MINISTRY OF ECONOMIC DEVELOPMENT OF THE REPUBLIC OF BOLIVIA
JAPAN INTERNATIONAL COOPERATION AGENCY

THE ENVIRONMENTAL IMPACT ASSESSMENT OF THE ROAD IMPROVEMENT BETWEEN SAN BORJA AND TRINIDAD IN THE REPUBLIC OF BOLIVIA

FINAL REPORT

SUMMARY

OCTOBER, 1995

CENTRAL CONSULTANT INC.

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March, 1995

US$1 = BS 4.8

PREFACE

In response to a request from the Government of Bolivia, the Government of Japan decided to conduct the Environmental Impact Assessment of the Road Improvement between San Borja and Trinidad in the Republic of Bolivia, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bolivia a study team headed by Mr. Takao Yamane of Central Consultant Inc. two times between December 1994 and August 1995.

The team held discussions with the officials concerned of the Government of Bolivia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Bolivia for their close cooperation extended to the Study Team.

October, 1995

Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

October, 1995

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan.

We are pleased to submit to you the final report on the Environmental Impact Assessment of the Road Improvement between San Borja and Trinidad in the Republic of Bolivia.

This study was conducted by Central Consultant Inc. under a contract to JICA, during the period December 1994 to October 1995. In conducting the study, we have examined the various environmental aspects related to the road improvement in Bolivia in order to complete the Environmental Impact Assessment of the Road Improvement between San Borja and Trinidad in the Republic of Bolivia.

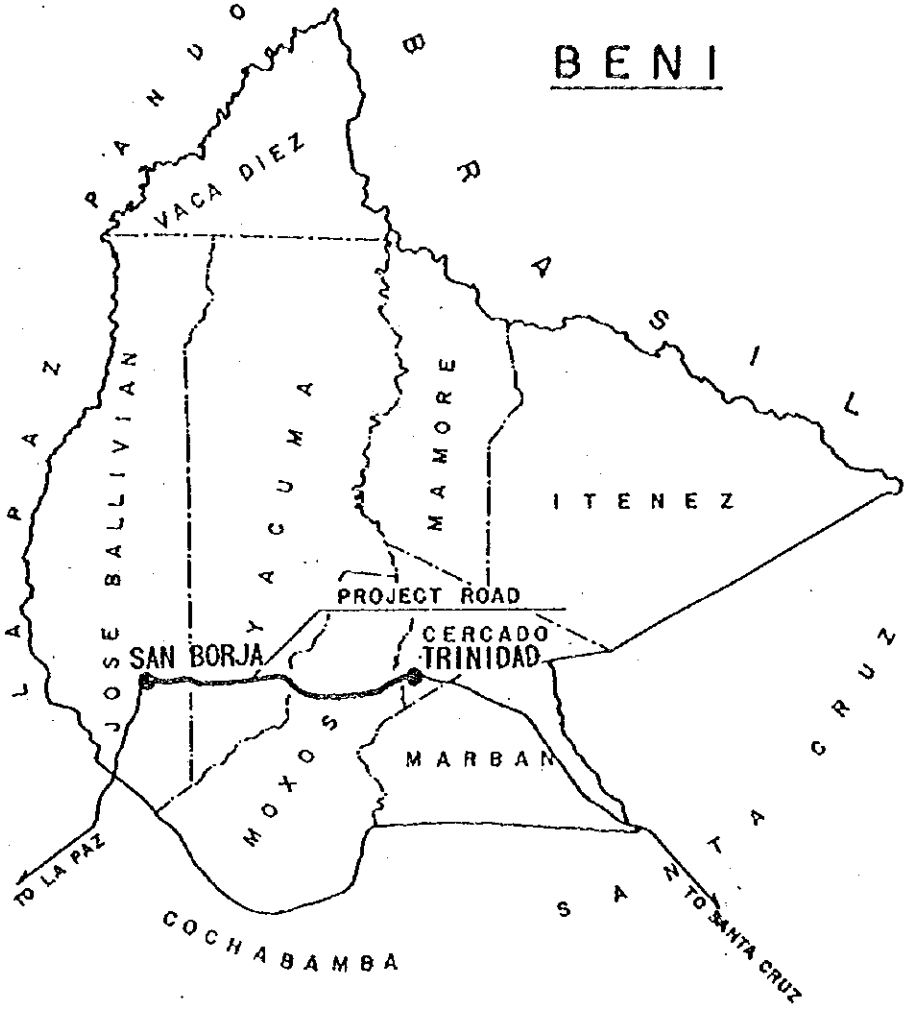
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA and the Ministry of Foreign Affairs. We would also like to express our gratitude to the officials concerned of the Ministry of Economic Development of the Republic of Bolivia and the Embassy of Japan in Bolivia for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

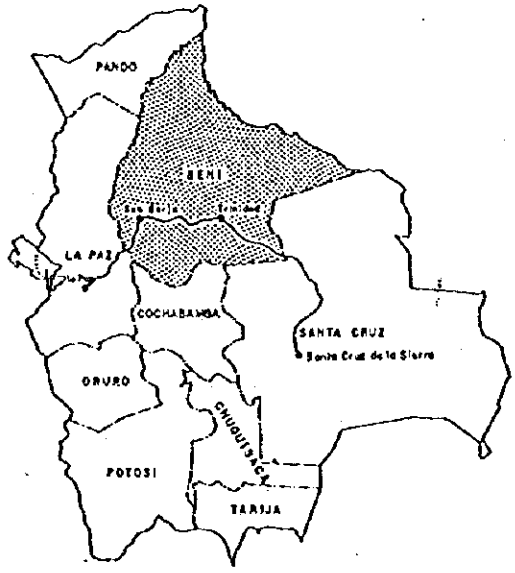
山根敬生

Takao Yamane
Project manager,
Study team on the Environmental Impact
Assessment of the Road Improvement between
San Borja and Trinidad in the Republic of Bolivia
Central Consultant Inc.



SOUTH AMERICA

BOLIVIA



The Environmental Impact Assessment of the Road Improvement between San Borja and Trinidad
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ABSTRACT

THE ENVIRONMENTAL IMPACT ASSESSMENT OF THE ROAD IMPROVEMENT BETWEEN SAN BORJA AND TRINIDAD IN THE REPUBLIC OF BOLIVIA

Study Period : From December 1994 to October 1995

Relevant Organization : Ministry of Economic Development

Servicio Nacional de Caminos

ABSTRACT

1. Background of the Study

The San Borja - Trinidad road is one section of National Road 3, connecting Trinidad with the capital, La Paz, the seat of government and the largest center of consumption in Bolivia, through the Beni Department, the largest agricultural and livestock production area. This road was completed in 1976. However, because it was built with a low-standard structure, it has become difficult for vehicles to circulate safely because of the severe road damage in many sections of the road. In addition, the road section 40 - 50 km west of Trinidad is completely inundated during the rainy season, making it impassable at this time of year. Therefore, the early completion of National Road 3, an all-weather-road, is one of Bolivia's priority projects.

To date, National Road 3 has been improved from La Paz up to San Borja. Therefore, the road section between San Borja and Trinidad is the only section currently requiring urgent improvement.

The government of Bolivia planned to begin improving this road after obtaining a loan from the Inter-American Development Bank (BID). However, due to growing world-wide concerns for environmental conservation, the BID now requests that all projects first implement an environmental impact study. However, because of the government of Bolivia's difficult situation, it could not implement this environmental study due to financial and technical considerations; consequently, it requested the government of Japan to carry out this environmental study on the above road improvement. Responding to this request, the government of Japan dispatched a Preparatory Study Team through the Japan International Cooperation Agency (JICA). Based in the results of discussions be-

tween the Preparatory Study Team and the Bolivian side, the Scope of Works was defined in March 16, 1994, and the implementation of this Study was determined.

2. Purpose of the Study

The main purpose of the Study is to conduct an environmental impact study on the road improvement between San Borja and Trinidad in order to obtain financing for the project from an international agency.

3. Outline of the Study

3.1 Premise of the Project

This assessment is premised on the Feasibility Study and Detailed Design of the road improvement between San Borja and Trinidad completed in 1987 and 1989, respectively. The outline of the road improvement project is shown in Table-1.

Table-1 Outline of the Road Improvement Project

Item		Description	Note
Project Scale	Origin-Destination	Trinidad - San Borja	
	Distance	221.93 km	Asphalt : 10.37 km Gravel : 210.57 km Bridge : 0.99 km
	Ferry Service	7.06 km	Mamore River
Specification	Classification	Class 3	
	Design Speed	100 km	
	No. of Lanes	2 lanes	
	Road Width	9 m	Vehicle lane : 7 m
Quantities and Other Aspects	Embankments	2,524,963 m³	
	Pavement (asphalt)	t = 6 cm, 71,000m³	
	Pavement (gravel)	t = 20 cm, 2,032,000m³	
	Bridges	10 bridges, 987.2 m	
	Ferry Ports	2 locations	
	Canals	3 locations, total distance 2,414 m	
	Construction Period	4 years	

3.2 Components of the Environmental Investigation

Table-2 shows components of the environmental investigation conducted as part of this assessment.

Table -2 Components of the Environmental Investigation

Items	Contents
1. Topography and geology	Data collection, topographical and geological field work (topographical and geologic features, river sediment, etc.)
2. Soil	Data collection, soil survey, (classification and distribution of soils, erosion conditions, etc.)
3. Water	Data collection, hydrological study (rate of flow: 10 sites, drainage conditions, inundation area, etc.)
4. Flora	Data collection, vegetation survey (classification and distribution of vegetation, distribution of valuable species of flora, usage of forestry resources, etc.)
5. Fauna	Data collection, habitat investigation and valuable fauna, exploitation of wild animals, etc.
6. Landscape	Data collection, landscape viewed from main observation points, landscape of altered sites, etc.
7. Community	Data collection, distribution of the community, minority races, culture, sanitary conditions, etc.
8. Economic activity	Data collection, conditions of the economic activity of the area, use of land, etc.
9. Ruins and cultural properties	Data collection, distribution of ruins and cultural properties, relations with citizens, etc.
10. Air quality	Data collection, air quality analysis (NO_2, SO_2, CO and M: 4 sites.)
11. Water quality	Data collection, water quality analysis (SS, BOD, COD, Ca, Mg, Na, K, HCO_3, SO_4, Cl, Fe, Mn, NO_3-N, DO.
12. Noise and vibrations	Data collection, noise level and traffic volume.

4. Summary of the Environmental Assessment

The environmental investigation and main countermeasures are summarized in Table-3.

5. Project Cost

Revised project costs for 1995 are US$ 57,835,890, with US$ 702,185 being allocated to environmental management. Initial project costs by year and a breakdown of the environmental management costs are presented in Tables-4 and 5, respectively.

Table-4 Initial Project Costs

(Unit: US$1,000)

Year	Local Currency	Foreign Currency	Total
1997	6,254	4,388	10,642
1998	10,264	7,203	17,467
1999	10,841	7,609	18,450
2000	6,625	4,652	11,277
Total	33,984	23,852	57,836

Table-3 Environmental Investigation Summary and Main Countermeasures

Item	Impact Factor	Forecast Results	Environmental Management Plan	Monitoring Plan
Topography Geology	Cleaving of Woods	If the cleaved area is limited to the right-of-way area, neither topography nor geology will be substantially changed by the cleaving of woods.	After the most suitable plant for protecting the slope are determined, the slopes should be re-sodded with this plants during the improvement work.	Periodic inspection of slope erosion two times per year in the rainy and dry season.
Soil	Drainage Facilities	Soil erosion at the drainage facilities is thought to occur during the wet season.	The flow-in and flow-out of the culverts should be protected by concrete.	-
Hydrology	Drainage Facilities	The area flooded by the rivers will not expand since there are a sufficient number of culverts.	-	Periodic inspections of drainage facilities.
Flora	Cleaving of Woods	The existing forest zones along the project road, such as the forest of the EBB, the forest of Chimane, gallery forests etc., will generally be cleaved within the right-of-way area(100m wide). The cleaved area of forests is estimated to be 579 ha.	The woods should not be cleaved in the forests between the Maniqui and Apere Rivers. Accordingly, the original plan calling for the cleaving and stripping of the woods within the right-of-way area (100 m wide) during the road improvement work should be changed.	Monitoring of influence on flora along the road every 3 years during the rainy and dry seasons /each time.
Fauna	Cleaving of Woods	The decrease in the forest area along the project road might be accompanied by a decrease in existing fauna which has its habitat along the road.	The woods should not be cleaved in the forests between the Maniqui and Apere Rivers. Accordingly, the original plan calling for the cleaving and stripping of the woods within the right-of-way area (100 m wide) during the road improvement work should be changed.	Monitoring of influence on fauna along the road every 3 years during the rainy and dry seasons /each time.
	Earth Works	The road embankment will be an obstacle preventing the small animals living near the project road crossing the road. The borrow pits will be very useful for wild animals, especially in the dry season since these will act as sources of water.	The ponds formed by side-borrow pitting should be left in good condition to provide shelter for wild animals.	-
	Traffic & Traffic Safety	With the increase of traffic, traffic accidents involving animals crossing the road will increase, especially on the road across the gallery forest between the Matos and Apere Rivers an area inhabited by many mammals.	To avoid traffic accidents involving animals, road signs should be set up and an eco-road (tunnel) should be constructed at sites where the embankment is higher than 2 meters high.	-
Landscape	Cleaving of Woods	If the forests along the project road are cleaved to a width of 100m, according to the design, the landscape will change substantially.	The woods should not be cleaved in the forests between the Maniqui and Apere Rivers. Accordingly, the original plan calling for the cleaving and stripping of woods within the right-of-way area (100 m wide) during the road improvement should be changed.	-
Air Quality	Traffic & Traffic Safety	The forecast concentration for the year 2020 varies from 0.0 ppm (0.0mg/m³) to 0.00014 ppm (0.00027 mg/m³), and from 0.0 (0.0mg/ m³) to 0.00026 ppm (0.00032 mg/m³) respectively.	To prevent the scattering of dust in the town areas, asphalt roads should be constructed or watering should be done.	Monitoring of air quality around the cities (2 times/year).
Water Quality	Earth Work	An increase in the amount of suspended solids in the river may be caused by the earth works or by the erosion of the embankment slope, if slope protection work is not carried out.	The drained water containing suspended solids should be discharged through the borrow pits to existing water courses. In this case, the borrow pits can be used as settlement ponds.	-
Noise	Traffic and Traffic Safety	The forecast noise levels at San Borja, San Ignacio, Trinidad for the year 2020, which are based on the forecast traffic volume and existing noise levels, range from 44.2 db(A) to 61.3db(A)	-	Monitoring on air quality around the cities (2times/year)
Community	Earth Works	At the intersections of the project road and access to the community, there is difference in the road surface height at 12 locations	If embankment height is high, it is necessary to consider the smooth communication between communities divided by the road.	-
Economic Activity	Reduction of Travel Time	Reduction of transportation costs and year-round traffic will facilitate deforestation as illegal cleaving will increase.	Monitors should seek out illegal cleaving. Inspection office to inspect illegal activity under the related organization.	-
Ruins and Cultural Properties	Side-borrow Construction Work	There is possibility that the side-borrow work will uncover new ruins. During construction, it will be necessary to dispatch personnel to observe the work.	Investigation before construction and observation of ruins along the road during the construction	Periodic inspection along and around the road.

Table-5 Breakdown of Environmental Management Costs

(Unit: US$)

Items of Counter Measure	Initial Investment	After Construction			Total Amount
		Unit Cost	Number	Investment	
(1) Environmental Management					
1. Traffic Signs	2,997	-	-	-	2,997
2. Construction of Eco-road	120,830	-	-	-	120,830
3. Embankment at Intersections	16,000	-	-	-	16,000
4. Supervision of Borrow Pit	28,800	-	-	-	28,800
5. Investigation of Ruins	17,120	-	-	-	17,120
(2) Environmental Monitoring					
1. Influence to Flora	-	10,000	6	60,000	60,000
2. Influence to Fauna	-	20,000	6	120,000	120,000
3. Air Quality around City	-	4,000	10	40,000	40,000
4. Noise around City	-	4,000	10	40,000	40,000
5. Investigation of Illegal Activities	37,938	2,600	20	52,000	89,938
6. Periodic Inspections of Ruins		4,000	20	80,000	80,000
(3) Others					
1. Emergency Medical Care	-	80,000	1	80,000	80,000
2. Creation of Bus Stop	6,500	-	-	-	6,500
Total	230,185			472,000	702,185

6. Economic Evaluation

As part of this study, economic evaluation was conducted based on the economic evaluation of the Detailed Design of this project. The evaluation process assumes the following tangible benefits : reduction in vehicle operating costs, travel time reduction, reduction of transportation costs, increase in agricultural income, ferry cost saving and reduction in maintenance costs. 12% assumed to be the discount rate given the discount rate of the Inter-American Development Bank (IDB). In this evaluation, environmental management costs including monitoring costs were included in the project costs. The evaluation results are shown in Table-6.

Table-6 Economic Evaluation Results

Economic Indicator	Result
Internal Rate of Return (IRR)	22.32%
Net Present Value (NPV)	US$ 53,018,334
Benefit/Cost Ratio (B/C)	2.35

From the economic evaluation results, the project is feasible even if environmental management costs are included as project costs. Furthermore, in the worst case of a 30% cost increase and a 30% benefit reduction, IRR remains 12.42%, which means that the project is still feasible enough to execute.

7. Recommendation

It is possible to realize the real function of the project road once the project road is utilized sufficiently. It is recommended that related organizations cooperate to promote the realization of sufficient usage of the road by the following activities:

① Improvement and expansion of medical facilities and allocation of sufficient doctors and nurses.

② Improvement of educational facilities and provision of sufficient teachers.

③ Promotion of registration of right of land possession to prevent land conflicts.

④ Management and supervision for the prevention of illegal cleaving and poaching.

⑤ Promotion of regional industries such as timber manufacturing, tourism, etc.

⑥ Introduction of a capital gains tax system.

SUMMARY

1. INTRODUCTION

1.1 Background of the Study

The objective area of this Study are the lowlands known as "Pampa" or "Llano" along the road between San Borja and Trinidad (about 228 km) in the Beni Department. This San Borja-Trinidad road is one section of National Road 3, connecting Trinidad with the capital, La Paz, the seat of government and the largest center of consumption in Bolivia, through the Beni Department, the largest agricultural and livestock production area. This road was completed in 1976. However, because it was built with a low-standard structure, collecting embankment materials from along both sides of the road, and because the embankment was only 40 - 50 cm above the ground, it is now difficult for vehicles to circulate safely because of the severe road damage in many sections of the road. In addition, the road section 40 - 50 km west of Trinidad is completely inundated during the rainy season, making it impassable at this time of year. Therefore, the early completion of National Road 3, an all-weather-road, is one of Bolivia's priority projects.

To date, the government of Bolivia has improved National Road 3 from La Paz for the following reasons:

- To develop the agricultural and livestock potential in this lowland area.
- To supply products from the Beni area to other areas more cheaply and more speedily.
- To attract settlers from other areas.
- To implement government policies that reflect the Beni area easily.

To date, National Road 3 has been improved from La Paz up to San Borja. Therefore, the road section between San Borja and Trinidad is the only section currently requiring urgent improvement.

According to the above circumstances, in 1985 the Government of Bolivia requested a road improvement study of this road section. In response to this request, the Government of Japan conducted "The Study of Road Improvement Between San Borja and Trinidad" from November 1985 to July 1987 and "The Study of Road Improvement Between San Borja and Trinidad (Phase II)" from September 1987 to January 1989.

Based in the results of these studies, the government of Bolivia planned to begin improving this road after obtaining a loan from the Inter-American Development Bank (IDB). However, due to growing worldwide concerns for environmental conservation, the IDB now requests that all projects first implement an environmental impact study. However, because of the government of Bolivia's difficult situation, it could not implement this environmental study due to financial and technical considerations; consequently, it requested the government of Japan to carry out this environmental study on the above road improvement. Responding to this request, the government of Japan dispatched a Preparatory Study Team through the Japan International Cooperation Agency (JICA). Based in the results of discussions between the Preparatory Study Team and the Bolivian side, the Scope of Works was defined in March 16, 1994, and the implementation of this Study was determined.

1.2 Purpose of the Study

The main purposes of the Study were the following:

① To conduct an environmental impact study on the road improvement between San Borja and Trinidad.

② To review project costs.

③ To conduct an economic evaluation.

④ To transfer the necessary technology to the Bolivian counterparts through the implementation of the Study.

1.3 Objective Area of the Study

The objective area of the Study included all the areas indicated in Figure-1, within 50 km of either side of the road, areas expected to be socially and physically effected by the road improvement project. Additionally, the national park, the dwelling place of natives such as Chimanes, Yuracare, etc., and the forest area were also included as part of the objective area.

1.4 Basic Approach to the Study

The Study was carried out according to the basic flowchart shown in Figure-2.

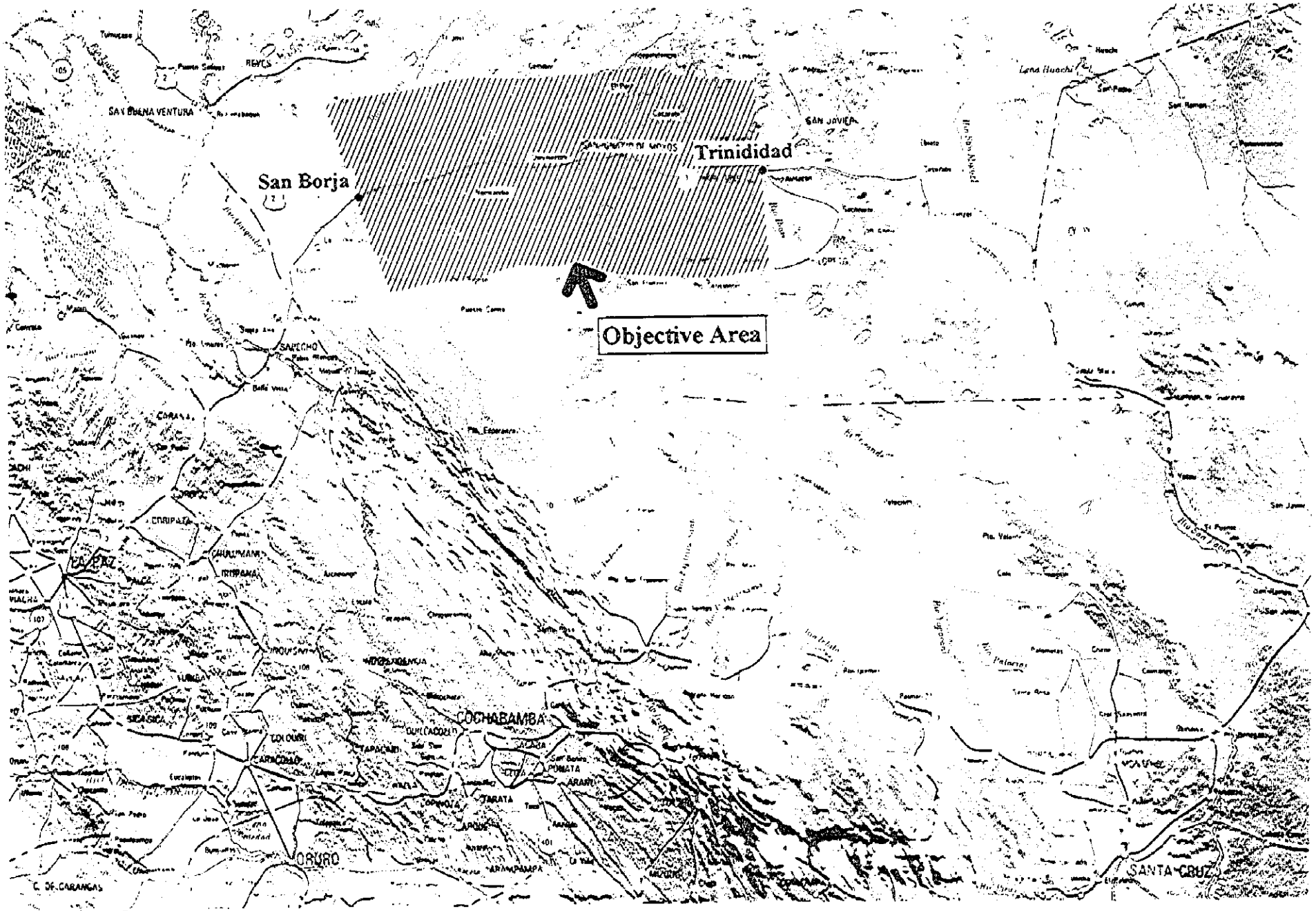

Figure-1 Objective Area of the Study

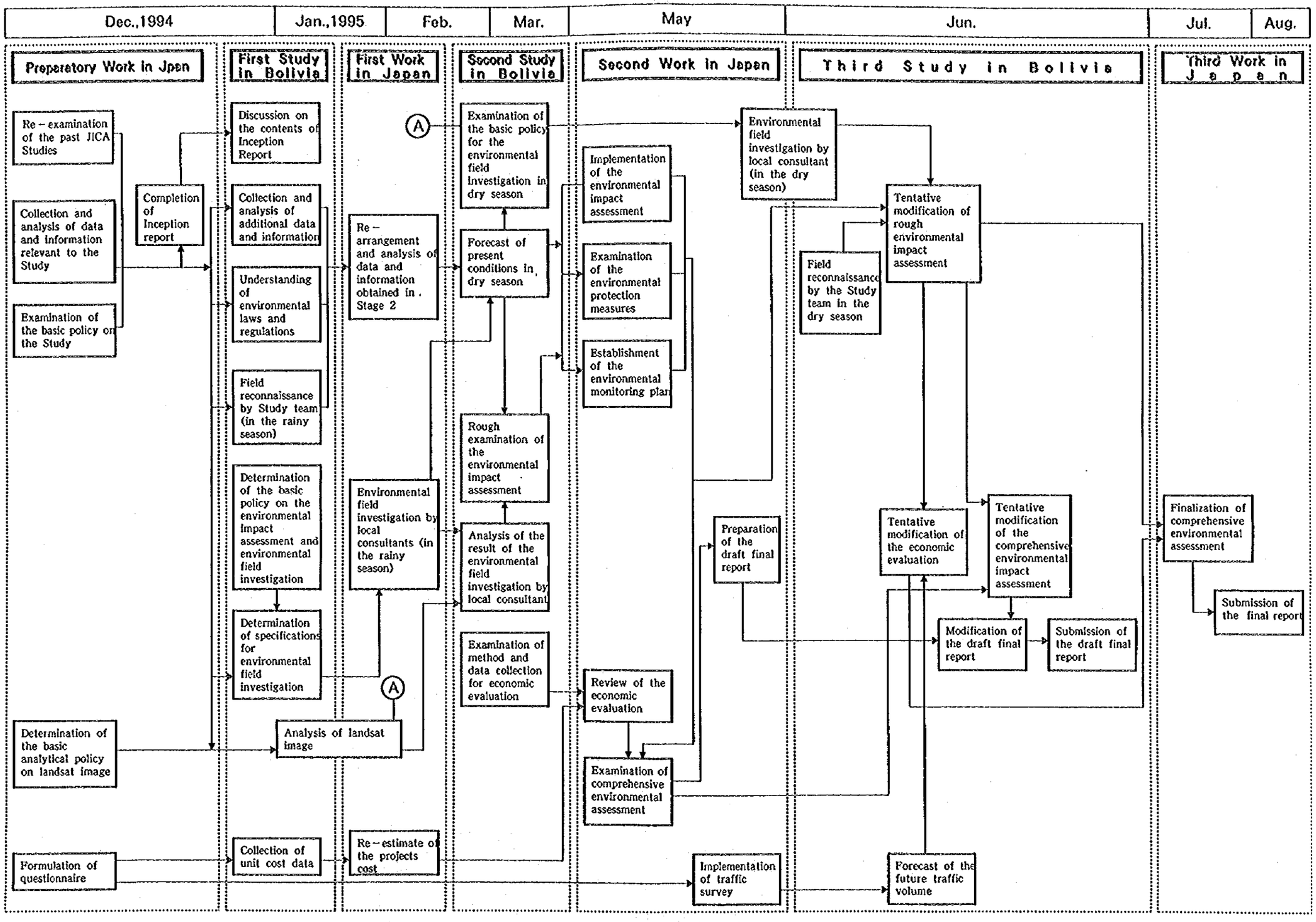

Figure-2 Basic Flowchart of the Study

2. PRESENT CONDITIONS OF THE STUDY AREA

2.1 Natural Conditions

The Republic of Bolivia is located in the center of South America surrounded by Peru, Brazil, Paraguay, Argentina and Chile, with no outlet to the sea. The area of the country is about 1.1 million km², making it almost three times the size of Japan. From a topographical viewpoint, the country can mainly be divided into the Mountainous Zone and Open Plain Zone. These two zones can further be subdivided into the following regions, as shown in Figure-3:

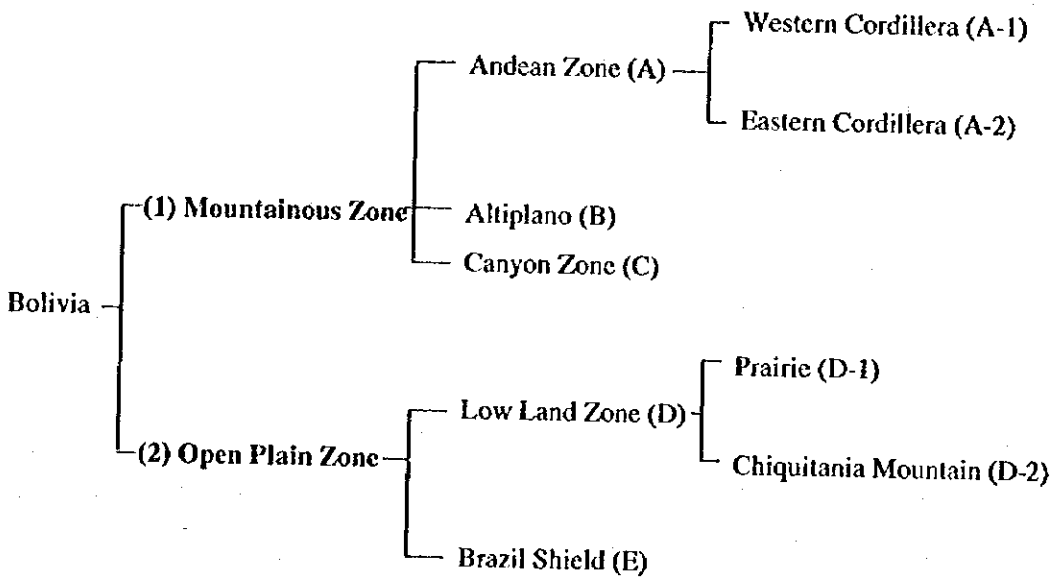

Figure-3 Topography in Bolivia

2.2 Meteorology

The climatic conditions in Bolivia vary widely according to the latitude and height above sea level. The climate is characterized by the following three zones:

(1) Altiplano Area (Plateau and Canyon Zone)

- Cold and dry climate

- Annual average temperature between 5° and 20°C
- Annual average rainfall less than 500 mm

(2) Amazon Lowlands

- Hot and humid climate
- Average temperature between 20° and 30°C
- Annual rainfall between 1,000 and 3,000 mm

The objective road of this Study is located in this area, that is, the Beni area. The climate of the Beni area is tropical with a rainy season during the summer and a dry season during autumn, winter, and spring.

(3) La Plata Lowlands

- Warm steppe climate
- Average annual temperature between 20° and 25°C
- Annual rainfall of 1,000 mm.

2.3 Land Use

The land use around the objective area is shown in Figure-4, based on a LANDSAT image. Most of the Southwest part of the objective area is covered by forests, except either side of the San Borja - Trinidad road. Most of the other land is covered by grasslands.

Between San Borja and Trinidad there are several preservation areas, such as the Biological Station of Beni, Yacuma National Park, Chimane's conservation area, etc., as shown in Figure-5.

PATH 232 - ROW 070 94.11.11
PATH 233 - ROW 070 94. 7. 3

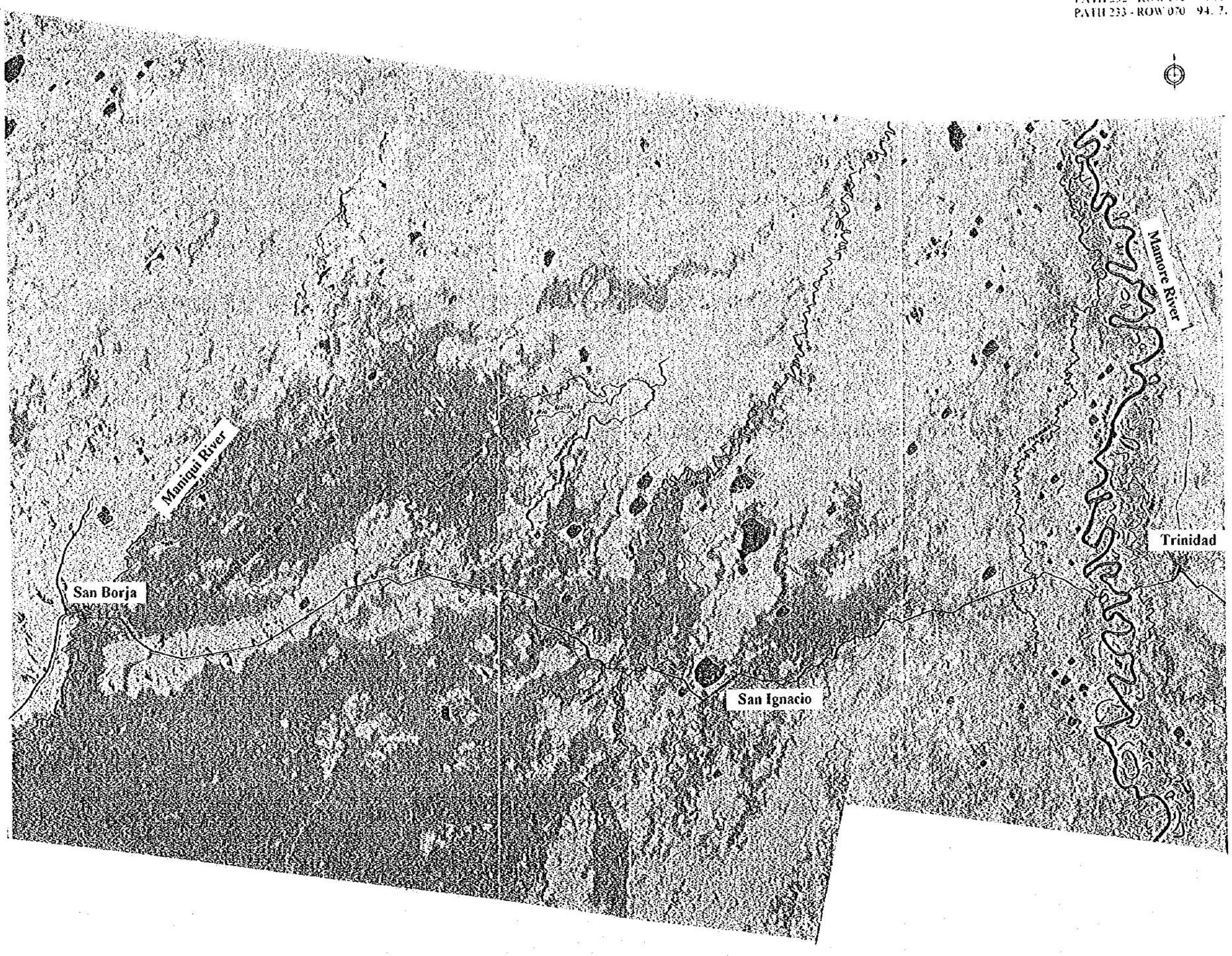

Figure-4 Land Use Map of the Study Area

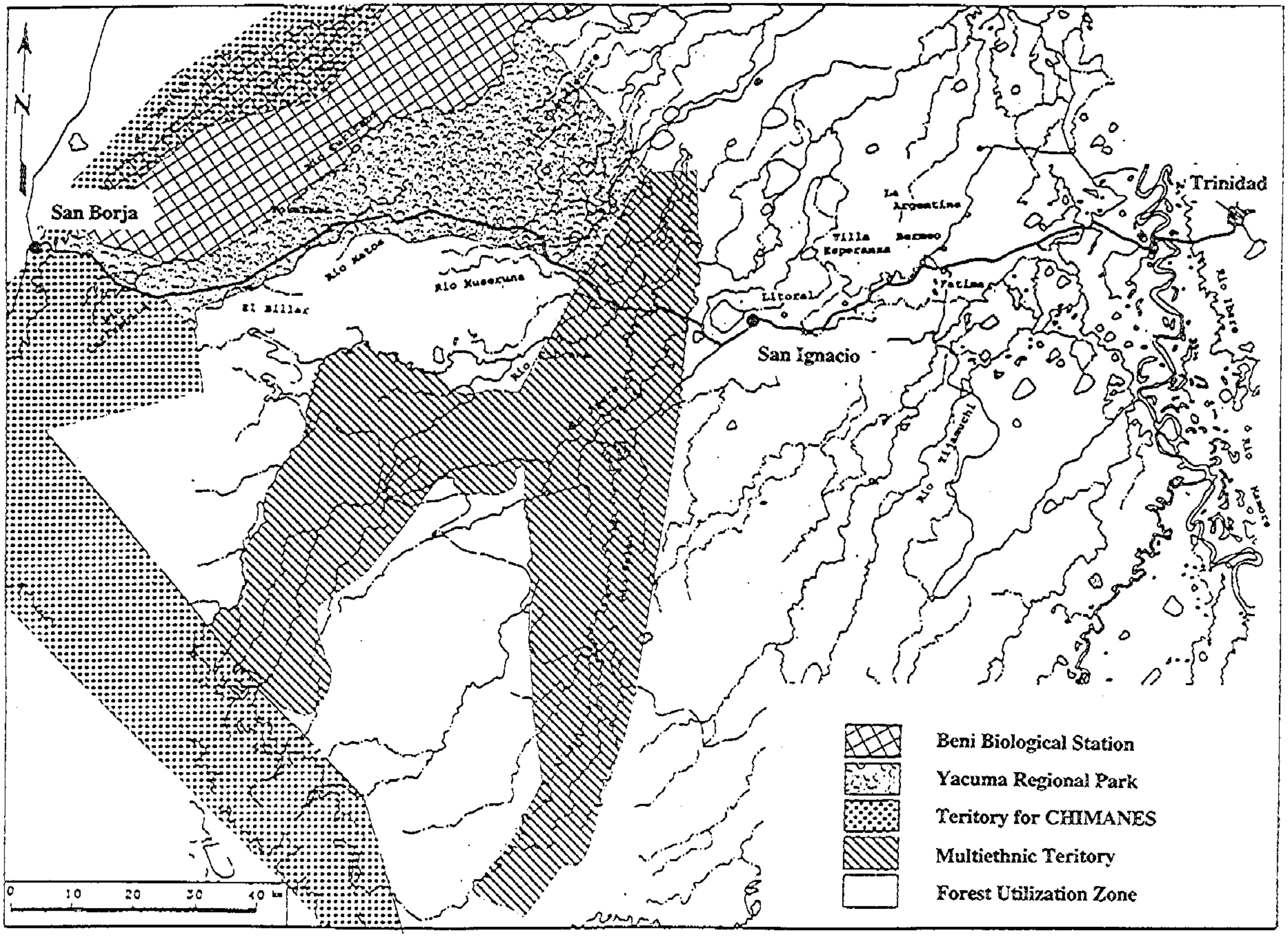

Figure 5 Preservation Approach

2.4 Population

According to a census conducted in 1992, the population of the whole country is 6.42 million, which represents an increase of 1.39 times (an annual average growth rate of 2.1%), compared the 1976 census which represented the population as 4.61 million. Meanwhile, the population of the Beni Department, including the objective area of this Study, increased from 168,000 inhabitants in 1976 to 276,000 inhabitants in 1992, with an average growth rate of 3.1%, which was higher than the national average growth rate of 2.1%.

2.5 Economy

The Bolivian economy registered a negative growth rate until 1986; however, since then, the Bolivian economy has been growing at a rate between 2% to 4%. In 1993 the growth rate was 3.2%.

The GNP per capita in 1992 was US$680. According to the economic classification by income of the Development Assistance Committee (DAC), Bolivia is second from last in the group of middle income economies (the per capita income ranges US$676 to US$8,355.) Even among Central and South American countries, the income per capita of Bolivia is the lowest, next to Nicaragua.

The consumer price increment reached 11,749.6% in 1985; however, since then it has decreased to 10 %, except in 1991. Therefore, in terms of inflation, Bolivia is considered a relatively stable country in South America. Table-1 shows the major economic indicators of Bolivia.

Table-1 Major Economic Indicators

Items	1988	1989	1990	1991	1992
Nominal GDP (Million Bs.)	11,791	13,925	16,937	20,915	23,520
Growth Rate (%)	2.80	2.70	2.50	4.10	3.88
Nominal GDP (Million US$)	4310	4520	4480	5019	5270
Per Capita GDP (US$)	570	620	630	650	680
Current Rev. & Expenditure (Million US$)	-306	-264	-194	-262	-533
Rate of Consumer Price Increase (%)	16	15.2	17.1	21.4	12.1
Foreign Debt Accumulation (Million US$)	4451	4359	4276	4075	4243
Exchange Rate (Bs./US$)	2.47	2.98	3.4	3.75	4.1
Debt Service Ration (%)	32.9	31.3	39.8	34	39

Source : "Bolivia - Recent Economic Development" (IMF)

The RGDP (regional GDP) in the Beni Department reached the highest level in 1990 (Bs.660 million); however, it then gradually decreased until 1992 (Bs.850 million.) Of all the economic activities in the area, the livestock industry represents 26.4% of the total RGDP, followed by manufacturing, which represents 18.5% of the total RGDP.

2.6 Road Conditions and Traffic Volume

The present existing road section between San Borja and Trinidad (completed in 1976) was constructed with earth embankments of 0.3 - 3.0 m on either side. On the road surface loose clay and ruts can be found everywhere because the clay road proved incapable of supporting the vehicle load. Moreover, the shoulders of the road have also crumbled in many places. The maximum width of the road is 9.0 m; however, there are some locations where the vegetation has grown into the road, and only one lane is passable. Rivers and streams intersect the present road in many places and pontoons have been constructed to cross the larger watercourses. Medium-sized and small river sections or places with insufficient drainage facilities have wooden bridges or steel corrugated pipes.

During the rainy season, the road section 40 - 50 km west of Trinidad is mostly under water and is, of course, impassable. Depending on the year, these periods often last from 5 to 6 months. At this time, water traffic utilizing the drainage channels created by the side borrows, replaces road traffic. The traffic volume of three sections of the road between San Borja and Trinidad is summarized in Table-2.

Table-2 Traffic Volume on the Road between San Borja and Trinidad

(Unit : vehicles)

Year	From San Borja to San Ignacio	From San Ignacio to Puerto Ganadero	From Puerto Varador to Trinidad
1985	69	74	286
1986	15	31	229
1987	96	93	155
1988	65	76	290
1989	37	36	260
1990	44	44	324
1991	60	71	218
1992	77	57	338
1993	74	72	399
1994	80	71	416

3. LEGAL ASPECTS

3.1 Laws and Regulations Related to the Environment

Bolivian legislation has as a main source of environmental legislation, the Natural Environment Law passed in April 1992. This law was the starting point for dealing with environmental issues in a global and systematic way. However, this does not mean that in the past there were no legal provisions regulating the use of natural resources and protecting national flora and fauna. On the contrary, a variety of laws were passed during the Republican Period. However, these provisions were not part of an overall approach to the natural environment, and were therefore very specific and somewhat haphazard.

The above law designates the following procedures for implementing an EIA (Environmental Impact Assessment):

- Submission of the environmental file (FICHA AMBIENTAL.)
- Revision of the submitted "Ficha Ambiental" and categorization of the project, carried out by the responsible authority (Categorized I to IV.)
- Implementation of the EIA study by executive agencies or by the environmental consultants, in case the project is categorized as Category I or II.
- Inspection of the EIA report by the responsible authority.
- Implementation of the project, following approval.

This law has a very general character. It therefore requires other regulations (environmental management, prevention, control, air pollution, hydraulic pollution and actives with dangerous substances) in order to be effective. As a matter of fact, such regulations have already been concluded, although they have not yet been approved by a Supreme Decree.

As for ethnic groups, the State recognizes, respects and protects the social, economic and cultural rights of the country's indigenous people, especially those rights related to their community lands, and guaranteeing the use of natural resources. It also recognizes the legal personality of indigenous and peasants communities.

3.2 Institutional Framework

In 1991, the first constitutional step was taken in this direction with the implementation of a specific constitutional framework for the natural environment and with the creation of the General Secretary of National Environment (SEGMA) under the Presidency of the Republic as an organism to control, formulate and execute environmental policies, and prepare programs and projects to improve the natural environment. This legal provision remained in effect until Natural Environment Law 1333 was approved in 1992, creating the National Secretary for Natural Environmental (SENMA), which is in charge of environmental issues. This department handles regulations, provisions and national policy directives dealing with the natural environment. Moreover, it plans, coordinates, evaluates and controls environmental activities. At the same time, ministries, public organizations and institutions of a national, departmental, and local character dealing with environmental matters have now adjusted their organizational structures in order to coordinate with SENMA.

This same Law provides for the creation of Departmental Councils of Natural Environment (CODEMA) and Departmental Secretaries of Natural Environment as decision-making bodies, which define and advise on policies at a departmental level. With the approval of the Law of Ministries of the Executive in 1993, the previously mentioned institutional framework has been substantially amended, with the creation of a strong organism in charge of environmental issues and general planning for the country. This is the Ministry of Sustained Development and Natural Environment (MDSMA), which consists of two national secretaries, the National Secretary of Planning and the National Secretary of Natural Resources and Environmental Issues.

The Ministry of Sustainable Development and Environment is the highest environmental authority of the Executive dealing with the formulation and application of laws and policies. This means that this entity is the one in charge of all norms and fiscal matters regarding the use of natural resources and the environment in coordination with sectorial ministries and according to general policies.

Its main objective is to contribute to sustainable development through economic and social policies, and through the application of norms to ensure the reasonable use of natural resources and their protection.

4. OUTLINE OF THE ROAD IMPROVEMENT PROJECT

4.1 Basic Specifications of the Project

The basic specifications for improving the San Borja-Trinidad road section are summarized in Table-3.

Table-3 Basic Specifications

Item	Specifications
Road width	Total = 9 m
	Carriageway 2×3.5 m = 7 m
Length of the Project	Road = 221.9 km
	Transfer = 7.1 km (Mamoré River)
	Total = 229.0 km
Main structures	17 bridges with a total length of 987.2 m (Seven of them are currently under construction and/or have been planned prior to the execution of the present Project.)
Ferryboat terminals	Two [2] (Mamoré River)
Channels	Three [3] (Mamoré River)
Type of pavement	Trinidad-Mamoré River: Asphalt concrete
	Mamoré River-San Borja: Asphalt concrete; however, a gravel surface will also be used between San Borja and the Mamoré River.

4.2 Design of the Road Project

The geometric design standards used for the road project are shown in Table-4.

Table-4 Geometric Design Standards

Item		Basic Value	Adopted Value
Topography		Plane	Plane
Design Speed (km/h)		100	100
Minimum Radius of Horizontal Curves (m)		415	425
Maximum Grade %	Recommended	4	
	Admissible	5	3
Minimum Visibility Distance (m)	Braking	155	208
	Passing	425	
Superelevation (%)	Recommended	6	6
	Admissible	8	
Vertical Curves (K): Crest	Recommended	107	
	Admissible	58	58
Vertical Curves (K): Sag	Recommended	52	
	Admissible	36	50
Minimum Vertical Clearance (m)		5.5	≥5

4.3 Bridges and Steel Corrugated Pipes

Rivers and streams intersect the present road in many places and pontoons are used to cross the larger watercourses. Medium-sized and small river sections or places with insufficient drainage have wooden bridges or corrugated pipes.

(1) Design of the Bridges

The design of the dimensions of the bridges in accordance with the following conditions is shown in Table-5 :

- Type of Bridge : Prestressed concrete simple composite girders
- Abutment : Cellular abutments
- Foundation : Reinforced concrete piles

Table-5 Design of the Dimensions of Bridges

Name of the Bridge	Total Length	Length of the Girder	Length of the Span
San Borja	25.660	25.660	25.000
San Gregorio	25.660	25.600	25.000
Puerto Almacén	25.660	25.600	25.000
Amistad	30.660	30.660	30.000
Sicuri	30.660	30.600	30.000
Tajibo	30.660	30.600	30.000
Mururita	30.660	30.600	30.000
Curirabita	20.660	20.600	20.000
Curiraba	25.660	25.600	25.000

(2) Steel Corrugated Pipes

A total of 349 steel corrugated pipes will be installed along the project road.

4.4 Construction Schedule

Construction work for the road improvement project is scheduled to start in 1997 and end in 2000.

4.5 Project Cost

Total project costs were estimated at US$ 61,771,000, as shown below.

Foreign Portion	: US$	37,122,000
Domestic Portion	: US$	23,694,000
Tax	: US$	9,171,000
Others	: US$	15,478,000
Total	**: US$**	**61,771,000**

4.6 Economic Evaluation

The economic analysis conducted showed that the project was highly feasible. The economic analysis results are as follows (the discount rate was assumed to be 12%) :

IRR	: 24.8%
NPV	: US$ 75,185,000
B/C	: 2.5

5. SELECTION OF ENVIRONMENTAL ITEMS

Environmental items were selected by the matrix method, as shown in Table-6. This method integrates the relationship between environmental items and environmental factors, while taking into account the influence of each environmental factor.

Consequently, the following environmental items were selected (selected environmental items for the construction stage shown in Table-6.)

- Land (topography and geology)
- Soil
- Water
- Flora
- Fauna
- Landscape
- Ruins and cultural properties
- Economic activity
- Community
- Air quality
- Water quality
- Noise and vibrations

Table-6 Environmental Factors - Environmental Items Matrix

(Selection of environmental items)

Environmental items	Road Construction*1													*3
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Environmental items*2														
- Natural environment														
1) Land (topography and geology)	0	0	-	0	0	-	0	0	-	-	-	-	-	⊙
2) Soil	0	0	-	-	0	-	0	0	-	-	-	-	-	⊙
3) Water	0	0	-	0	0	0	0	0	-	-	-	-	-	⊙
4) Meteorology	-	-	-	-	-	-	-	-	-	-	-	-	-	
5) Sea and sea shores	-	-	-	-	-	-	-	-	-	-	-	-	-	
6) Flora	0	-	-	-	-	-	0	0	-	-	-	-	0	⊙
7) Fauna	0	0	-	-	-	0	0	0	-	-	-	0	0	⊙
8) Landscape	0	0	-	0	0	-	0	0	-	-	-	0	-	⊙
- Social environment														
9) Waste	-	-	-	-	-	-	-	-	-	-	-	-	-	
10) Historic and cultural monuments (ruins and cultural properties)	-	0	-	-	0	-	-	0	-	-	-	-	-	⊙
11) Traffic conditions	-	-	-	-	-	-	-	-	-	-	-	-	-	
12) Sanitation	-	-	-	-	-	-	-	-	-	-	-	-	-	
13) Hazards	-	-	-	-	-	-	-	-	-	-	-	-	-	
14) Cutting districts	-	-	-	-	-	-	-	-	-	-	-	-	-	
15) Relocation	-	-	-	-	-	-	-	-	-	-	-	-	-	
16) Socioeconomic conditions (economic activity)	-	-	0	0	-	-	-	0	-	-	-	-	-	⊙
17) Security	-	-	-	-	-	-	-	-	-	-	-	-	-	
18) Community	0	-	0	0	-	-	-	0	-	-	0	0	0	⊙
19) Recreational facilities	-	-	-	-	-	-	-	-	-	-	-	-	-	
20) Water rights and common rights	-	-	-	-	-	-	-	-	-	-	-	-	-	
- Living environment														
21) Air quality	-	0	0	-	-	-	0	0	0	-	-	0	0	⊙
22) Water quality	-	0	0	0	0	0	0	0	0	0	0	0	0	⊙
23) Soil contamination	-	-	-	-	-	-	-	-	-	-	-	-	-	
24) Noise and vibrations	-	0	0	0	-	-	-	0	0	0	0	0	0	⊙
25) Land subsidence	-	-	-	-	-	-	-	-	-	-	-	-	-	
26) Odors	-	-	-	-	-	-	-	-	-	-	-	-	-	
27) Light	-	-	-	-	-	-	-	-	-	-	-	-	-	

Note - *1:

- Construction stage
  1) Clearing of woods
  2) Earth works (cutting, embankment, etc.)
  3) Use of heavy machines and dump trucks
  4) Bridges
  5) Culverts
  6) Water control
  7) Waste
  8) Aggregate and sand quarries
  9) Pavement and asphalt plants
  10) Concrete plants
  11) Facilities for workers
- Road use stage
  12) Road facilities (road, bridges, culverts, sidewalks, etc.)
  13) Traffic and traffic safety

*2 : 0 - Related environmental items

*3: Selection of environmental items

⊙: Selected environmental items

6 PRESENT ENVIRONMENTAL CONDITIONS OF THE PROJECT AREA

6.1 Items of the Environmental Investigation

The environmental investigation for the environmental impact evaluation was conducted based on the 12 items mentioned in Section 5.

The length of the investigation area is 228.99 km, corresponding to the road project between San Borja and Trinidad. The width of the area is approximately 50 km to both to the north and 50 km to the south of the road, as shown in Figure-6.

6.2 Methodology

The components of each of the selected environmental items of the environmental investigation are shown in Table-7.

Table-7 Components of the Environmental Investigation

Items	Contents
1. Topography and geology	Data collection, topographical and geological field work (topographical and geologic features, river sediments, etc.)
2. Soil	Data collection, soil survey, (classification and distribution of soils, erosion conditions, etc.)
3. Water	Data collection, hydrological study (rate of flow : 10 sites, drainage condition, inundation area, etc.)
4. Flora	Data collection, vegetation survey (classification and distribution of vegetation, distribution of valuable species of flora, usage of forestry resources, etc.)
5. Fauna	Data collection, habitat investigation and valuable fauna, exploitation of wild animals, etc.
6. Landscape	Data collection, landscape that can be viewed from the main points, landscape of altered sites, etc.
7. Community	Data collection, distribution of the community, minority races, culture, sanitary conditions, etc.
8. Economic activity	Data collection, condition of the economic activity of the area, use of land, etc.
9. Ruins and cultural properties	Data collection, distribution of ruins and cultural properties, relation with the citizens, etc.
10. Air quality	Data collection, air quality analysis (NO_2, SO_2, CO and M : 4 sites.)
11. Water quality	Data collection, water quality analysis (SS, BOD, COD, Ca, Mg, Na, K, HCO_3, SO_4, Cl, Fe, Mn, NO_3-N, DO.
12. Noise and vibrations	Data collection, noise level and traffic volume.

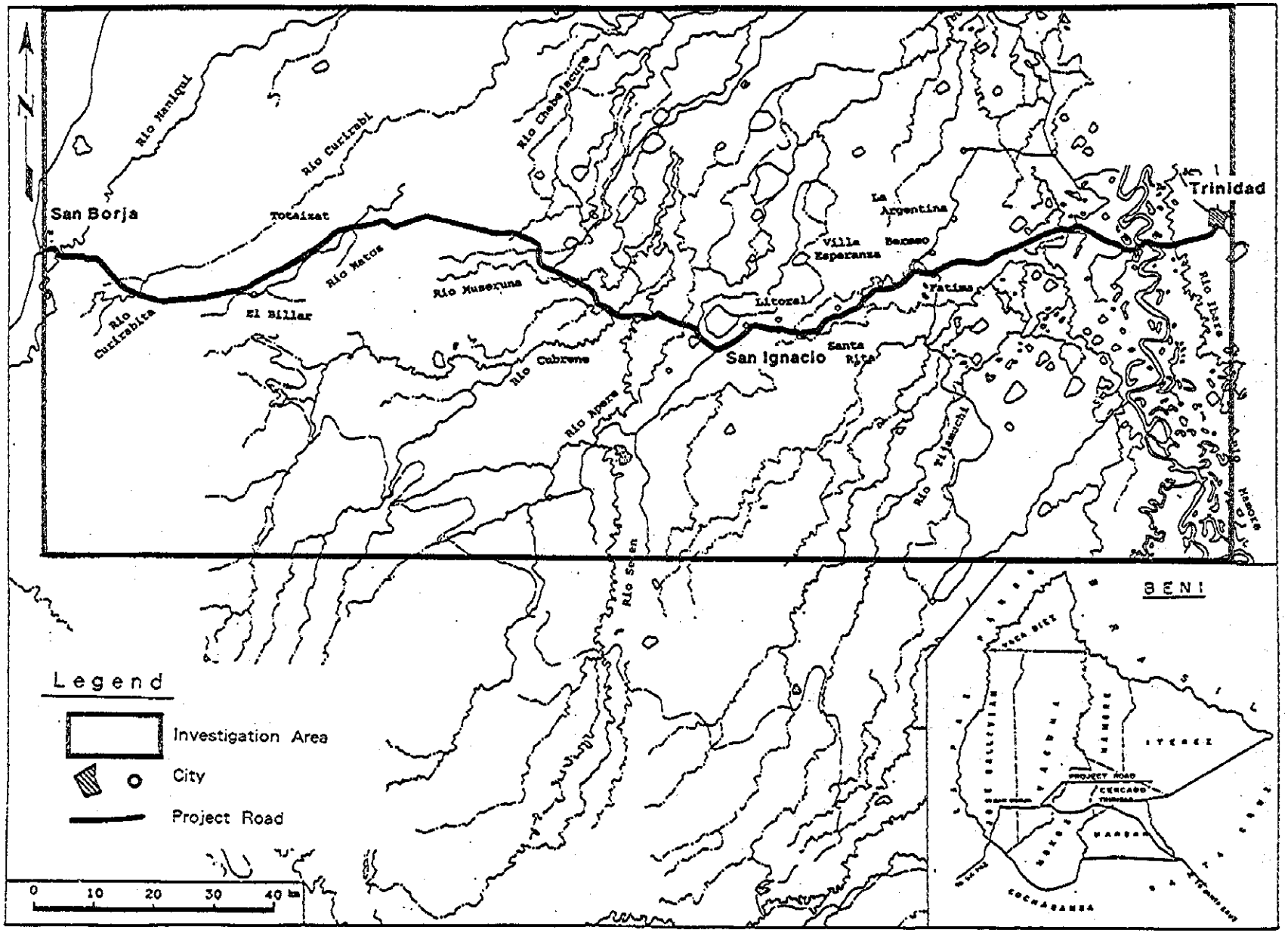

Figure-6 Investigation Area

6.3 Investigation Results

The investigation results are briefly explained in this section.

(1) Natural Environment

a) Topography and geology

Topography

The surveyed section is 228.99 km long. The elevation of San Borja and Trinidad is 194.20 m and 153.10 m above sea level, respectively (JICA, 1989.) The difference of elevation between both the two regions is 41.10 m.

Topographically, the project area consists of lowlands (alluvial plain), which can be classified into the following regions: Alluvial fan, sub-recent floodplain, fan-like floodplain, insular micro salient, recent river floodplain, natural levee (micro salient), back swamp, swamps (lakes), marshes, rivers, and artificial topography. Particularly, the sub-recent floodplain and the back swamp make up a vast zone in the project.

It is recognized that the ground level of the fan-like floodplain is approximately 30 to 150 cm higher than that of the sub-recent floodplain. This difference is the result of the sediment of each river, which means that the width and elevation will differ in accordance with the amount of sediment in each river. In particular, an extremely large amount of sediment has been observed in the Mamoré and Maniqui Rivers, and their flood plains and meandering dimensions are quite large. Furthermore, this relative difference in elevation influences the flora of the area.

The Maniqui River forms a large-scale fan-like floodplain east-north to east-northeast of San Borja. This fan-like floodplain is covered by the EBB forests.

An old flood plain lies between the Curirabita and Matos Rivers, which slightly trends from the southwest to northeast, showing the largest slope in the surveyed section.

The rivers and small streams located between the Chevejecure and Apere Rivers converge near the surveyed road because of the watershed, which is located west part of those rivers, extending in a west-southwest to east-northeast direction,. For this reason, middle-scale hinterland marshes are formed in the upstream part of such rivers and streams.

The upstream areas of the hinterland marshes between the Matos and Apere Rivers form a slight fan-like plain.

In San Ignacio and its vicinity, a crested land extends from the west-southwest to east-northeast part of Fátima, forming a watershed. This very slight watershed plays an important role geographically, extending towards the southwest on the eastern side of the Apere River, and clearly dividing the watersheds of the Apere and Tijamuchi Rivers.

The road section from west of San Ignacio to east of Fátima is located in the southern slope of the watershed.

Between Fátima and the Tijamuchi River, the Tijamuchi River basin drainage converges to the east due to the watershed that extends from the west-southwest to east-northeast, forming a large-scale hinterland marsh in its upstream.

The Mamoré River and its vicinities form a recent floodplain that is approximately 12 km wide, and a slight watershed that has including natural banks.

The road project mainly consists of an embankment ranging from 0.2 to 2.5 m in height. As banking materials in the recess zone (floodplain, swamp, etc., generally covered with grassland), alluvium earth from both sides of the road was used, mainly consisting of silt and clay. Of those embankments, those located in the old floodplains, which are slightly sagged, and those located in the marshes, have been eroded by rain; the shoulders and the surface are partially gully eroded and the banking body is locally becoming narrower. On the other hand, roads located in the slight watershed (mainly in the forests) are not as badly eroded.

The borrow pits used for the materials of the embankment located in the recess zone (marshes) are 15 to 30 m wide, and are filled with water. In the eastern part of Fátima,

where roads cannot be used during the rainy season, these borrow pits are used as transportation channels for barges, etc. On the other hand, in the forests, where a large amount of soil is not required for the embankments, side borrows are not used in series and have a depth varying between 1.5 and 3 m, which is why they become a hazard when they fill up with water.

Geology

The project is widely covered by alluvial deposits from the Holocene Era of the Quaternary Period. In the southern part of the project area, layers of the Tertiary, Cretaceous and Paleozoic Periods are widely distributed, forming the Sub Andino (the eastern rim of the Andes Mountains.)

The alluvial deposits consist of sub-recent river deposits, fan deposits and recent river deposits, made up of sand, silt and clay.

Generally, the geological structure of the Sub-Andino trends from northwest to southeast, while the fans located in the alluvial plains are also aligned in a northwest-southeast direction. In addition, it is assumed that the existence of bends and the slight watershed stretching from the west-northwest to the east-south should indicate the geological structure of the basement.

The results of geological surveys conducted prior to the construction of bridges show that the geological structure mainly consists of various beds or layers, that is, clay layers (having a thickness between 1 and 3 m), clay/silt layers, silt/fine sand layers, and fine sand layers. In general, sand layers are found in depths ranging between 10 and 15 m. The N value of these sand layers is between 30 and 45, which means that it is a soil structure capable of supporting bridges.

The crested lands forming the watershed and the slightly crested lands formed of flood plains, natural banks, fan-like flood plains are mainly composed of silt and sand. On the other hand, old flood plains, marshes (including hinterland marshes), and slightly sagging land are mainly composed of clay or silt.

The soil of the present road is mainly composed of clay (Class A-7) and silt (Class A-4.) The clay soil roads have no drainage and are therefore in bad condition. On the other hand, the silty soil roads contain some sand and have comparatively better drainage, which means that these roads remain in rather good condition even during the rainy season.

Only small-scale failure of the slope of embankments caused by erosion was found in the upper parts of the embankments located on the side walls of the steel corrugated pipes. In terms of volume of sediment, erosion due to rain water and overflow on to the road is believed to be much more severe than that caused by embankment failures.

b) Soil

The soil of the Study Area is made up of alluvial soils, which are distributed in raw warp soils (Ramble), gray lowland soils (Paternia), brownish lowland soils (Vega), and Gley soils. A detailed survey will be conducted separately during the dry season.

The soil in the forest zone consists of a light-brown to brownish lowland soil with a layer that is between 60 and 120 cm thick. Humus soil (Class A0 or A1) is distributed above the above-mentioned layer, which is 10 to 30 cm thick; occasionally, brownish gray bleached soil with a thickness between 10 and 20 cm can be observed at depths between 30 and 60 cm. Actually, no soil erosion at the road sides was observed.

c) Water

The rivers in the project area belong to the fluvial system of the Mamoré River, which is the main stream. The tributary rivers include the Maniqui, Curirabe, Curirabita, Matos, Chebejecure, Cuberene, Apere, Tijamuchi, and Ibare Rivers. Each tributary river flows northeast, joining the Mamoré River. These rivers are subdivided into five river basins, consisting of the Maniqui, Apere, Ibare, Tijamuchi, and Mamoré River basins.

The slightly crested land in the WSW-ENE direction bends the river flow of the Apere and the Tijamuchi River basins toward a WSW-ENE direction, further influencing the Mamoré River (including the Ibare river) to form a flood area (retarding basins) upstream of each river. While the flood area of the Apere River basin is 1,300 km² and the one of

the Tijamuchi River basin is 2,550 km², the flood area of the Mamoré River basin covers an area of 14,200 km². The flood area of the Ibare river basin is 2,920 km².

The Maniqui River flooded in December 1994, overflowing the Curiraba River and greatly expanding the fan-like flood plain in this area. Presumably, this is what caused the river channel of the Maniqui River to be drastically altered (including meandering).

As each river in the Apere River basin has geographical conditions to gather water flow, exceeding its drainage capacity in the rainy season, an overflow for a short period occurs every year and a flood occurs every two years.

The Tijamuchi River has a water level difference of approximately 10 m between the rainy and dry seasons. When it is flooded during the rainy season, the overflowed river water of the Mamoré River flows into the flood basin of the Tijamuchi River, which leads to a further expansion of this flood area. The flood situation of the Ibare River, which is located in the right bank side of the Mamoré River, is almost the same as that of the Tijamuchi River.

The floodplain of the Mamoré River is between 8 and 12 km wide, forming a natural bank-like floodplain in series, and zigzagging in the floodplain in a complex manner.

It is assumed that flooding in the project area occurs as follows:

① At the beginning of the rainy season, the water level upstream of the rivers gradually rises because of rainfall (around November.)

② As the outflow from the upstream part of the rivers is increased at a greater rate than the drainage capacity of the river at the turtle-neck sites, which are formed by the insular micro salient around the project road, the water level upstream of the rivers rises further, and as a consequence, the river channels overflow (November and December.)

③ This extra river water overflows and pours into the crescent lakes in the flood-plain from each river and back swamp zones as residual water from the Apere, Tijamuchi, Mamoré and Ibare River basins (December.)

④ In the case of the Maniqui River, where the back swamp zone is small, local flooding caused by heavy rain upstream of the river suddenly occurs at the southern part of San Borja.

⑤ In the case of the Mamoré River, the water level around the road project reaches up to a maximum of 154.7 m due to stagnant residual water. The maximum height of the water level from the Mamoré River is 1.1 m higher than that of the Tijamuchi River and 0.1 m higher than that of the Ibare River. Therefore, the water from the Mamoré River is overflowed and poured into the Tijamuchi and Ibare River basins (December through January.)

⑥ As the water of the Mamoré River is turbid because it water contains a large volume of tractional and suspended loads, it is possible to observe the mixture of this water with the water from the Tijamuchi and Ibare Rivers, which is clear and humid.

⑦ As the residual water increases, the water level of the flood area rises and a huge flood area is formed (January through March.)

⑧ Since the discharge from upstream of the rivers decreases at the end of the rainy season, the water level of the flood area gradually decreases because the discharge in the lower stream becomes greater than that of the inflow from upstream of the rivers.

⑨ Finally, the flood area disappears in the reverse order in which it appears (March through May.)

The volume of suspended solids (SS) in the Maniqui and Mamoré Rivers is 864.9 mg/l and 146.7 mg/l, respectively. The water of these rivers is muddy (called "agua negra"). The volume of SS in other rivers ranges between 5.5 and 80.3 mg/l, and this water is fume-colored (usually called "agua blanca.") The sizes of the floodplains and slightly crested land (natural banks) of the Maniqui and Mamoré Rivers are proportional to the volume of SS.

d) Flora

The flora in the Study Area is categorized into high savannas, flooded savannas, tropical forests, marshy vegetation, secondary vegetation influenced by settlers, secondary vege-

tation influenced by ethnic groups, forests, evergreen forests located in Sub-Andino terraces, forest islands and gallery forests (10 types of flora.)

Flora can generally be divided into forests and grasslands (savannas). The surveyed sections are mainly covered by high savannas, flooded savannas and flooded forests. The forests are distributed over the fans and slightly crested lands, in contrast with the grasslands, which spread over slightly sagging land.

The forests in some areas have been partially destroyed or adversely influenced by agriculture and forestry activities. The savannas are mainly used as pasture lands for livestock.

e) Fauna

A wide variety of fauna was found in the surveyed section. In particular, 330 or 340 species of fowl, including resident and migratory birds, live there. This number is higher than indicated by previously existing data.

It is assumed that the fauna has not yet been influenced by mankind, with several exceptions; however, the mammals, especially those that can be hunted, have been greatly influenced by human activities, and according to the native people, their numbers have been decreasing.

f) Landscape

Topographically, the area is quite flat. The forests, grasslands and lakes/marshes are strongly contrasted with landscape.

(2) Social Environment

a) Community

Along the present road, there are many communities; however, most of them were established after 1952 when agrarian reforms were carried out, and during the 70's, when the present roads were constructed.

The natives living near the present roads are mainly Moxeños, Chimanes, Yuracare and Movimas. New immigrants, however, have settled in the territories of the natives, and as a result, conflicts have arisen. Disputes often arise concerning the borders of the territories between the natives and the owners of ranches near their communities because the land ownership rights of existing communities have never been legally recognized.

b) Economic activity

The main industries of the area located along the road are agriculture, cattle farming, and forestry. Native families mostly live by engaging in hunting and fishing activities. Some new residents are also engaged in illegal deforestation or hunting and fishing without a permit.

c) Ruins and cultural properties

Along the present road, there are approximately eight groups of archaeological remains. Of these, five have been separated or cut by the present road. Research on such remains is currently in progress. Most of these archaeological remains are poorly conserved.

(3) Living Environment

a) Air quality

In the surveyed section, no air pollution caused by the road traffic was observed. It should be noted that during the dry season a lot of dust is produced, causing intermittent or temporary traffic obstructions. Moreover, dust is regularly dispersed to the areas near the road.

b) Water quality

In the surveyed section, no water pollution due to the road improvement work and traffic was observed, except for the increased amount of SS caused by such work and during rainfall.

During the rainy season, especially during heavy rainfall, a temporary or partial increase of SS due to erosion of the road surface has been observed. The volume of increased SS, however, is relatively small.

The road improvement work includes excavations of earth for the construction of embankments, the transport of this earth and civil works in general. Each of these works seems to increase the amount of suspended solids. Although the volume of SS differs depending on the type of work, most volumes were relatively small. With respect to changes in water quality upstream and downstream of the road, it can be concluded that no change will occur as drainage facilities are planned to avoid any increase in the present levels of the water reservoir. No water pollution due to the road improvement work, except the increase in the amount SS during such work, has been observed.

c) Noise

In the surveyed section, no public nuisance due to traffic noise or vibrations was observed.

7. PROJECT FORECASTING

7.1 Topography and Geology

(1) Impact of Cleaving of Woods

If only the right-of-way area is cleaved, neither the topography nor the geology will be greatly changed.

(2) Impact of Earth Works

The road consists mostly of embankments. The stability of the embankment slopes was examined by circular-sliding stability analysis. However, it is expected that newly raised embankments will be more eroded by heavy rainfall during the construction stage.

7.2 Soil

(1) Impact of Cleaving of Woods

The cleaving of woods will be limited to the area around road. Therefore, large-scale soil erosion will not occur.

(2) Impact of Earth Works

After the road improvement work is completed, it is expected that the area of gray soil upstream of the road project area will expand due to expansion of the flood area. However, to minimize this expansion, water from the flood area will be drained by numerous drainage facilities including steel corrugated pipes and bridges. As a result, the water level will remain the same as at present or may even be reduced.

(3) Impact of Drainage Facilities

It is expected that soil erosion will occur during the rainy season at some drainage facilities.

7.3 Hydrology

(1) Impact of Cleaving of Woods

Because only woods bordering the road will be cleaved, no large-scale hydrological changes will occur.

(2) Impact of Earth Works and Drainage Facilities

The flood area of the Tijamuchi, Mamore, and Ibare Rivers will not be expanded by newly constructed embankments because a sufficient number of drainage facilities such as corrugated pipes and bridges will be installed. Accordingly, no great change in the existing hydrology is expected.

7.4 Flora

(1) Impact of Cleaving of Woods

The existing forest zones along the project road, such as the forest of the Biological Station of Beni (E.B.B.), the Forest of Chimanes, the forest of Yacuma Regional Park gallery forests, etc., will generally cleaved within the right-of-way area (a width of 100 m) during the road improvement work. The area of forest to be cleaved is estimated to be 579 ha, which means that a considerable number of trees along the road will disappear. The influence of such cleaving will extend a certain distance into the forests, consequently causing a decrease in plant and vegetation formation activities.

(2) Impact of Waste

A volume of the waste generated by the road improvement work will be quite limited. As a result, no serious impact on the area's flora is expected.

7.5 Fauna

(1) Impact of Cleaving of Woods

The forests along the project road play an important role in the movement of fauna between the northern forests and the southern forests of the project road. The decrease of forest area along the project road might restrict this movement, which would cause a decrease in the fauna which has its habitat near the road.

(2) Impact of Earth Works

The borrow pits along the road will serve domestic and wild animals as watering holes, especially during the dry season.

(3) Impact of Waste

A volume of waste expected to be generated by the road improvement work will be quite limited. Therefore, it should not have a serious impact on the area's fauna. Moreover, waste thrown from vehicles will likely increase after the road improvement; however, such waste will also have little impact on animals.

(4) Impact of Traffic

As traffic volume increases, traffic accidents involving animals crossing the road will also increase, especially on the road section passing through the gallery forest between the Matos and the Apere Rivers, an area inhabited by many mammals.

7.6 Landscape

(1) Impact of Cleaving of Woods

If the forests along the project road are cleaved over a width of 100 m according to the detailed design, the landscape will substantially change.

(2) Impact of Earth work

a) Embankment

Although most of the project road will include embankments, it will still be a gravel road. Accordingly, the road itself will not greatly change the landscape.

b) Side-borrow pitting

Because of the side-borrow pits, artificial ponds will be formed in several places along the project road. The ponds previously formed by road embankments have already been integrated with the surroundings area in various places.

(3) Impact of Waste

A volume of waste attributable to the road improvement work will be quite limited. Therefore, the landscape is not expected to change substantially.

(4) Impact of Road Facilities

a) Bridge

The landscape will be changed, but the degree of change will depend on the coloring of bridge piers and girders.

b) Culvert

The culverts are not expected to seriously change the landscape, since they will not be visible, although the corrugated steel pipes for the culverts will not match the surroundings.

7.7 Community

(1) Impact of Realization of Year-round Traffic

① The number of new immigrants will increase

- There is a possibility that an increasing number of conflicts between native peoples and new immigrants will arise, involving matter of residence, cleaving and poaching.
- There is some possibility that antagonism between native peoples who do not have legal title to the land and new immigrants who own livestock farms will increase with respect to land possession.

② It will become easier to implement the policies of central and local governments in this area.

(2) Impact of Shortening Travel Time

① Transportation costs will be reduced.
Movement and exchanges between communities will be facilitated.

② The number of traffic accidents near the communities might increase.

③ It will be possible to operate a regular bus service throughout the year.
Residents of San Borja and Trinidad will have better access to higher levels of education.

④ It will be easier to transport emergency cases to clinics or hospitals.

⑤ It will be easier to promptly inform the relevant offices of the occurrence of disasters and accidents.

(3) Impact of Earth Works

There will be a difference between the height of the project road and access roads to communities

Table-8 Time Saving among Core Communities

(unit : hours)

Location	Project	San Borja	San Ignacio	Trinidad
San Borja	Without	-	4.5	8.4
	With	-	2.8	5.1
	(Time Saving)	-	1.7	3.3
San Ignacio	Without	4.5	-	3.9
	With	2.8	-	2.3
	(Time Saving)	1.7	-	1.6
Trinidad	Without	8.4	3.9	-
	With	5.1	2.3	-
	(Time Saving)	3.3	1.6	-

Source : Study Team

7.8 Economic Activities

(1) Impact of Realization of Year-round Traffic

① Commodity flow between communities and between the area along the road and outside this area will increase. With this activity, commercial agglomeration will be promoted in the core communities along the road, and this region will attract considerable attention as a sightseeing area with an abundance of natural flora and fauna.

② New business might flow into the area.

(2) Impact of Shortening Travel Time

① Transportation costs will be reduced.

- Commodity flow between communities and between the area along the road and outside this area will increase. With this activity, the economic growth of the core communities along the road, such as San Ignacio will be promoted
- The road will facilitate the transport of agricultural products and livestock.
- The road will facilitate the transport of timber. As a result, the timber industry will become more active, and deforestation will spread.

② Land prices along the road will increase. Consequently, the income gap between rich and poor might increase.

7.9 Ruins and Cultural Properties

(1) Direct Impact of Road Improvement Work

During the construction of the San Borja - Trinidad road (1976-1978), some archaeological sites were seemingly destroyed because there was no information about ruins. However, because of this opportunity, the study of ruins along the road has progressed, and new ruins have been uncovered. Such new ruins are not likely to be destroyed since the construction work entails improving the existing road, not creating a new road.

However, the artificial earth elevation in the complex of ridges might be destroyed due to human activity and natural soil erosion on a small scale. Moreover, some pits will be excavated by side-borrowing in some places. In such a case, new ruins could possibly be discovered and destroyed.

(2) Impact after Completion of Improvement

In accordance with the population increase, small-scale destruction of ruins would occur due to the construction of private roads and houses, the activities of animals, and cultivation.

7.10 Air Quality

Air quality around the road is mainly influenced by scattered dust, and gas exhausted by heavy construction machines and vehicles using the road. Air quality forecasting was limited to urban areas such as San Borja, San Ignacio, and Trinidad.

(1) Impact of Earth Works

Earth works, mainly the building of embankments and the digging of side borrows will generate dust when road improvement work is conducted in the dry season.

(2) Impact of Using Heavy Machines and Dump Tracks

The generation of pollutants including SOx from heavy machines during road improvement can be somewhat controlled by the arrangement of machines. Therefore, air quality forecasting focused on gas exhausted from heavy machines carrying out improvement work.

The heavy machines, which have diesel engines with large exhaust volumes, generally exhaust small quantities of NO_2 and CO. Therefore, air quality forecasts only considered the effect of SO_2 emitted by heavy machines.

According to the simulation results concerning SOx and NOx during construction, the concentration of SOx ranges from 0.00001 ppm (0.000029 mg/m^3) to 0.00023 ppm (0.00066 mg/m^3). The concentration of NOx ranges from 0.00016 ppm (0.00031 mg/m^3) to 0.005 ppm (0.00658 mg/m^3).

Most of the concentration values are less than at present. The concentration values of SOx during the dry season are almost the same as the forecasted values.

(3) Impact of Traffic

Gasoline engines generally exhaust a small quantity of SO_2. Therefore, in forecasting air quality, only the NO_2 and CO emitted by vehicles were considered. The increase in traffic volume for the years 2001 and 2020 was assumed to be 20.0% and 20.6%, respectively.

7.11 Water Quality

(1) Impact of Earth Works

During the construction stage, it is expected that suspended solids (SS) will be generated during the rainy season. In addition, it is expected that turbid water containing suspended solids whenever it rains will mostly flow into the borrow pits, where a treatment pond will be formed. Therefore, most of these suspended solids will settled in these borrow pits rather than flow into existing water courses.

(2) Impact of Using Heavy Machines and Dump Tracks

Gasoline, engine oil, etc., which will be used for heavy machines and dump tracks during road improvement work, may contaminate underground wells or river water.

(3) Impact of Drainage Facilities

The soil near culvert inlets and outlets may be eroded, thereby increasing the amount of suspended solids in the river water.

(4) Impact of Waste

Waste oil exhausted by heavy machines and dump tracks during the road improvement work, may contaminate underground wells or river water.

(5) Impact of Worker Facilities for Workers

Water discharged from worker's camps or workshops may also contaminate the river water.

7.12 Noise

Noise in 2020 at the same points as in major urban areas (San Borja, San Ignacio and Trinidad) where present noise levels were measured was forecasted by analyzing the traffic volume in 2020 and the noise levels of vehicles.

The noise forecasting results for 2020 are shown in Table-9.

Table-9 Noise Forecasting Results for 2020

(Rainy Season)

(Unit : db(A))

Measurement Point	Time	Present Noise Level	Forecasting Noise from Vehicles	Forecasting Composite Noise
San Borja	Morning	44.2	29.4	55.8
	Day Time	46.4	37.0	50.5
	Evening	48.1	37.0	55.5
San Ignacio	Morning	54.2	30.0	51.2
	Day Time	45.8	37.1	44.2
	Evening	49.5	37.1	50.0
Trinidad	Morning	50.3	46.3	54.7
	Day Time	55.4	53.7	58.0
	Evening	60.4	53.7	60.4

(Dry Season)

(Unit : db(A))

Measurement Point	Time	Present Noise Level	Forecasting Noise from Vehicles	Forecasting Composite Noise
San Borja	Morning	44.7	29.4	55.8
	Day Time	45.2	37.0	50.5
	Evening	48.8	37.0	55.5
San Ignacio	Morning	47.6	30.0	51.2
	Day Time	46.0	37.1	44.2
	Evening	40.7	37.1	50.0
Trinidad	Morning	46.7	46.3	54.7
	Day Time	47.2	53.7	58.0
	Evening	53.8	53.7	60.4

8. AIMS OF ENVIRONMENTAL CONSERVATION AND EVALUATION

8.1 Aims of Environmental Conservation

(1) Topography and Geology

To avoid substantially changing the present topography and geology, and to prevent natural disasters related to both topography and geology such as large-scale landslide and slope collapse.

(2) Soil

To prevent soil erosion and the soil flow out, and preserve present soil conditions.

(3) Hydrology

To avoid causing any substantial hydrological change of rivers, underground water, or flooded area.

(4) Flora

To avoid substantially affecting existing flora.

(5) Fauna

To avoid substantially affecting fauna habitats.

(6) Landscape

To conserve an excellent landscape by not creating any incongruities in the area.

(7) Air Quality

Not to exceed the present air quality or standards, and to preserve the health of residents by following the National Ambient Air Quality Standards of USA (see Table-10).

Table-10 National Ambient Air Quality Standards of the USA

Pollutant	Average Time	Primary 1		Secondary 2	
		ppm	$\mu g/m^3$	ppm	$\mu g/m^3$
Ozone	1 hour	0.12	235	0.12	235
Carbon monoxide	8 hours	9	10	-	-
	1 hour	35	40	-	-
Nitrogen dioxide	AA	0.053	100	0.053	100
	1 hours	0.05	-	0.05	-
Sulfur dioxide	AA	0.03	80	-	-
	24 hours	0.14	365	-	-
	3 hours	-	-	0.5	1300
Suspended Particle Matter	24 hours	-	150	-	150
	AAM	-	50	-	50

(8) Water Quality

To avoid causing a drop in present water quality levels, and to avoid violating the water quality standards of the Ministry of Urban Affair.

(9) Noise

Not to exceed the present noise level

(10) Community

To assist in the formation of harmonious and peaceful communities, without adversely affecting the living environment of communities.

(11) Economic Activity

To promote a solid development of the economic activities of local societies, without adversely affecting sustainable development.

(12) Ruins and Cultural Properties

To avoid damaging ruins and cultural properties in the area.

8.2 Evaluation

(1) Topography and Geology

Cleaving woods, cutting earth or building embankment will not substantially change the present topography or geology. However, it will be necessary to take some measures against possible land erosion in uncovered slopes.

(2) Soil

Cleaving woods, cutting earth or building embankments will not cause soil erosion. But, it will be necessary to take some measures to prevent soil erosion possible to courier, probably little scale, at the mouth of drainpipes.

(3) Hydrology

Cleaving woods, elevating the road, or the lack of a drainage system will not cause any remarkable hydrological change such as extension of the flood areas of the Tijamuchi, Mamore, and Ibare Rivers. However, driftwood or the like may block drainpipes. Therefore, it will be necessary to conduct routine maintenance checks.

(4) Flora

Cutting the forests, according to the plan, in the right-of-way area (100 m wide) will have a remarkable negative impact on existing flora in the forests where there is a wide diversity of plant species. Therefore, it will be necessary to avoid cutting forests whenever possible. Especially important are the existing forests of EBB, the protected area of Chimanes and the gallery forests. The increase of waste thrown from vehicles will not have a big negative impact on the flora near the road, although it may have some effect if the waste concentrates in any given area.

(5) Fauna

Cutting the forests, according to the plan, in the right-of-way area (100 m wide) will block important animal crossings and therefore have a remarkable negative impact on the environment of existing fauna. Therefore, during the work, it will be especially important to avoid cutting woods in these areas.

Artificial ponds formed by side-borrow pits will serve as habitats for fish and water birds, and so will have a positive impact on the fauna. Therefore, these artificial ponds should be kept in a condition that will allow animals to live there. Some adequate measures to deal with the increase of traffic volume and the resulting increase in thrown from vehicles should be taken.

(6) Landscape

Cleaving of woods, elevation of the road, artificial ponds formed by side-borrow pitting, or construction of bridges and drainage works may alter the landscape. In particular, the cleaving of woods will have a very negative and destructive impact on the beautiful environment, and should therefore be avoided whenever possible. On the other hand, the creation of more artificial ponds by the road will harmonize with the surroundings and have a positive impact.

Bridges, elevated road section, and drainpipes may alter the surroundings, and therefore have a negative impact. Therefore, some measures to harmonize these structures with the surroundings should be taken. Increased waste thrown from vehicles will have a negative impact. Therefore, some measures will have to be taken to deal with it.

(7) Community

a) Impact of year-round traffic

① "Conflict between new immigrants and native inhabitants" and " Conflict between native inhabitants who have not registered their land ownership and farmers who have" will be a negative effect harming the development of a harmonious and peaceful society. Therefore, some measures must be taken to diminish this impact.

② The policies of the central and local government will be easier to implement. This will have a positive impact on help the development of a harmonious and peaceful society.

b) Impact of shortening travel time

① A decrease in transportation costs will promote movement and interaction between communities and regions, deepen mutual understanding between regional inhabitants, and positively contribute to the development of a harmonious and peaceful society.

② The increase in travel speed will cause more traffic accidents and negatively affect the environment of regional inhabitants. Therefore, adequate measures should be taken.

③ A punctual and frequent bus service available throughout the year, will be able to be implemented. With the regular operation of buses, young people from these communities (San Borja and Trinidad) will have better access to higher education. This change will have a positive impact on the development of harmonious and peaceful society.

④ It will enable emergency cases to be brought clinics or hospitals quickly. This change will have a positive impact on the residential environment.

⑤ It will facilitate informing the related offices of disasters and accidents promptly, so that rescue activities can be undertaken quickly. This will also have a positive impact on the residential environment.

(8) Economic Activities

a) Impact of year-round traffic

Commodity flow among communities and between this area and the outside will increase in all seasons. As a result, economic activities will be increased in the core communities along the road. This will contribute to the further development of this area's economy.

b) Impact of shortening travel time

① Reduction of transportation costs will also promote new economic activity promoting the flow of commodities between communities and between the area along the road

and the outside throughout all seasons. With this activity, commercial activities will be promoted in core communities along the road and this region will attract considerable attention as a sightseeing area abounding in interesting flora and fauna. This will contribute to the development of regional economic activities.

Also the reduction of transportation costs will facilitate the transport of agricultural products, livestock, and timber. At the same time, deforestation will increase. This would have a negative impact on sustainable development. Accordingly, any appropriate policy would have to examine the positive and negative aspects of facilitating the transport of timber.

② Because land prices along the road will be increased by various factors, this might widen the income gap between the rich and the poor. A widening of the income gap would have a negative effect on the development of a harmonious and peaceful society.

(9) Ruins and Cultural Properties

a) Direct impact of road improvement work

When new ruins are uncovered, some measures will have to be implemented so that valuable ruins and cultural properties are not destroyed.

b) Impact after the completion of improvement

After the completion of improvement, no ruins will be destroyed. However, as any destruction of ruins will be permanent, appropriate measures must be implemented before such destruction occurs, irrespective of its scale.

(10) Air Quality

a) Impact of earth works

The dust scattered by earth works may become a problem during the dry season. Therefore, the appropriate countermeasures must be taken.

b) Impact of using heavy machines and dump trucks

Environmental quality standards for SO_2 (24 hours) and NO (1 hour) are both 0.05 ppm. The forecasting concentrations from heavy machines during road construction are 0.0 to 0.00014 ppm and 0.0 to 0.00026 ppm, below environmental standard limits. Therefore, the influence on air quality (beside dust) is expected to be very small. Dust is to rise from the surface of the project road.

c) Impact of traffic

The environmental quality standards for NO_2 (1 hour) and CO (1 hour) are 0.05 and 35 ppm, respectively. The forecasting concentrations of NO_2 and CO generated by vehicles for 2020 are 0.0011 to 0.0029 ppm and 0.000 to 0.055 ppm, which is lower than environmental standard limits. Therefore, the influence on air quality (beside dust) is expected to be very small. Dust is expected to rise from the surface of the project road.

(11) Water Quality

a) Impact on earth works

Earth works will increase the amount of suspended solids in river water. Therefore, proper countermeasures must be taken during the road improvement work.

b) Impact of using heavy machines and dump tracks

The aims of environmental conservation, as shown in Table-10, have been established based on the natural and social conditions of the project area.

c) Impact of drainage facilities

The soil near culvert outlets may increase the amount of suspended solids in river water. Therefore, proper countermeasures should be taken during the road improvement.

d) Impact of waste

Waste oil exhausted by heavy machines and dump trucks may contaminate underground water wells or river water. Therefore, proper countermeasures should be taken during the road improvement.

e) Impact of worker facilities

Water discharged from worker's camps or workshops may locally contaminate river water, but not to a substantial degree. Therefore, it will be sufficient to follow SENAC standards.

(12) Noise

The forecast noise levels at San Borja, San Ignacio and Trinidad are only a maximum of 3 dB(A) higher than present noise levels. Therefore, the impact of noise is expected to be very small.

9. ENVIRONMENTAL MANAGEMENT PLAN

9.1 Management Plan before Improvement

(1) Pre-investigation for Confirmation of Ruins

An Inventory survey to confirm the presence of ruins at the construction site is should be conducted before the construction work. At the same time, the risk of destruction of these ruins should be examined, and appropriate measures to conserve ruins and relative facilities should be implemented. If there appear to be some ruins within the construction area, a more detailed investigation will be necessary, and a TOR will have to be formulated.

9.2 Management During the Road Improvement

(1) Establishment of an Prohibited Area where Cleaving is Prohibited

Woods should not be cleaved in the forests between the Maniqui and Apere Rivers, or in the forests of EBB, Yacuma Regional Park, and the Chimane reservation. Accordingly, the initial plan calling for the cleaving and stripping of woods within the right-of-way area (100 m width) during the road improvement work must be changed.

(2) Prevention for Traffic Accidents Involving Animals

To prevent traffic accidents involving animals, eco-roads (tunnels) should be constructed at sites where embankments are more than 2 m high. Moreover, traffic signs to warn drivers of animal crossings should be installed along the road.

(3) Side Borrow Pits

Ponds formed by side-borrow pitting should be kept in good condition so that local fauna can establish habitats there.

(4) Slope Protection

When a suitable species of plant is selected for slope protection by sodding, it should be planted on the slope as improvement work progresses.

(5) Usage of Heavy Machines and Dump Trucks

When using heavy machines and dump trucks, engines should not be left idling as this would cause for the prevention of air contamination and noise. Gasoline, engine oil, etc., used by heavy machines and dump trucks should be managed so that underground water wells and rivers are not contaminated during the road improvement work.

(6) Bridge Construction

The bridges should be painted so as to make them as inconspicuous as possible.

(7) Protection Work at Culvert Inlets and Outlets

Culvert inlets and outlets should be protected by concrete to prevent soil erosion.

(8) Observation of the Borrow-pit Area During the Improvement Work

During the construction stage, at least one archaeologist will have to remain at the construction site to observe the borrow-pit areas and check for archaeological ruins. If archaeological ruins are discovered, said archeologist will be able to stop the borrow-pit works and examine the ruins in more detail. Of course, such an area would not be utilized as a borrow-pit area until the improvement of the ruins located there is determined.

9.3 Management Plan after Improvement

(1) Water Sprinkler

To prevent dust from scattering around town areas, water sprinklers should be used periodically.

(2) Decrease of Land Ownership Conflicts and Illegal Settlement

Conflicts among residents will mainly arise with respect to land titles. Accordingly, to prevent such conflicts, land titles should be given to the natives as soon as possible and land registration among the natives should be promoted. It will be essential to cooperate with the Ministry of Human Resources to further this plan.

(3) Prevention of Illegal Activities such as Deforestation and Poaching

It will be necessary to establish a regional office of the central government, not the regional government, to inspect illegal activities such as deforestation and poaching. In this area, the cooperation of the Ministry of Sustainable Development and Environment or the Forest Public Corporation, which will soon be established, will be necessary. Effective utilization of limited timber resources will also be necessary to prevent illegal deforestation. Timber exploitation should be promoted and restricted by special tax treatment, as this is currently the area's main economic activity.

(4) Prevention of Land Price Increases

An appropriate capital gains tax law might be the best way to prevent land price increases, which would widen the income gap in the area. Cooperation by tax authorities will be necessary.

9.4 Management Plan to Increase the Positive Aspects

(1) Greater Convenience for Bus Users

To improve convenience for local people, covered bus stops should be constructed together with bus bay and concrete road surfaces at about 13 locations.

(2) Tourism

Signs should be posted along the road to facilitate the movement of tourists within the area. To promote tourism in the Beni Biological Station, Yacuma Regional Park, etc.,

special treatment for restaurants and hotels along the road through low interest loans or tax exemptions should be examined.

(3) Improvement of Emergency Clinics

The hospital in San Ignacio should be provided with all the necessary medical equipment such as stretchers, oxygen masks, etc., so that it will be better able to handle emergencies.

10. MONITORING PLAN

(1) Periodic Inspection and Maintenance of Drainage Facilities (2 times/year)

It will be necessary to periodically inspect water and of drainage system conditions along the project road during and after the road construction stage.

(2) Periodic Inspection and Maintenance to Prevent for Slope Erosion and Slope Failure (2 times/year)

It will be necessary to periodically inspect the topographic features and soil conditions to prevent erosion, slope failure, etc., along the project road during and after the road construction stage.

(3) Monitoring of Affect on Vegetation (1 time/3 years)

It will be necessary to carry out periodic investigations of the flora and fauna, including what species exist, volume of vegetation, and the degree of deforestation at fixed observation points after the road improvement work is concluded.

(4) Monitoring on Affect on Fauna (1 time/3years)

It will be necessary to carry out periodic investigations of the fauna to know what species live there, what their numbers are, how many wild and domestic animals have been involved in traffic accidents, etc., at fixed observation points along the road.

(5) Monitoring of Air Quality Around the City (1 time/2years)

It will be necessary to periodically observe and measure air quality at fixed points in the urban areas, San Borja, San Ignacio and Trinidad, after the road improvement work is concluded.

(6) Monitoring of Noise Around the City (1 time/2years)

It will be necessary to periodically measure the noise level at fixed points in the urban areas, San Borja, San Ignacio and Trinidad, after the road improvement work is concluded.

(7) Periodic Inspection for the Conservation of Ruins

The relevant agencies will be expected to inspect the area to ensure the conservation of ruins and prevent their destruction by the construction of private road and houses, by animals, and by cultivation.

11. COST ESTIMATION AND ECONOMIC EVALUATION

11.1 Cost Estimation

The total cost of the project (revised in 1995) is expected to be US$ 57,835,890 with US$ 702,185 being allocated for environmental management. Environmental management costs include the cost of installing traffic signs to warn drivers about animals, installing eco-roads (tunnels for animals), and other environmental conservation and monitoring measures. Total project cost, initial project cost by year, and a breakdown of environmental management costs are shown in Tables-11 to 13, respectively.

Table-11 Total Project Costs

(Unit : US$)

Cost Items	Amount	
	Foreign Currency	Local Currency
• Earth Fill	4,372,231.82	4,599,854.61
• Removal of Existing Corrugated Pipes	3,839.74	9,858.05
• Installation of Corrugated Pipes	1,307,340.22	592,059.81
• Crossbeam	60,625.10	1,060,594.80
• Pavement	8,564,766.53	12,241,067.27
• Complementary Works	296,095.27	1,540,069.15
• Installation of Cranes	466,967.38	623,613.18
• Total 9 Bridges	564,926.46	1,286,492.20
• Tijamuchi Bridge	351,894.67	880,514.73
Total of Direct Cost (A)	15,988,687.19	22,834,123.70
• General and Administrative Expenses (15% of (A))	2,398,303.08	3,425,118.56
Sub-total (1)	18,386,990.27	26,259,242.26
• Utilities (10%of Sub-total (1))	1,838,699.03	2,625,924.23
Sub-total (2)	20,225,689.30	28,885,166.48
• Transactional Taxes (1% of Sub-total (2))	202,256.89	288,851.66
Total of Construction Cost (B)	20,427,946.19	29,174,018.15
• Contingency (10% of (B))	2,042,794.62	2,917,401.81
Sub-total (3)	22,470,740.81	32,091,419.96
• Supervision (6% of Sub-total (3))	1,348,244.45	1,925,485.20
Total Cost	23,818,985.26	34,016,905.16
Grand Total	57,835,890.41	

Table-12 Initial Project Costs

(Unit: US$1,000)

Year	Local Currency	Foreign Currency	Total
1997	6,308	4,388	10,696
1998	10,348	7,207	17,555
1999	10,947	7,615	18,562
2000	6,682	4,652	11,334
Total	34,285	23,862	58,147

Table-13 Breakdown of Environmental Management Costs

(Unit: US$)

Items of Counter Measure	Initial Investment	After Construction			Total Amount
		Unit Cost	Number	Investment	
(1) Environmental Management					
1. Traffic Signs	2,997	-	-	-	2,997
2. Construction of Eco-road	120,830	-	-	-	120,830
3. Embankment at Intersections	16,000	-	-	-	16,000
4. Supervision of Borrow Pit	28,800	-	-	-	28,800
5. Investigation of Ruins	17,120	-	-	-	17,120
(2) Environmental Monitoring					
1. Influence to Flora	-	10,000	6	60,000	60,000
2. Influence to Fauna	-	20,000	6	120,000	120,000
3. Air Quality around City	-	4,000	10	40,000	40,000
4. Noise around City	-	4,000	10	40,000	40,000
5. Investigation of Illegal Activities	37,938	2,600	20	52,000	89,938
6. Periodic Inspections of Ruins		4,000	20	80,000	80,000
(3) Others					
1. Emergency Medical Care	-	80,000	1	80,000	80,000
2. Construction of Bus Stop	6,500	-	-	-	6,500
Total	230,185			472,000	702,185

11.2 Economic Evaluation

The following are the premises of the evaluation and the evaluation indicators. Current traffic volume and estimated future traffic volume are shown in Table-14.

① Premise of Evaluation

- Construction period : 4 years from 1997 to 2000
- Evaluation period : 24 years from 1997 to 2000
- Basic price : 1995 price
- Residual value : none

② Evaluation Indicators

- Internal Rate of Return (IRR)
- Net Present Value (NPV)
- Benefit-Cost Ratio (B/C)

As part of this study, economic evaluation was conducted based on the economic evaluation of the Detailed Design of this project. The evaluation process assumes the following tangible benefits : reduction in vehicle operating costs, travel time reduction, reduction of transportation costs, increase in agricultural income, ferry cost saving and reduction in maintenance costs.

Table-14 Future Traffic Volume on the Project Road by Sections

(San Borja - San Ignacio Section)

(Unit : vehicles/day)

Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large Truck	Total
1995	37	3	1	6	8	19	74
2001	57	5	2	9	12	29	110
2005	71	6	2	12	15	36	142
2010	109	9	3	18	24	56	219
2015	147	12	4	24	32	75	294
2020	221	17	6	34	46	108	432

(San Ignacio - Puerto Varador Section)

(Unit : vehicles/day)

Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large Truck	Total
1995	42	5	-	15	3	6	71
2001	65	8	-	23	5	9	110
2005	81	10	-	29	6	12	136
2010	124	15	-	44	9	18	209
2015	166	20	-	59	12	24	281
2020	239	28	-	85	17	34	404

(Puerto Varador - Trinidad Section)

(Unit : vehicles/day)

Year	Passenger Car	Bus	Large Bus	Small Truck	Medium Truck	Large Truck	Total
1995	198	7	-	52	12	19	288
2001	248	9	-	65	15	24	361
2005	282	10	-	74	17	27	410
2010	349	12	-	92	21	34	508
2015	417	15	-	110	25	40	607
2020	507	18	-	133	31	49	738

12% assumed to be the discount rate given the discount rate of IDB. In this evaluation, environmental management costs including monitoring costs were included in the project costs. The evaluation results are shown in Table-15.

Table-15 Economic Evaluation Results

Economic Indicator	Result
Internal Rate of Return (IRR)	19.84 %
Net Present Value (NPV)	US$36,586,341
Benefit Cost Ratio (B/C)	1.93

From the economic evaluation results, the project is feasible even if environmental management costs are included as project costs. 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.

A summary of benefits and costs is given in Table-16.

Table-16 Summary of Costs and Benefits

(Unit : US$)

Year	Benefits							Costs		Cash Flow
	VOC Saving	Travel Time Saving	Transportation Cost Saving	Agricultural Development	Ferry Transportation Cost Saving	Maintenance Cost Saving	Total of Benefits	Construction Costs	Monitoring Costs, etc.	
1997	-	-	-	-	-	-	-	13,785,120	-	-13,785,120
1998	-	-	-	-	-	-	-	13,671,840	-	-13,671,840
1999	-	-	-	-	-	-	-	14,438,580	-	-14,438,580
2000	-	-	-	-	-	-	-	8,831,940	-	-8,831,940
2001	7,136,205	67,655	2,748,009	784,274	638,915	215,331	11,590,391	-	64,600	11,525,791
2002	7,792,827	73,075	2,852,187	812,665	694,203	215,331	12,440,288	-	26,600	12,413,688
2003	8,455,324	78,494	2,956,366	841,056	749,490	215,331	13,296,060	-	34,600	13,261,460
2004	9,116,905	83,914	3,060,544	869,446	804,777	215,331	14,150,917	-	56,600	14,094,317
2005	9,776,329	89,333	3,164,722	897,837	860,064	215,331	15,003,617	-	14,600	14,989,017
2006	10,439,641	94,753	3,268,900	926,228	915,351	215,331	15,860,204	-	6,600	15,853,604
2007	12,007,829	106,411	3,381,248	956,608	993,706	215,331	17,661,133	-	44,600	17,616,533
2008	13,582,841	118,070	3,493,597	986,988	1,072,060	215,331	19,468,887	-	6,600	19,462,287
2009	15,148,015	129,728	3,605,946	1,017,369	1,150,414	215,331	21,266,802	-	14,600	21,252,202
2010	16,711,551	141,386	3,718,295	1,047,749	1,228,768	215,331	23,063,080	-	36,600	23,026,480
2011	18,295,309	153,045	3,830,643	1,078,129	1,307,122	215,331	24,879,579	-	14,600	24,864,979
2012	19,856,765	164,703	3,954,360	1,111,357	1,385,476	215,331	26,687,993	-	6,600	26,681,393
2013	21,426,620	176,361	4,078,078	1,144,585	1,463,830	215,331	28,504,805	-	44,600	28,460,205
2014	22,985,476	188,020	4,201,795	1,177,813	1,542,184	215,331	30,310,619	-	6,600	30,304,019
2015	24,566,806	199,678	4,325,512	1,211,041	1,620,538	215,331	32,138,907	-	14,600	32,124,307
2016	26,128,676	211,336	4,449,229	1,244,269	1,698,892	215,331	33,947,734	-	36,600	33,911,134
2017	29,229,611	232,977	4,578,367	1,278,710	1,822,282	215,331	37,357,278	-	14,600	37,342,678
2018	32,330,228	254,618	4,707,504	1,313,152	1,945,671	215,331	40,766,504	-	6,600	40,759,904
2019	35,441,654	276,259	4,836,641	1,347,593	2,069,060	215,331	44,186,539	-	44,600	44,141,939
2020	38,542,271	297,900	4,965,778	1,382,034	2,192,450	215,331	47,595,765	-	6,600	47,589,165
Total	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	509,675,100

IRR	22.32%
NPV	53,018,334
Discount Rate	12%
B/C	2.35

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 counternmeasures 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 BBB 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 side-borrows 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

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.

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 loans 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 - 17.

Table - 17 Summary of Environmenta Assessment (1)

Impact by	Environment Factors	Results of Forecasting	Aims of Environmental Conservation	Evaluation Results	Environmental Management Plan			Monitoring Plan		
					Plan	Cost	Assigning	Plan	Cost	Assigning
Cleaving of woods	Topography and geology	If the cleaving area is limited within the right of way area, neither topography nor geology is changed much by the cleaving of woods.	Not to change remarkably the present topography and geology, and to prevent natural disasters related to both topography and geology such as large-scale landslide and slope collapse.	The present conditions of topography and geology is not changed much.	-	-	-	-	-	-
	Soil	Only the cleaving of woods in the limited area of the road sides does not cause a large-scale soil erosion.	To prevent the soil erosion and the soil flow out, and to conserve the present soil.	The clearing of woods has no possibility of a large-scale soil erosion.	-	-	-	-	-	-
	Hydrology	Only the clearing of woods in the limited area of the road sides does not cause a large-scale hydrological change.	Not to cause a remarkable hydrological change of rivers, underground water and flooded area.	The clearing of woods has no possibility of a remarkable hydrological change such as expansion of the flooded area.	-	-	-	-	-	-
	Flora	The existing forest zones along the project road, such as the forest of the EBB, the forest of Chumanes, gallery forests, etc., are generally cleaved within the right of way area (100 m wide). The cleaving area of forests is estimated in 579 ha.	Not to give a remarkable influence to the existing flora.	If the woods along the project road is cleaved according to the Design, the existing flora will be remarkably influenced.	The woods should not cleave in the forests between Maniqui and Apere rivers. Accordingly, the original plan that the woods within the right of way area (100 m wide) are cleaved and stripped during the road improvement should be changed.	-	-	To monitor impacts to the flora along the road, studies of species and situation of growing of flora. The study should be realized two time in dry and rainy season (a time per about 3years)	$3,800	SENAC
	Fauna	The decrease of the forest area along the project road might be accompanied by a decrease of the existing fauna which has its habit located along the road.	Not to give a remarkable influence to the habitat of fauna.	If the forests along the project road which play a important role in the movement of fauna are cleaved, it will give a remarkable negative impact to the fauna inhabits.		-	-	To monitor impacts to the wild animals, studies of species, inhabitat and diet of fauna along the road such as mammals, reptiles, amphibian, birds. The study should be realized two time in dry and rainy season (a time per about 3 years)	$6,600	SENAC
	Landscape	If the forests along the road project are cleaved with a width of 100 m, according to the Design, the landscape will remarkably change.	To conserve an excellent landscape and not to give an incongruity sense to the surroundings.	The cleaving of woods is the negative impact destoroying an excellent landscape. Accordingly, it is necessary to avoid the cleaving of woods.		-	-	-	-	-

Table - 17 Summary of Environmenta Assessment (2)

Earth work (cutting, embankment, etc.)	Topography and geology	The safety analysis of the embankment slope occupying most part of the road shows that the safety factor of a circular arc sliding is 1.7 in minimum and the embankment slope is stable. Some edges and bare-slopes of the road are eroded by rainfall.	Not to change remarkably the present topography and geology, and to prevent natural disasters related to both topography and geology such as large-scale landslide and slope collapse.	Neither topography nor geology is remarkably altered by the earth works such as embankment and side-borrow pitting. The bare surface of the embankment, however, has a possibility to suffer a gully erosion.	After the most suitable species of plant for the slope protection to sod is studied before the road improvement, it should be planted on the slope with the process of the improvement.			Regular inspectation and maintenance for erosion and slide of slope (2 times/year, before and after the rainy season) in all sections of the road.	-	SENAC
	Soil	The area flooded by the Tijamuchi, Mamore and Ibare rivers may not expanded since sufficient number of culverts to drainage the water is installed under the road embankment. Consequently, the soil may not flow out.	To prevent the soil erosion and the soil flow out, and to conserve the present soil.	The surface soil of the embankment and the soil at the lowerstream side of the culverts may suffer a erosion.	-	-	-	-	-	-
	Hydrology	The area flooded by the Tijamuchi, Mamore and Ibare rivers may not expanded since sufficient number of culverts to drainage the water is installed under the road embankment. Consequently, the existing hydrology may not change remarkably.	Not to cause a remarkable hydrological change of rivers, underground water and flooded area.	the hydrology in the area may not change remarkably. The maintenance of the culverts is necessary because the culverts will not function if its are blockaded by driftwoods and others.	-	-	-	-	-	-
	Fauna	The road embankment will be an obstacle for the small animals inhabiting near the project road to across the road. The borrow pits will be very useful habitat for the wild animals, especially in the dry season since these are a source of water supply.	Not to give a remarkable influence to the habitat of fauna.	As the ponds formed by the side-borrow pitting become useful habitats for the wild animals, they should be left in good conditions.	The ponds formed by the side-borrow pitting should be left for habitats of wild animals in good condition.	-	-	Monitoring about impacts to wild animals	Monito-ring about impacts to wild animals	Monito- ring about impacts to wild animals
	Landscape	Although most part of the project road will be embanked, it is still left a gravel road. Accordingly, the road itself gives little change to the landscape.	To conserve an excellent landscape and not to give an incongruity sense to the surroundings.	The formation of artificial ponds is a positive impact since they will, in the future, become harmonized with the surroundings as well as the existing ponds. So that they should be left after the road improvement.	-	-	-	-	-	-

Table - 17 Summary of Environmenta Assessment (3)

	Air quality	By the earth works mainly of embankment and side-borrow pitting, the dust will be scattered from bare ground during the road improvement in the dry season.	Not to exceed the present air quality or the standards for the purpose of health protection in National Ambient Air Quality Standards of USA	The dust scattering by the earth works is feared during the dry season, so that proper countermeasure for prevention of the scattering should be done during the road improvement	-	-	-	-	-	-
	Water quality	An increase of the suspended solids in the river may be caused by the earth works. Also , it may be caused by the erosion of the embankment slope , if the slope protection is not done.	Not to exceed the present water quality revels or the water quality standards by the Ministry of Urban Affair.	The earth works may increase the suspended solid in river water, so that proper countermeasure should be done during the road improvement.	The drained water containing suspended solids should be discharged through the borrow pits to the existing water courses. In this case, the borrow pit is used as settlement ponds.	-	-	-	-	-
Using heavy machines and dump truck	Air quality	The concentration of SOx ranges from 0.00001 ppm (0.000029 mg/m3) to 0.00023 ppm (0.00066 mg/m3). The concentration of NOx ranges from 0.00016 ppm (0.00031 mg/m3) to 0.00335 ppm (0.00658 mg/m3).	Not to exceed the present air quality or the standards for the purpose of health protection in National Ambient Air Quality Standards of USA	The forecasting concentrations from heavy machines at the stage of road construction are 0.0 ppm□'0.00014 ppm and 0.0 ppm□' 0.00026 ppm, less than that of the environmental standards.	When using heavy machines and dump tracks, the engines should not be idled for the prevention of air contamination and noise.	-	-	-	-	-
	Water quality	Gasoline, engine oil, etc., which are used by heavy machines and dump tracks during the road improvement, may permeate into underground or flow into river, and contaminate underground water or river water.	Not to exceed the present water quality revels or the water quality standards by the Ministry of Urban Affair.	Gasoline, engine oil, etc., used by heavy machines and dump-tracks may contaminate underground water or river water, so that proper countermeasure should be done during the road improvement.	Gasoline, engine oil, etc., used by heavy machines and dump-tracks should be managed not to contaminate underground water or river water, during the road improvement.	-	-	-	-	-
Drainage facilities	Soil	The soil erosion at the drainage facilities is thought to occur during the wet season.	To prevent the soil erosion and the soil flow out, and to conserve the present soil.	As the flood water is drained by numerous culverts established under the embankment of the project road, the flood area will not be expanded more than the present conditions.	The flow-in and flow-out of the culverts should be protected by concrete for the prevention of the soil erosion.	-	-	-	-	-
	Hydrology	The area flooded by the Tiamuchi, Mamore and Ibare rivers may not expanded since sufficient number of culverts to drainage the water is installed under the road embankment. Consequently, the existing hydrology may not change remarkably.	Not to cause a remarkable hydrological change of rivers, underground water and flooded area.	the hydrology in the area may not change remarkably. The maintenance of the culverts is necessary because the culverts will not function if its are blockaded by driftwoods and others.	-	-	-	Regular inspection of sufficient function and maintenance of uregular parts of drainpipes (2 times/year, before and after the rainy season)	-	SENAC

Table - 17 Summary of Environmenta Assessment (4)

	Landscape	No serious change may occur for the landscape, since culverts under the road are usually not seen, although corrugated steel pipes for the culverts are not matched with the surroundings.	To conserve an excellent landscape and not to give an incongruity sense to the surroundings.	Many culverts may give a little negative impact to the surroundings, so that proper countermeasures are necessary.	-	-	-	-	-	-
	Water quality	The soil near the flow-out and flow-in of culverts may be eroded and increase suspended solid in river water.	Not to exceed the present water quality revels or the water quality standards by the Ministry of Urban Affair.	The soil near the flow-out of culverts may increase the suspended solid in river water, so that proper countermeasure should be done during the road improvement.	The flow-in and flow-out of the culverts should be protected by concrete for the prevention of the soil erosion.	-	-	-	-	-
Waste	Flora	A volume of the waste regarding to the action of the road improvement is quite limited, so that no serious impact may occur for flora.	Not to give a remarkable influence to the existing flora.	The volume of the waste regarding to the road improvement and thrown away from vehicles during the road use is not serious impact to flora.	-	-	-	-	-	-
	5.Fauna	A volume of the waste regarding to the action of the road improvement is quite limited, so that no serious impact may occur for fauna.	Not to give a remarkable influence to the habitat of fauna.	With an increase of the traffic volume, animals such as deers and monkeys will have more chance to eat the waste thrown away from the vehicles. In this case, the waste may give a negative impact to the fauna habitats.	-	-	-	-	-	-
	Landscape	A volume of the waste regarding to the road improvement is quite limited, so that no serious change may occur for the landscape.	To conserve an excellent landscape and not to give an incongruity sense to the surroundings.	An increase of the waste thown away from vehicles is the negative impact destroying an excellent landscape. But it may be not serious problem.	-	-	-	-	-	-
	Water quality	The waste oil which was exhausted by heavy machines and dump tracks during the road improvement, may permeate into underground or flow into river, and contaminate underground water or river water.	Not to exceed the present water quality revels or the water quality standards by the Ministry of Urban Affair.	The waste oils exhausted by heavy machines and dump-tracks may contaminate underground water or river water. Proper countermeasure should be done during the road improvement.	The waste oils exhausted by heavy machines and dump-tracks should be managed not to contaminate underground water or river water, during the road improvement.	-	-	-	-	-

Table - 17 Summary of Environmenta Assessment (5)

Facilities for work	Water quality	The living water discharged from the worker's camp or workshop may contaminate river water.	Not to exceed the present water quality revels or the water quality standards by the Ministry of Urban Affair.	The living water discharged from the worker's camp or workshop may locally contaminate river water but the degree is not remarkable, so it is enough to follow the SENAC standard.	The living water discharged from the worker's camp or workshop should be properly drained according to the SENAC standard.	-	-	-	-	-
Bridge	Landscape	The landscape will be changed. The degree of the change depends on coloring of bridgepiers and girders.	To conserve an excellent landscape and not to give an incongruity sense to the surroundings.	The artificial building such as a bridge may give a negative impact to the surroundings more or less, so that it is necessary not to give more incompatible sense to the surroundings.	The bridge should not be painted by an incompatible color with the surroundings.	-	-	-	-	-
Traffic and traffic safety	Fauna	With increase of quantity of traffic, a traffic accident for the animals crossing the road will increase. Especially, on the road across the gallery forest between the Matos and Apere rivers, where a lot of mammal animals are observed to inhabit.	Not to give a remarkable influence to the habitat of fauna.	An increase of the traffic accidents for the animals gives a negative impact to the fauna habitats.	For avoidance of the traffic accident for animals, road signs should be set up and eco-road (tunnels) should be installed at the sites of high embankment more than 2 meters high.	Road sign $3,000 Tonnel for wild animals $120,000	SENAC	-	-	-
	Air quality	The forecast concentration for the years 2020 varies from 0.0 ppm (0.0 mg/m3) to 0.00014 ppm (0.00027 mg/m3) and from 0.0 (0.0 mg/m3) to 0.00026 ppm (0.00032 mg/m3) respectively.	Not to exceed the present air quality or the standards for the purpose of health protection in National Ambient Air Quality Standards of USA.	The forecasting concentrations of NO2 and CO from vehicles for the years 2020 are 0.0011 ppm□'0.0029 ppm and 0.000 ppm□' 0.055 ppm less than that of the environmental standards.	For the prevention of the dust scattering around the town areas, asphalt road or watering should be done.		SENAC	Monitoring of air quality around the cities(1time/2year), regular measurement of aire quality in 3 points such as San Borja, San Ignacio, Trinidad.	$2,000	SENAC
	Noise	The forecasting noise levels at San Borja, San Ignacio and Trinidad for the years 2020, which are based on the forecasting traffic volume and the existing noise levels, range from 44.2 dB(A) to 61.3dB(A).	Not to exceed the present noise level	The forecasting noise levels at San Borja, San Ignacio and Trinidad are only 3 dB(A) in maximum higher than that of the present noise levels. Therefore, the influence to the noise is considered to be very small.	-	-	-	Monitoring of noise around the cities(1time/2year), regular measurement of noise in 3 points such as San Borja, San Ignacio, Trinidad.	$2,000	SENAC

Table - 17 Summary of Environmenta Assessment (6)

Earth work (cutting, embankment, etc.)	Ruin and cultural properties	As considered the character of the improvement, there is little possibility to destroy other new ruins. But pits will be excavated by side borrow in some places for the elevation of road, then other ruins can be excavated and destroyed	Ruins and cultural properties should be conserved without the devaluation	Respect to the possibility to discover and destroy other ruins, some measurement should be taken during the work	Distribution study before the work and regular observation during that by specialists should be taken place to avoid the destruction of unconfirmed ruins.	Distribution study before the work $17,120 Regular observation $28,800	SENAC	–	–	–
Road facilities (road, bridge, culvert, etc.)		As considered the increase of population in future, there is possibility of the destruction of ruin and cultural properties by constructing private road and house, and cultivating farms	Ruins and cultural properties should be conserved without the devaluation	The improvement can not be direct reason for the destruction. But it is necessary to deliberate the measurement for avoid a little damage, too.	–	–	–	Regular observation study for the conservation of ruin□↳P time□^year□), that is realized for preventing the destruction of ruin and cultural properties by constructing private road and house, and cultivating farms	$4,000□^"N	Institute of ruin
Elevation of movement	Community	Positive impacts; easy reflection of politics, quick medical treatment, easy attendance to high education, regular bus operation Negative impacts;illegal residence, illegal woods cutting, poaching, conflict of landownership	Development with harmony and peace should be given to society and eminent negative impact should not be given to life environment.	Hospital, facilities for high grade education and traffic facilities should be expanded. Some measurement for illegal action and conflict of landownership should be taken.	Bus stop, minimum emergency medical equipment should be installed. Local office and guardian should be prepared.	Busstop $6,500 emergency medical equipment $80,000	SENAC Welfare Ministry	Monitoring system arrangement for mediation of conflict by illegal action $89,938 (early stage $37,938) Every year $2,600	$2,600	Public corporation of Forest
Earth work (cutting, embankment, etc.)		Level difference between the objective road and access road to community can be obstacle for traffic.	Development with harmony and peace should be given to society and eminent negative impact should not be given to life environment.	Some measure should be taken to avoid obstacle element for communication between communities, transportation of goods, and security	The low part should be filled up as high as objective road	Fill up $16,000	SENAC			
Passage in whole year	Economic activity	Activation of distribution of goods, development of agriculture and farming, creation of new industry, illegal woods cutting, elevation of land price, extension of economic difference between landowner and who does not own a land	Development with harmony and peace should be given to regional economy and eminent negative impact should not be given to sustainable development.	It is necessary to arrange distribution facilities, to grow timber processing and tourism industry, and to order a monitoring system for illegal woods cutting.	Local office and personal for monitoring should be installed			(See Community above mentioned)		Public corporation of Forest