the project is still feasible, given the 12 % IDB interest rate.

Table 11-2-27 Sensibility Analysis Results

(IRR)

		(166)		(Unit:%)
Cost		Ber	iefit	
	0%	-10%	-20%	-30%
0%	22.32	20.84	19.27	17.58
10%	20.98	19.57	18.05	16.43
20%	19.81	18.44	16.99	15.41
30%	18.76	17.44	16.03	14.51

.....

Cost		Benefit					
	0%	-10%	-20%	-30%			
0%	53,018	43,792	34,567	25,341			
10%	49,094	39,868	30,642	21,417			
20%	45,170	35,944	26,718	17,492			
30%	41,246	32,020	22,794	13,568			

11.2.13 Summarized Benefits and Costs

The summarized benefits and costs of this project are shown in Table 11-2-28.

Momitoring Costs, etc. 					Danafite				Crete	-	Cash Flow
Saving Cost Saving Development Transportation Cost Saving	Year	Ľ	Travel Time	Transportation	Agricultural	Ferry	Maintenance	Total of Benefits	Construction		COLONE & SOL
· ·		•	Saving	Cost Saving	Development	Transportation Cost Saving	Cost Saving		Costs	Costs, etc.	
····································	1997		•	•		,		1	13.785.120	•	-13,785,120
	1998				-				13.671.840		-13.671.840
<td>1999</td> <td>+</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>*****</td> <td>14,438,580</td> <td>•</td> <td>-14,438,580</td>	1999	+						*****	14,438,580	•	-14,438,580
7.136,205 67:655 2.748,006 784,274 6.83,915 215,331 11,590,391 - 64,600 7.792,827 77,914 2385,137 81,2665 694,203 215,331 11,240,396 - 266,00 8.775,827 77,914 3.85,313 3.266,734 869,466 793,531 12,400,367 - 14,600 9.116,978 88,313 3.266,734 869,466 753,311 15,003,617 - 14,600 9.116,978 88,313 3.266,734 869,466 215,331 15,003,617 - 14,600 9.116,978 88,0164 11,8070 3,493,551 126,023 - 44,600 11,357,11 11,3570 11,357,91 11,3531 12,503,600 - - 44,600 11,357,238 113,6713 11,357,91 11,35014 215,331 21,566,799 - - 44,600 11,357,138 15,5134 15,5311 21,566,799 - - 44,600 15,113,461 <	2000						****		8.831.940	1	-8.831,940
7/792.827 77.905 2.852.187 811.066 664.203 215.331 12.440.288 26.600 8.455.324 78.494 2.955.366 841.056 749,490 215.331 13.296.000 24.600 9.716.339 86.3334 3.164.722 887.837 860.064 215.331 13.5005.617 - 76.600 9.716.339 86.3334 3.366.964 215.331 15.600.214 - 14.600 11.207.829 86.339 3.366.964 1.107.369 1.13.061.13 - 6.600 15.007.829 106.411 3.530.064 1.107.369 1.107.369 1.13.600.511 - 6.600 15.10614 3.350.596 1.107.369 1.107.369 1.130.614 215.331 23.605.309 - 6.600 15.1467.135 141.3369 1.130.614 215.331 23.66.8799 - 6.600 - 15.1467.135 141.3567 1.256.319 21.56.8799 - 6.600 - - 6.600 - 1	1002 2001	<u> </u>	67,655	2,748,009	784,274	638,915	215,331	11.590,391	•	64.600	11,525,791
R.455.2pt 78.494 2.966.366 841.056 749.400 215.331 13.296.060 - 94.600 9.116.905 833.914 3.060.544 860.447 215.331 14.150.917 - 9.6600 9.776.535 3.316.544 860.446 804.777 215.331 15.150.051 - 9.6600 10.4396.41 3.316.547 956.038 915.351 215.331 15.661.133 - 6.600 115.0450 3.935.547 956.038 10.077.369 1.307.108 215.331 25.6600 - 44.600 15.14501 113.870 3.495.566 1.077.369 1.307.122 215.331 25.665.069 - 14.600 15.14501 138070 3.495.566 1.077.369 1.307.122 215.331 25.665.050 - 14.600 15.14501 1380705 1.818.070 215.331 215.651.837 26.600 - 14.600 15.145151 113.571 1.375.122 215.331 215.651.887 - 14.600	2002	. _	73.075	2.852.187	812,665	694,203	215,331	12.440.288	•	26,600	12,413,688
9.116,905 88,914 3,060,544 866,440 315,331 14,150,971 - 56,600 9,776,329 8,8333 3,164,772 887,837 860,064 215,331 15,035,617 - 14,600 110,0428 106,411 3,312,830 956,603 933,706 215,331 17,661,133 - - 44,600 13,582,841 118,070 3,437,59 986,688 1,077,366 215,331 19,668,887 - - 44,600 13,582,841 118,070 3,437,59 1,860,133 21,5331 21,566,802 - - 44,600 15,143,015 13,043,85 1,860,133 1,807,126 1,11,357 1,385,476 215,331 21,566,802 - - - 46,600 - - 44,600 - - - 46,600 - - - 46,600 - - 46,600 - - - 46,600 - - - 46,600 - - -	2003		78,494	2,956,366	841,056	749,490	215,331	13.296.060	•	34,600	13,261,460
9776,379 89333 3164,772 897,857 860,064 215,331 15,003,617 - 14,600 10,439,641 94,733 3,268,000 266,233 915,531 15,860,204 - 14,600 11,2323,013 13,933,128 3,938,128 956,683 10,7369 11,506,113 - - 6,600 15,148,015 139,728 3,605,946 10,17,369 11,506,113 21,265,802 - - 6,600 15,148,015 139,728 3,605,946 10,17,369 1,107,369 11,307,133 21,331 21,266,802 - - 6,600 16,711,551 141,386 1,077,369 1,1304,123 1,353,311 21,566,802 - - 4,600 16,711,551 141,386 1,407,369 1,111,357 1,385,476 215,331 23,568,003 - - 4,600 16,671,551 144,386 1,144,582 1,385,476 215,331 23,568,003 - - 4,600 11,228,64,60 11,34	2004	. 	83,914	3,060,544	869,446	804,777	215.331	14,150,917	•	56,600	14,094,317
10.439.441 94.753 3.268.900 926.228 915.351 15.860.204 - 6.600 12.007.829 106.411 3.381.248 956.608 993.706 215.331 15.860.204 - 6.600 13.582.841 138.015 108.641 3.381.248 956.608 993.706 215.331 19.648137 - 6.600 15.15.82.841 138.0543 1.017.369 1.017.369 1.017.369 1.017.369 1.661.133 - 6.600 15.14.8015 1235.055 1.413.867 1.017.369 1.017.369 1.35.331 23.658.097 - 14.660 15.14.81 143.8256 1.017.369 1.35.476 215.331 23.658.097 - 14.660 18.295.306 155.065 1.43.807 1.385.476 1.111.357 1.385.476 215.331 23.667.09 - 6.600 21.456.802 166.703 215.331 23.667.993 - 14.600 - 6.600 - 6.600 - 6.600 - - </td <td>2005</td> <td></td> <td>89,333</td> <td>3,164,722</td> <td>897.837</td> <td>860,064</td> <td>215,331</td> <td>15,003,617</td> <td>•</td> <td>14,600</td> <td>14,989,017</td>	2005		89,333	3,164,722	897.837	860,064	215,331	15,003,617	•	14,600	14,989,017
12.007.829 106.411 3.381,248 956.008 993,706 215.331 17.661.133 - 44.600 13.582.841 118.070 3.493,507 986.988 1.077.060 215.331 17.661.133 - 44.600 15.582.841 118.070 3.493,507 986.988 1.077.060 215.331 21.368.87 - 14.600 16.711.551 1.13.70 1.237.739 1.217.831 230.56.96 1.11.557 1.46.00 - 44.600 18.575.50 16.47.03 3.954.360 1.111.557 1.307.122 215.331 23.056.93 - 44.600 18.586.765 164.703 3.954.360 1.111.557 1.367.132 215.331 23.056.93 - 44.600 21.656.705 164.703 3.954.360 1.114.585 1.463.830 - 44.600 21.456.805 153.045 215.331 30.310.619 - 44.600 21.426.805 21.133.152 1.267.138 215.331 37.377.248 - 44.600	2006		94,753	3,268,900	926,228	915,351	215,331	15.860.204		6,600	15,853,604
13.582.841 118.070 3.403.597 986.988 1.072.060 215.331 19.468.87 - 6.600 15.143.015 129.728 3.605.946 1.077.369 1.150.414 215.331 21.266.802 - 14.600 16.711.551 141.336 3.718.295 1.0047.749 1.255.718 215.331 21.266.802 - 14.600 16.711.551 141.336 3.718.295 1.0047.749 1.255.718 215.331 21.266.802 - 14.600 18.295.306 155.045 118.020 4.201.795 1.111.357 1.385.476 215.331 23.568.806 - 44.600 21.5265.806 199.678 4.201.795 1.117.813 1.542.184 215.331 30.310,619 - 36.600 22.3856.806 199.678 4.3255.12 1.117.813 1.542.184 215.331 30.310,619 - 14.600 22.3856.806 199.678 4.3255.12 1.211.641 1.620.338 215.331 37.3778 - 14.600 23.33.02	2007		106,411	3,381,248	956,608	993.706	215,331	17.661,133	•	44.600	17,616,533
15,148,015 129,728 3.605,946 1.017,369 1.150,414 215,331 21,266,802 - 144,600 16,711,551 141,386 3,718,295 1.047,749 1.255,768 215,331 23,065,000 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 36,600 - 44,600 - 44,600 - - 44,600 - - 14,600 - - 44,600 - - 44,600 - - - 44,600 - - - 44,600 -	2008	<u> </u>	118.070	3,493,597	986.988	1,072,050	215.331	19,468,887	•	6,600	19,462,287
16/711.551 141.386 3.718.295 1.047.749 1.225.768 215.331 23.063.080 - 36.600 18.205.309 153.045 3.830.643 1.078.129 1.307.122 215.331 24.879.579 - 146.00 18.205.309 153.045 3.830.643 1.078.129 1.307.122 215.331 24.879.579 - 66.00 21.456.500 176.361 4.078.078 1.117.813 1.367.122 215.331 26.87993 - 66.000 21.456.500 176.361 4.078.078 1.177.813 1.542.184 215.331 30.310.619 - 66.000 21.456.500 195.676 1.936.773 1.227.231 30.310.619 - 14.600 22.985.476 188.0200 4.409.229 1.278.109 1.542.134 215.331 30.347.734 - 14.600 22.123.6611 22.206.109 1.547.732 1.660.0333 215.331 40.766.504 - 66.000 23.200.511 23.205.611 1.247.535 21.5331 <td< td=""><td>2009</td><td></td><td>129,728</td><td>3.605.946</td><td>1,017,369</td><td>1.150.414</td><td>215,331</td><td>21.266.802</td><td>•</td><td>14,600</td><td>21,252,202</td></td<>	2009		129,728	3.605.946	1,017,369	1.150.414	215,331	21.266.802	•	14,600	21,252,202
18.295.309 153.045 3.830.643 1.078.129 1.307,122 215.331 2.4.879.579 - 14.600 19.856.765 164.703 3.954.360 1.111.357 1.385.476 215.331 26.687.993 - 6.600 - 21.426.620 176.361 4.078.078 1.111.357 1.385.476 215.331 25.687.993 - 6.600 - 21.426.620 176.361 4.078.078 1.117.613 1.542.184 215.331 23.504.805 - 44.600 - 6.600 - 6.600 - 6.600 - 6.600 - - 44.600 - - 44.600 - - 6.600 - - 6.600 - - - 44.600 - - 6.600 - <	2010		141.386	3.718.295	1,047.749	1.228.768		23.063.080	•	36.600	23,026,480
19,856,765 164,703 3.954,360 1.111.357 1.385,476 215,331 26,687,993 - 6.600 21,426,620 176,361 4,078,078 1.144,585 1,463,830 215,331 28,504,805 - 44,600 22,985,476 188,020 4,201,795 1,177,813 1,542,184 215,331 30,310,619 - 6,600 22,985,476 188,020 4,201,795 1,177,813 1,542,184 215,331 30,310,619 - 44,600 24,6680 199,678 4,325,512 1,211,041 1,620,538 215,331 33,947,734 - 14,600 25,123,671 25,123,671 1,373,572 1,344,502 1,345,671 215,331 37,357,278 - 36,600 32,330,228 254,618 4,707,504 1,313,152 1,945,671 215,331 37,357,278 - 6,600 32,330,228 23,330,228 2,165,504 - 14,600 - 6,600 32,330,228 2,353,2728 4,0,766,504 -	2011		153.045	3,830,643	1.078.129	1.307,122	215,331	24.879.579	•	14.600	24.864.979
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	2012	 	164,703	3,954,360	1.111.357	1,385.476	215,331	26.687,993	1	6.600	26,681,393
22.985,476 188,020 4,201,795 1,177,813 1,542,184 215,331 30,310,619 - 6,600 6,600 24,566,806 199,678 4,325,512 1,211,041 1,620,538 215,331 32,138,907 - 14,600 24,566,806 199,678 4,325,512 1,211,041 1,620,538 215,331 32,138,907 - 14,600 26,128,676 211,336 4,449,229 1,211,041 1,620,538 215,331 37,377,738 - 14,600 29,229,611 233,0228 233,0228 215,331 37,377,778 - 14,600 - 6,600 313,30,228 254,618 4,707,504 1,313,152 1,945,671 215,331 37,377,78 - 6,600 - - 44,600 - - 44,600 - - 6,600 - - 6,600 - - 44,600 - - 44,600 - - 44,600 - - 44,600 - - 44,600 - - 44,600 - - 44,6600 - -	2013	l	176.361	4.078.078	1,144,585	1,463,830	215,331	28,504,805	,	44.600	28,460.205
24.566.806 199,678 4.325,512 1,211,041 1,620,538 215,331 32,138,907 - 14,600 26,128,676 211,336 4,449,229 1,244,269 1,698,892 215,331 33,947,734 - 36,600 26,128,676 211,336 4,449,229 1,244,269 1,698,892 215,331 37,397,734 - 14,600 29,229,611 232,977 4,578,367 1,2178,710 1,822,282 215,331 37,397,738 - 14,600 313,302,258 254,618 4,707,504 1,313,152 1,945,671 215,331 37,357,278 - 6,600 35,441,654 276,259 4,836,641 1,382,034 2,155,331 40,766,504 - 6,600 35,441,654 276,259 4,836,641 1,382,034 2,154,500 215,331 41,186,539 - 6,600 5	2014		188,020	4,201,795	1.177.813	1,542,184	215,331	30,310,619	•	6.600	30,304,015
26,123,676 211,336 4,449,229 1,244,269 1,698,892 215,331 33,947,734 - 36,600 29,229,611 232,977 4,578,367 1,278,710 1,822,282 215,331 37,357,278 - 14,600 29,330,228 254,618 4,707,504 1,313,152 1,945,671 215,331 40,766,504 - 6,600 32,330,228 254,618 4,707,504 1,313,152 1,945,671 215,331 40,766,504 - 6,600 35,441,654 276,259 4,836,641 1,347,593 2,069,060 215,331 41,186,539 - 6,600 38,542,271 297,900 4,965,778 1,382,034 2,192,450 215,331 47,595,765 - 6,600 38,542,271 297,900 4,965,778 1,382,034 2,192,450 215,331 47,595,765 50,177,100 502,000 502,000 378,970,882 3,137,717 76,177,722 21,428,903 26,155,252 4,306,625 510,177,100 50,727,480 502,000 108,700 378,970,882 3,137,717 76,177,722 21,428,903	2015		199,678	4,325,512	1,211,041	1,620,538	215,331	32,138,907	•	14,600	32.124.307
29.229,611 232,977 4,578,367 1,278,710 1,822,282 215,331 37,357,278 - 14,600 32.330,228 2254,618 4,707,504 1,313,152 1,945,671 215,331 40,766,504 - 6,600 32.330,228 2254,618 4,707,504 1,313,152 1,945,671 215,331 40,766,504 - 6,600 35,441,654 276,259 4,836,641 1,313,152 1,313,152 1,347,595 - 6,600 38,542,271 297,900 4,965,778 1,382,034 2,192,450 215,331 47,595,765 - 6,600 - 378,970,882 3,137,717 76,177,722 21,428,903 26,155,252 4,306,625 510,177,100 50,727,480 502,000 - NPV 378,970,882 3,137,717 76,177,722 21,428,903 26,155,252 4,306,625 510,177,100 50,727,480 502,000 - NPV 378,970,882 3,137,717 76,1177,722 21,428,903 26,155,252 4,306,625 510,177,100 50,727,480 502,000 - NPV NPV NPV	2016		211,336	4,449,229	1,244,269	1,698,892	215,331	33,947,734	ŀ	36.600	33.911.134
32.330.228 254.618 4.707.504 1.313.152 1.945.671 215.331 40.766.504 - 6.600 35.441.654 276.259 4.836.641 1.347.593 2.069.060 215.331 44.186.539 - 6.600 35.441.654 297.900 4.965.778 1.347.593 2.192.450 215.331 47.595.765 - 6.600 38.542.271 297.900 4.965.778 1.382.034 2.192.450 215.331 47.595.765 - 6.600 378.970.882 3.137.717 76.177.722 21,428.903 26.155.252 4.306.625 510.177.100 50.727.480 502.000 1 788.970.882 3.137.717 76.177.722 21,428.903 26.155.252 4.306.625 510.177.100 50.727.480 502.000 1 788.970.882 3.137.717 76.177.722 21,428.903 26.155.2522 4.306.625 510.177.100 50.727.480 502.000 1 788.60000 10.177.100 50.177.100 50.127.1480 502.000 1 1 1 1 1 1 1 1 1 1	2017		232.977	4.578,367	1.278.710	1.822,282	215,331	37,357,278	•	14,600	37,342,678
35,411,654 276,259 4,836,641 1,347,593 2,069,060 215,331 44,186,539 - 44,600 38,542,271 297,900 4,965,778 1,382,034 2,192,450 215,331 47,595,765 - 6,600 378,970,882 3,137,717 76,177,722 21,428,903 26,155,252 4,306,625 510,177,100 50,727,480 502,000 1 NPV 1 76,177,722 21,428,903 26,155,252 4,306,625 510,177,100 50,727,480 502,000 1 NPV 1 76,177,722 21,428,903 26,155,252 4,306,625 510,177,100 50,727,480 502,000 1	2018		254,618	4.707.504	1.313,152	1,945,671	215,331	40,766,504	•	6,600	40,759,904
38.542.271 297.900 4.965.778 1.382.034 2.192.450 215.331 47.595.765 - 6.600 378.970.882 3.137.717 76.177.722 21.428.903 26.155.252 4.306.625 510.177.100 50.727.480 502.000 IRR NPV 1 10.177.100 50.727.480 502.000 1 0.117.117 76.177.722 21.428.903 26.155.252 4.306.625 510.177.100 50.727.480 502.000 1.11 NPV 1 1 1 1 1 1 1 1.11 NPV 1	2019		276,259	4,836,641	1.347,593	2,069,060	215,331	44,186,539	•	44,600	44,141,935
378.970.882 3.137.717 76.177.722 21.428.903 26.155.252 4.306.625 510.177.100 50.727.480 502.000 IRR NPV Observed Discount Rate	2020		297,900	4,965,778	1.382.034	2,192,450	215,331	47,595,765	•	6,600	47,589,165
IRR NPV Discount Rate	Tota		3,137,717	76,177.722	21,428,903	26.155,252	4,306,625	510.177.100	50.727.480	502.000	509.675.10
		Į								IRR	22.32%
										VPV	53,018,334
										Therease Date	1202

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CHAPTER 12

CONCLUSION AND RECOMMENDATION

CHAPTER 12 CONCLUSION AND RECOMMENDATION

12.1 Conclusion

The road between San Borja and Trinidad is an important section of National Road No3. connecting a major center of production with Bolivia's capital, La Paz, the country's major center of consumption. In the rainy season, 50 km of the road near Trinidad becomes flooded and impassable, while in other sections vehicles cannot pass easily because of the bad conditions of the road surface. Therefore, improving the road will not only develop the Beni Department's farming and livestock industries, but will also facilitate the transport of products, thereby increasing the population and promoting the development of this area.

This project will be financed by international organizations like IDB, which require that an environmental assessment be conducted before releasing funds for any project. This study was undertaken to meet this requirement.

If improvement of this road is realized according to the design in "The Study of Road Improvement Between San Borja and Trinidad (Phase II)" and adequate assistance is provided by the relevant governmental organizations, it will be possible to make this road passable all year, and thereby provide direct and indirect economical benefits. At the same time, the likelihood of adversely affecting the environment will be minimized. Of course, after completion of the road improvement work, it will be necessary to monitor potential problems such as illegal cutting of woods, indiscriminate hunting of wild animals, and conflicts between natives and owners of stock farms or new settlers.

This study considered the positive and negative impacts of road improvement on the environment assuming completion of the road according to its design.

Our conclusion was that road improvement would be possible only if the design were altered somewhat, certain countermeasures were implemented, and impacts were monitored after completion of the work.

12.2 Results of Consideration of Environmental Aspects

During the environmental impact study, real conditions during both the dry season and the rainy season were considered. In addition, a wide range of effects were considered, including those on the natural environment, those on the economic activities of communities, and those on ruins near the road. As explained above, some negative effects of road improvement can be foreseen, but this study concluded that they would not be too serious. Nevertheless, because of the importance of the flora, fauna and forests of this area, in particular to the native people living here, we proposed some measures to monitor and protect the environment. By minimizing the negative aspects, such measure would highlight the positive effects of improving this road, a project which would greatly promote the development of Bolivia as a whole.

12.3 Results of Consideration of Economic Aspects

The results of our study of the economic impact of the project indicate that it will be necessary to install eco-roads and road signs to promote environmental protection, to hire monitors to prevent the illegal cutting of woods, and to measure air quality and noise levels on a regular basis. Moreover, our study considered the feasibility of the project, taking into consideration project costs including the costs of the above-mentioned measures and comparing these to the benefits to be derived by road improvement. The results indicated that the road improvement project was feasible after applying IRR, B/C, and NPV analysis methods..

12.4 Recommendations

To limit the negative aspects of improvement, the above recommendations are indispensable.

(1) Protection of Fauna and Flora

Cutting trees near the road (100 m from the center of the road on each side) as per the plan will adversely affect vegetation in the area. In particular, if the forests of the EBB where wide variety of flora and fauna live, the Yacuma National Park, and in the protected area of Chimanes are cut, the negative environmental impact will be great indeed. Therefore, to protect the flora and fauna, the original plan should be changed to minimize the number of trees to be cut during the work, and to prevent any cutting in the area between the Maniqui and Apere Rivers.

To decrease the number of traffic accidents involving for animals, tunnels that will permit animals to cross safely must be constructed, and road signs that will warn drivers of crossing animals must be posted. In addition, artificial ponds formed by sideborrows will have to be preserved as habitats for fish and aquatic fowl.

Finally, after the project is completed, monitoring of the entire area will be required.

(2) Prevention of Illegal Deforestation and Poaching

Illegal deforestation and poaching will likely be promoted by road improvement. Therefore, the Ministry of Sustainable Development and Environment will have to implement concrete measures to prevent such activities. Such measures may include establishing a local office in Beni Department or the Public Corporation of Forests, and hiring guards to patrol the area. This responsibility should not be passed on to local entities.

(3) Prevention of Conflicts Between Inhabitants about Land Ownership

It is expected that conflicts between inhabitants with respect to land ownership will increase, especially with the arrival of new settlers. To prevent such conflicts, it will be necessary to force local residents, especially the natives in the area, to register their ownership with the relevant organizations.

(4) Increase of Land Prices

Another possible indirect impact of the project is an increase in land prices. To prevent this, the relevant authorities will have to pass special capital gains tax regulations.

(5) Environmental Protection Near Urban Areas

and the state of the

Although serious problems are not foreseen, the use of machinery and dump trucks during the work will have to be strictly controlled to prevent air pollution and noise, and gasoline and oils will have to be carefully controlled to prevent water pollution.

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In addition, signs will have to be posted to prevent traffic accident on the road, the roads near communities will have to be filled to make then level with the main road, and a periodic sprinkling will have to be done to prevent excessive dust in the air in urban centers, especially during the dry season.

After the work is completed, air quality and noise will have to be monitored (at least once every two years) in urban centers such as San Borja, San Ignacio, and Trinidad.

(6) Conservation of Ruins and Cultural Properties

During the construction period, periodic inspections should be conducted by experts to prevent the destruction of ruins by side borrows work.

(7) Others

Once the most suitable species of plant for sodding the slopes is selected, it should be as work on the road progresses. Culvert inlets and outlets should be protected by concrete to prevent soil erosion.

Additionally, after the completion of the road improvement work, periodic inspections of slopes (erosion, possibility of breakage, etc.,) and drains should be conducted twice a year, once in the rainy season and once in the dry season). If any part collapses, repair work must be done immediately.

An improved road will be beneficial for a number of reasons. To realize the full benefits of this project, the following plans should be done by the relevant organizations: (1) Improvement of medical facilities

A new hospital should be constructed in San Ignacio and a sufficient number of doctors and nurse should be hired.

(2) Improvement of educational facilities and availability of teachers

Educational facilities should be improved and a sufficient number of teachers should be hired.

- (3) Promotion of regional industry
 - Promotion of timber industry

To prevent illegal deforestation, the timber manufacturing industry should be supported and carefully monitored.

• Utilization of tourism resources

To attract tourists to the Beni Biological Station, Yacuma Regional Park, etc., low interest toans and special tax privileges should be granted to restaurants and hotels along the project road.

(4) Periodic investigations for the conservation of ruins

To prevent the destruction of ruins by the construction of private roads and houses, the movement of animals, and cultivation, as well as to discover new ruins, periodic investigations should be conducted by the relevant agencies.

Summary of environmental assessment in this study is shown in Table 12-4-1.

Table 12-4-1 Summary of Environmenta Assessment (1)

			· · · ·				
	Assignant	\$	1	I	S K N A C	SENAC	B
vg Plan	ğ	<u> </u>	1	\$	009 13	89 X	1
Monitoring Plan	Plan	•	1	1	To movidor impacts to the foor along the road, invides of species and utableon of growing of foor. The shudy should be realized two time in day and miny season (a time per shout 3years)	To monutor impusite to the wild animula, intradies of appenda- along the read stach as hong the read stach as marmada, tropolita- burds. The stach about be realized two turne in dry and realized two turne or dry and trainy season (a turne per about 3 years)	I
	Awigning	ı	1		1	.1	I
	Cost	· · · · · ·	I	1	4	1	1
	neig	3	1	1	The woods should not cleave in the foress between human in the foress between human in and Apore threes between which the regard plan plan the woods within the regard plan plan the sould be changed, improvement should be changed.		
	Evaluation Results	The present conductors of lopography and geology is not changed much.	The clearang of woods has no possibility of a large- scale soil crosson.	The cleaning of woods has no possibility of a remarkable hydrological charge such as expansion of the flooded area.	If the woods along the project road is claswed according the Dasign the costing then will be remarkably influenced.	If the forests along the project road which play a unportant of dama are cherred, it will give a remarkable negetive impact to the fauna uthabits.	The clearing of woods is the negative impact allocarys an succellent landscarpe, normelaryly, it is necessary to avoid the clearing of woods.
	Conservation	Not to charge ternarkably the present topography and geology, and datasters failed to both topography and geology auch as large scale andsluke and stope oflapse.				<u> </u>	ş
	Forecasting	If the clarving area is implied within the right of way area, the clarving of woods, the clarving of woods,	Only the cleaving of woods in To prevent the soil eround the lamised area of the road and the soil flow out, and to such does not cause a large- conserve the present soil, scale soil erousin.	Only the cleaning of woods in Not to cause a remarkable the limited area of the road hydrological change of sides does not cause a large- rivers, underground water scale hydrological change. and flooded area.	The example forest zones Not to give a termarkuble store to project rook, arch as influence to the existing the formul of the EBR, the form, forest of Chimanos, gallary forest is, etc., are generally starved swithin the right of way starved from wide). The clearing area of forents is estimated in 579 ha.	The decrease of the forest area. Not to give a termutualite along the project round might influence to the habitist of accompanied by a faura. decrease of the origing faura. which has its habit horsted along the road.	If the forests along the noded To conserve an excellent project are cleaved with a landscape and not to give with of 100 m, according to lincongruiny sense to the the Design, the landscape will surroundings. trimmitably change:
STERIES BALLES	Factors	Clearing of Topography and geology woods	Sou	Hydrology	Por	Fature	Landsoupe
	Impact by	Wroods wroods					- -

 Table 12-4-1
 Summary of Environmenta Assessment (2)

SENAC	,	I	Monic- Tug About impacts to wird animula Minimula	ı
1	k.	1	Monito- ring about unpucta (o wild anumala	1
Regular inspectation and maintenances for motion and before and art for inner/year, before and art for inner teason) in all sections of the road.	I	ł	Monitoring about anpacts to wild avainats	I
	1	•	I	1
	1	I	1	ŀ
After the most suitable species of plant for the slope protection to sed is shuthed before the transf is antipprovement, it should be planted on the slope with the process of the improvement.	F	1	The pondu formed by the stde- berrow pitting should be left for habituts of wild animals in good condition.	1
Neither topography nor geology is remutably altered by the earth works in the second second and altered to the earth works altered and the second second the second second second and second second second altered second second a possibility to suffer a guily erosion.	The surface soil of the embackment and the soil at the lowerstream side of the cuivers may suffar a evelon.	the hydrology in the area may not change remarkaby. The maintenance of the culverts is necessary because the coverse with not function if driftwoods and others.	As the ponds formed by the side-borrow priting bocome useful habitals for the wild animula, they should be left in good conditions.	The formation of artificial poinds is a positive impact since they will, in the future, become harmonized with the aurourdings as well as the exaining poinds. We are they aboutd be left unprovement.
Not to charge remarkably the present topography and seconds, and to prevent animal duasters related to both topography and protocy auch a large-scale innduide and slope collapse.	To prevent the soil eroscon and the soil flow out, and to conserve the present soil.	Not to cause a remarkable hydrological claunge of invers, underground water and Doodod area.	Not to give a remarkable influence to the habitat of faum.	To conserve an excellent landscape and not to give an incongruity serve to the surroundings.
The addry variety and the Not to charge remetably embandment alope occupying the present topography and those part of the read aboves greekogy, and to prevent that the addry functor of a natural durater related to experiment at the property and minimum and the problem and super address related and alope collapse of the read are encled by reinfull.	The wise (bootled by the To prevent the soil erosion Tipamuch, Mamore and there and the soil flow out, and to sufficient more conserved amore the present soil sufficient more of cubrets to daulage the wale is installed under the road enhandment. Consequently, the soil may not there out.	The area flooded by the Nor to cause a remarkable figurated, Manner and Thare Nydrobood clauge of news may not expanded since inverts, undergound wire aufficient humber of culverts and flooded area. To drainage the waler is installed under the road embalment. Concequently, the existing hydrology may not change remarkably.	The road ambument will be Not to give a remarkable an obstack for the small influence to the habitat o project road to are the faure. road. The borrow gits will be very useful habitat for the wild attimut, especially in the dry attimut, especially in the dry of water supply.	Atthough most part of the To consurve an excellent project road will be embanded, landsarge and not to give an it is gravel road, incomputity sense to the gross inductions, the road read read spress inductions.
Earth work Topography and geology contracts enhankment etc.)	3	Hydroidegg	feus	Fundeente
Earth work 7 (suring, embanisment , etc.)	5			

Table 12-4-1 Summary of Environmenta Assessment (3)

•	1		· · · · · · · · · · · · · · · · · · ·	1	T
l	1			i .	SENAC
Ę	1	•	ł		I .
1	ł)	,	1	Regular unspection of sufficient function and maintenance of urregular parts of downyrytes (2 urregular parts of downyrytes (2 urregular parts)
1	1	•	,		•
1	1		I	1	
· 1	The drawed water containing suppended solids should be discharged through the borrow pits to the existing water courses, in this case, the borrow pit is used as wetternent ponda.	When uury "sary machines and durp track is ergines abuld not by faled for up prevention of au contanturation and notes.	Caachine, engone oil, etc., uaod by havy machuna and dump-thuids abould be managed not to abould be managed not to contantusie underground weier or inter water, during the road unprovement.	The Low-in and Dow-out of the culterts should be protected by conducts for the prevention of the seal crosson.	•
The dust statements by the earth works is facted during the dry season, so that proper countermeasure for provember of the scattering should be done during the cost unprovement	The earth works may increase the suspended solid in river water, so that proper countermeasure should be done during the road improvement.	forn heavy stage of a are 0.0 70m and 0026 ppm. the	Guadure, angine oil, etc., Gaaoiner, mgine oil, etc., u used by heavy machines. heavy machines and dump and dump-tracks may should be managed not to contamuuk underground contamuuk underground v avaiter of three water, duang the road proyer constrameaure improvement. took unprovement.	As the flood water is denined by numerous cuberts activities dening to estimation of under project road, the flood area will not be expanded more than the present conditions.	the hydrology in the area may not change remarkably. The remarkably. The remarkably. The remarkable of the chiverts is not sure that the defineoods and others.
5	Not to exceed the present white quality revels or the write quality standards by the Minusty of Urbarn Affair.	Not to exceed the present at. The forecast up, quality or the standards for the purpose of health. Investines at the protection in Naborual prond" 0.0014, Ambient Air Quality Standards of USA. Oppmd" 0.00141 leas than that 0.00 environmental s		· · · · · · · · · · · · · · · · · · ·	
By the such wards manyly of Not to stood the predit a probationer in ad ade-horrow quality or the standards for pricture. I de dut will be the purpose of health assittand from bare ground protection in National during the road improvement the day season. Standards of USA	An unreaso of the supervised Not to exceed the present soluds in the niver may be writer quality revels or the caused by the earth works. I writer quality standautus by Juko, it may be extraord by the the Minulety of Lithen Affair, account of the standardment above. If the slope protochion is not dome.	The conventurion of SOK ranges from 0,0001 ppm (0,00005 mg/m3) to 5,00073 (ppm (0,0006 mg/m3). The ppm (0,0006 ppm (0,00011 from 0,00031 ppm (0,00638 mg/m3).	Consoline, engine out, etc., Nor to exceed the present which are used by heary. Water quality rovels or the machines and dump thecks. Water quality standards by during the road improvement, the Masiatry of Urban Adfair univergent of dow into invert, and contaminate underground water or river water.	The soil crosses at the To prevent the soil crosses drumage factifies is thought to and the soil flow out, and to locard during the wet season, conserve the present and,	The area Booded by the Nor to cause a remarkable Trijamuch, Mannere and Thate hydrological change of Invers may not coparded ance. Invers, underground whet aufficient number of cubrats and Booded area, to datage the ware is usualed under the nord the ecuting hydrology may the ecuting hydrology may not change remarkably.
Alarmo av	Water quulity	Arithma Br	Water quality	to s	ltydrology
······································		Using heavy Ar quality Recharges and damp Duck	- 4	Drumaçe Geolites	

12-8

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	s S	To conserve an excellent Many culverts may give a landacape and not to give an lattle negative impact to the incongruity sense to the surroundings, so that	Many cubrets may give a little negative impact to the surroundings, so that						
	usually not accel, accounting contriguted stell proper for the culteria are not matched with the surroundings.	autourourga.	proper countermeasures are nectatary.	1	I	· · · ·	1	I	ı
Wser quality	The soil near the Dow-out and Nor to excend the present. The soil near the Dow-out Dow-an of out-rest may be water quality rends on the of out-rest may interess encoded and increase: water the Munitary of Urban ALL. There water, so that proper suspended sold in mer water, the Munitary of Urban ALL. There water, so that probe done during the road interested.	Not to exceed the present when quality standards by the Muniscy of Urban Affair		The Downs and Dow-out of the cultures should be proverted by contracts for the provention of the sold eroston.	1	•	1	I	1
	A volume of the wate repruding to the action of the road improvement is quite initied, so that no serious unpact may occur for flore.	Not to give a verturble undurnee to the existing Dore.	The volume of the weaks regarding to the read improvement and thrown a way from vehicles during the road use is not serious impact to flore.	I	1	1	- - - - - - -	- - I	I
5,Fearma	A volume of the wate regarding to the action of the road improvement is quite timited, so that no actions unpart may occur for faura.	Not to give a ramarkable influence to the habitat of faura.	With an increase of the traffic volume, animula such as deen and monkeys will have more chance to ear the waite thrown away from the valueds. In this case, the waite mover to the negative impact to the faura habisto.	1	1 .	1	. 1 	ł	4
Andreape	A volume of the waste To conterve an excellent regarding to the road landscape and not to giv umprovement is quirk limited, uncompany sense to the so that no serious change nery surroundings. cocur for the landscape.	To conserve an excellent landscape and not to give an uncongrapt sense to the surroundings.	An increase of the water thema away from vehicles is the negative unpact destroying an excellent destroying an excellent hardcape. But it may be not serious problem.	2	i	P)	1	
W ster quality	The wast of which was Not to exceed the preast exhausted by heavy machines water quality reveal or the and dump their during the water quality standards by read improvement, muy to holdingsty of Urban ALB permaste anto underground or dow uso neer, and dow uso neer, and water or neer water.	Not to exceed the present water quality revels or the water quality issued by the Münistry of Urbun Allar.	The wate out coll collwated by here, machines and dump-tracks may contamuate underground varia or inver water. Proper contremeneure about the done during the road intyrovernent.	The warte out echanical The wards out echanical by heavy by heavy muchures and muchures and dump-tracts should dump-tracts may be managed wit or orner water, and or ner water. Proper during the road improvement, constrementure abouid to done during the road	1	1	1	1	1

Table 12-4-1 Summary of Environmenta Assessment (4)

12-9

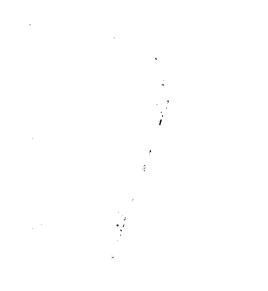
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Assessment (5)
of Environmenta
Summary (
Table 12-4-1

ŀ	1	1	SENAC	N N N N N N N N N N N N N N N N N N N
ş	ł	I	87 87 88 73 80	S
	1	1	Monutoring of air quality acound the cides(Itimo/2yeat), ingular meaurement of aire quality in 3 points such as San Boop, San Ignecio, Thindad,	Moutoning of noise around the ottoo(1 timo 2)veu), regular measurement of noise in 3 prints and as San Borja, San Ignaroo, Thinidad.
1	1	SENAC	SENAC	1
1	ł	Rowd aign \$3,000 Torusi for wild \$120,000		ł
The horing water discharged (The horing water discharged from the from the worker's carrup or worker's carrup or workshop abould workshop may 'locally' 'be properly drawed according to the workshop may 'locally' 'be properly drawed according to the the degree is not remarkshop to fue should be degree is not should be follow the SIS'AC standard.	The broker should not be premised by an incompatible color with the surroundings.	For avoidance of the theffic accident for animula, road ages abould be set up and ecches (runnel) should be up and ecches into of high embarkment more due 2 meters high.	For the prevention of the dust scattering around the town areas, suptail road or watering should be done.	1
The hyring water duscharged The hyring water duschargery or worker's camp or from the worker's camp or worker's camp or worker's camp or be properly drama contaminate throw water but SENAC standard. The degree is not the degree is not contaminate to the SENAC standard.	The artificial building such as a bridge may give a reguive unpact to the surroundings more or leas, surroundings more proceedings, some to the surroundings,	An increase of the traffic accidents for the animals gives a negative anywor to the fauna habitats.	The forceasting concentrations of NO2 and CO from vehicles for the years 2020 eero 0.00 1 princt 0.0025 ppm and 0.000 ppmCf 0.0055 ppm less than that of the environmental standards.	The Greekenger noise levels at San Booy, San Ignacio at San Booy, San Ignacio at Traidad are only 5 (25(A) in maximum higher that that of the prasm that that of the prasm that that to be very the influence to be very small.
Not to exceed the preaent when quality revels or the water quality standards by the Minustry of Lithern Afflat,	To conserve an excellent landscape and not to give an incongruidy sense to the eurroundings.	Not to give a remutuble influence to the habitat of fauna.		Not to exceed the present noise level
The Inverge water dusthargod from the worker's earnip or workaloop may conternante river water,	The landscape will be To conserve an excellent changed. The degree of the landscape and not to giv change depends on coloring incongruity sense to the of bridgepters and guiden.	With instrease of quantity of Not to give a remarkable mattice, it watts associated for the influence to the habitat of aurimals remarks the nod will fautur. Instrease: Esposably, on the instrease. Esposably, on the instrease and Apere between the Matoa and Apere internal are observed to inhabit.	The forecast concentration for Nor to ercored the pre- tibe year 2020 verse from quality or the standard 0.00 ppm (0.00 mg/m2) personation in Nakional and from 0.0 (0.0 mg/m3) to Ambent Air Quality 0.00026 ppm (0.00032 mg/m3) Standards of USA respectively.	The forecasting inductions large at Not to ecceed the present San Booja, San Ignucio and nouse level Trinuda for the years 2020, Which are back to year 2020, Which are back on the forecasting noise levels, muge from 44.2 dB(A) to 61.3dB(A).
Water quulity	Lundrape	1	Arr quality	Notes
Feacificers for Water quulity work	Bndge	Traffic and Fearra		

Summary of Environmenta Assessment (6)
Table 12-4-1

1	lusanue of nun	Public components Forest		Public corputation of Forest
1	N			
1	Regular observation study for 1 the conservation of trainflip time(2) yearching to destruction of run and cultural protectes by constructing provide road and house, and cultivating farms	SENAC Montorne system Welfare Miniary armagement for mediation of conflict by illegal action 259, 938 (244) sites 537,938) Every year 52,600		(See Connnutly above mentioned)
SENAC		senac Velfare Ministry	SENAC	
Dutabution andy before \$17,120 Regular \$28,800 \$28,800	1	Bueatop 26,500 cmergeney nedical 580,000	म् म्	
As considered the character of Kuma and outmut properties (Resport to the potentibuly to Courtburton study before the work the impowerment, then introduced be conserved without (Lacover and deatryy other and regular observation during that the network. But puts will be the manutement of the potential about the denviation of the reasonable to the formation of the denviation of the denviat	ŀ	Development with harmony Hospital, facilities for high. Blue stop, maintum concrements and peace should be given to packe education and factific machinal equipment should be notacy and eminent negative facilities should be impact should not be given expanded. Some abould to prepared, measurement for all abould be prepared, measurement for all abould be hardownenhip should be taken.	The low part should be fulled up as high as objective road	Local office and personal for monitoring abound be installed
Respect to the possibility to discover and dearby other ruins, acons measurement should be taken during the work	and cultural properties. The improvement can not the conterved without be direct maton for the destruction. But it is destruction to deliberate the incounterment for avoid a little damage, too.		x 8	it a necessary to armage distribution facilities, to grow timber processing and tourism industry, and to tourism industry, and to order a monitoring system for illegal woods cutting.
સ્વામ્પ્ર ક્ષતે વર્ધોમાં કુલ્લકુલ્લા કુલ્લકુલ્લા કુલ્લકુલ્લા કુલ્લકુલ્લા કુલ્લકુલ્લા કુલ્લકુલ્લા કુલ્લકુલ્લા ક બેઠલ તેનખોંગાયોળ બેઠલ તેનખોંગાયોળ	and outhura) properties d be conterved without valuation	Development with harmony Hospital, Bacultos for high and peace should be given to grade education and traffic recenty and emurant negative Bacultose should be impact should not be given required. Some measurement for Begul to life environment, action and conflict of landownenhing should be taken.	Development with humony Some measure should be and peace should be given to taken to avoid obstacle society and emurent negative latment for continuationals impact should not be given between communication to life environment. and security	Development with harmony it is necessary to arrange and peace should be given to distribution facilities, to regional contomy and grow timber processing a entiment negative impact tourism industry, and to should not be given to order a monitoring syster sustainable development. (or idegal woods cuting, sustainable development.
As considered the character of Kums the mpowement, that a little hould possibility to destroy other the mark. But puts will be cates watch by adde bottow in sume character bottow in but other nums can be consisted and destroyed	As considered the increase of Ruius population in fature, there is about possibility of the dostruction the do of ruin and cultural properties by constituting private road and house, and culturating fatts	Positive angurds, easy reflection of politics, quick, and p interlead treatment, easy strandance to high olicention, intra- regruid the operation Negative to Me regruid the operations, iteral woods outfurg, poseching, woods outfurg, poseching, oontflett of landowmenhing	Level dufference between the Development with humony. Some measure should be objective road and access road and peace should be given to inden to around obstacle to community can be obstacle society and eminent negative dement for communication for theffic. (or theffic.	Activation of dustribution of Development with har goods, development of and peace should be a apriculture and farming, reportal contomy and creation of new industry, emission should not be given to filteral woods entrang, advation should not be given to of land point extratusion of austainable developme contome diafference between landowner and who does not
Kum and cultural properties	· · ·	Continued		Economic activity
Earth work (evrinte, cribentiment, etc.)	Rond facilities (rond, bridge, culver, etc.)	Elevation of movement	Earth work (surbreg, embankment, etc.)	Pressente n whole year
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