6.8 Community

6.8.1 Distribution of Native People

According to the document "Caracterización Ambiental y Socioeconómica, Fundación para el Desarrollo de la Ecología e Instituto de Ecología" (Salm and Flores, 1994), the distribution of natives in the Study Area is as follows:

(1) Moxean (Mojeños - Ignatian and Trinitarian)

They occupy the Central and Southern regions of the Beni Department. Their major settle-ments, since the Jesuit Missions are: Trinidad, San Ignacio, San Javier and Loreto, while the settlements from the Republican era are: San Lorenzo and San Francisco. The Moxean are found along the rivers, mainly in the middle and high reaches of the Mamoré River, the rivers from the Isidoro-Secure basin, and those of the so-called "Chimanes Forest."

(2) Chimanes

These people occupy the Maniqui River basin and the lower slopes and foothills of the mountain ranges, following the Secure-Yucumo-Rurrenabaque colonization project.

(3) Yuracare

These people occupy the Chapare River zones, the Isidoro-Secure basin and some communities from the Multiethnic Native Territory.

(4) Movima

These people occupy the territories of the Yacuma Province, especially the central part.

The above native territories and the Chimanes Forest are shown in Figures 6-8-1 and 6-8-2, respectively.

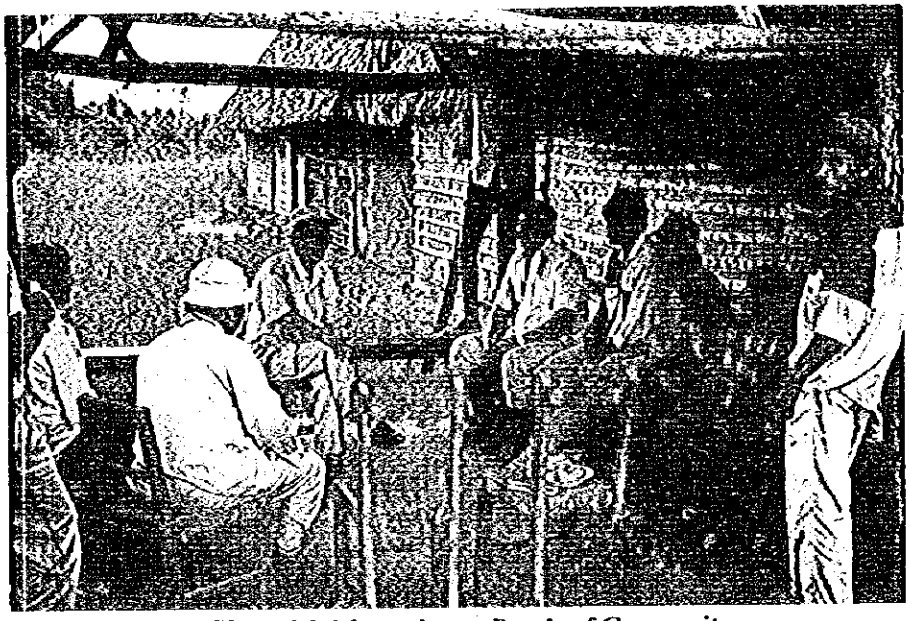


Photo 6-8-1 Interview to People of Community

Photo 6-8-2 Traditional Culture in San Ignacio

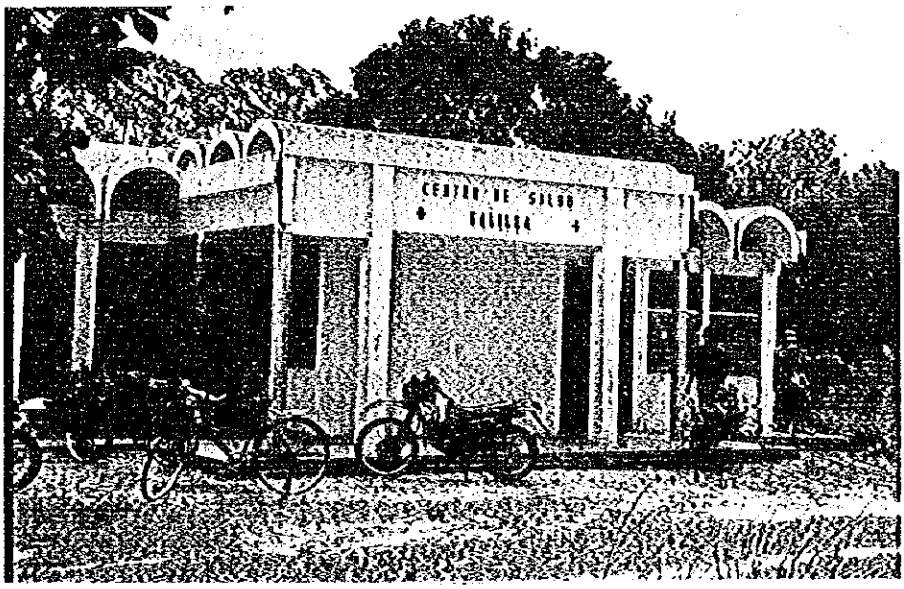
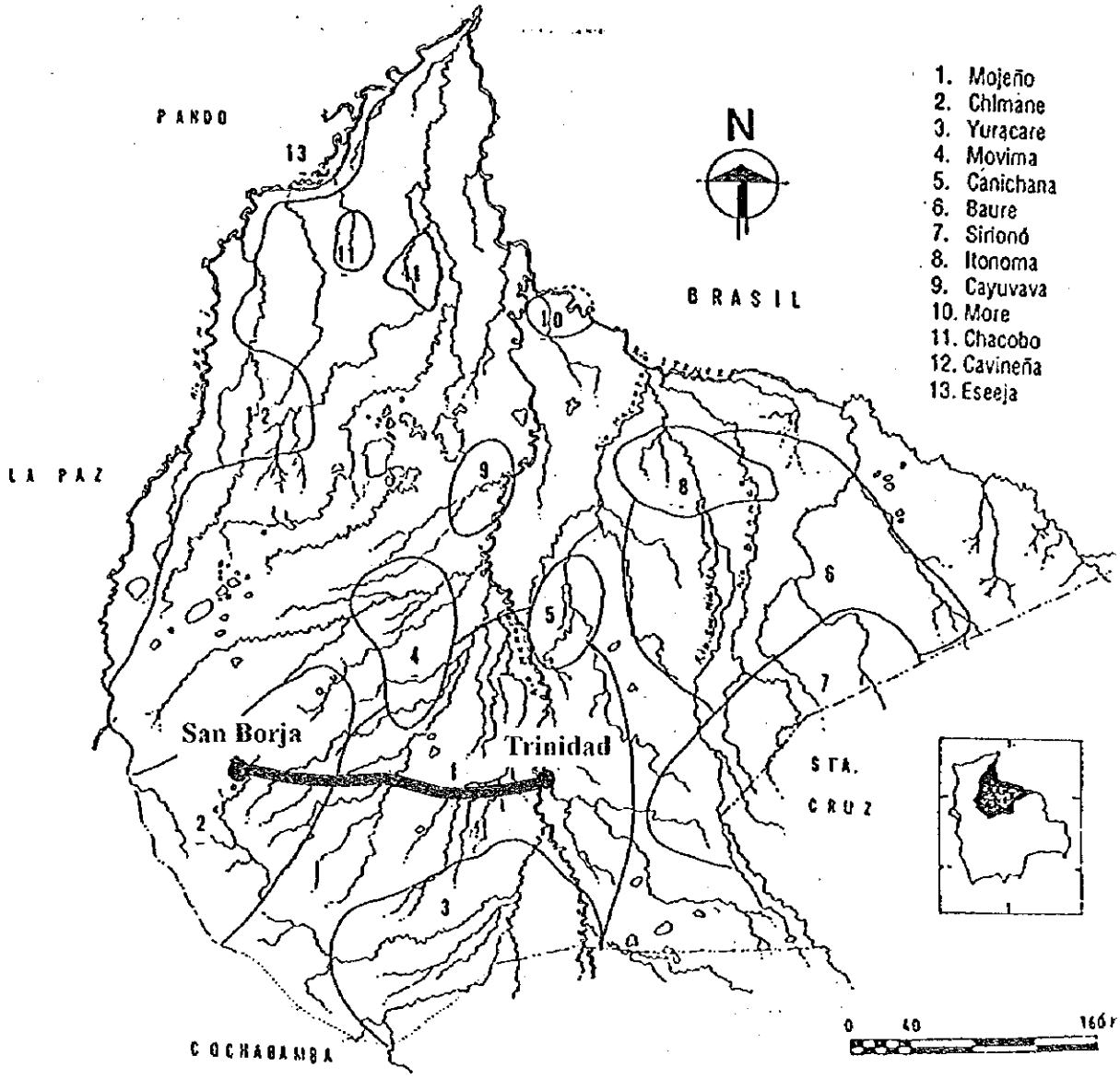


Photo 6-8-3 Health Center in Villa Garitea between Rio Curiraba and San Borja

Figure 6-8-2 Chimanes Forest



Source : Plan de la Reserva de la Biosfera
Estación Biológica del Beni

Figure 6-8-1 Distribution of Main Indigenous Groups in Beni

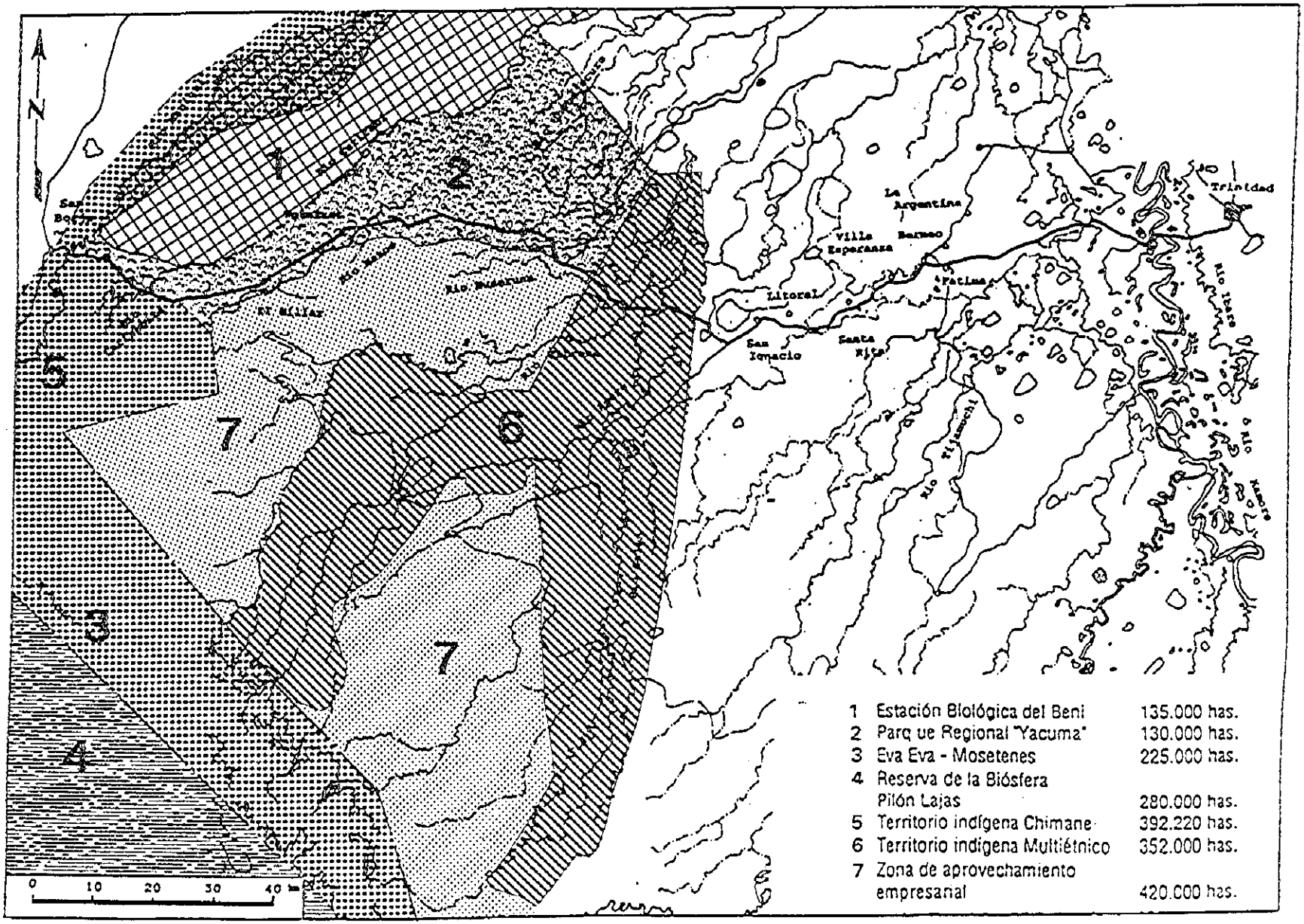


Figure 6-8-2 Chimanes Forest

6.8.2 Population

The actual number of native people is not yet known, but according to the Bolivian Indigenous Institute, 1990 (Instituto Indigenista Boliviano, 1990), the population of some ethnic groups in Beni is estimated at approximately 600,000, which accounts for 22% of the total number of inhabitants belonging to ethnic groups in Bolivia, as shown in Table 6-8-1.

Table 6-8-1 Estimated Population of Some Ethnic Groups

Ethnic Group	Province	Linguistic Family	Estimated Population	
			Minimum	Maximum
Baure	Itenez	Arawac	4,000	4,000
Canichana	Mamoré	Canichana*1	1,000	1,000
Cavineno	Vaca Diez Ballivian	Tacana	500	2,000
Cayubaba	Yacuma	Cayubaba*1	40	40
Chacobo	Yacuma	Cayubaba*1	40	40
Chimán	Ballivian	Moseten	4,500	6,200
Esse Ejja*2	Vaca Diez Ballivian	Tacana	500	1,500
Ignaciano	Moxos	Arawac	4,000	12,000
Itonama	Itenez Mamoré	Itonama*1	110	4,500
More	Mamoré	Chapacura	150	350
Moseten*3	Ballivian	Moseten		1,200
Movima	Yacuma	Movima	1,000	2,000
Reyesano	Ballivian		1,000	1,000
Siriono*4	Cercado Itenez	Tupi guaranf	610	1,000
Trinitario	Cercado Moxos	Arawac	5,000	18,000
Yuracare	Cercado	Yuracare*1	500	4,000
Total				59,590
Total in the Department				276,174
Percentage of Indigenous Population				21.58

Note - * : Formed by isolated families
*1 : Distributed in Pando and Beni
*2 : Distributed in Beni and La Paz
*3 : Distributed in Beni and Santa Cruz
Source : Bolivian Indigenous Institute, 1990

6.8.3 Number of Families and Typical Family Composition

During the field work study period, the data of the number of families, inhabitants and inhabitants per family in each community was collected as shown in Table 6-8-2. The location of these communities is shown in Figure 6-8-3. Most communities consist of less than 50 families and 300 inhabitants. The average family size is about 5 to 8 members. As will be noticed, it was not possible to obtain data in several cases.

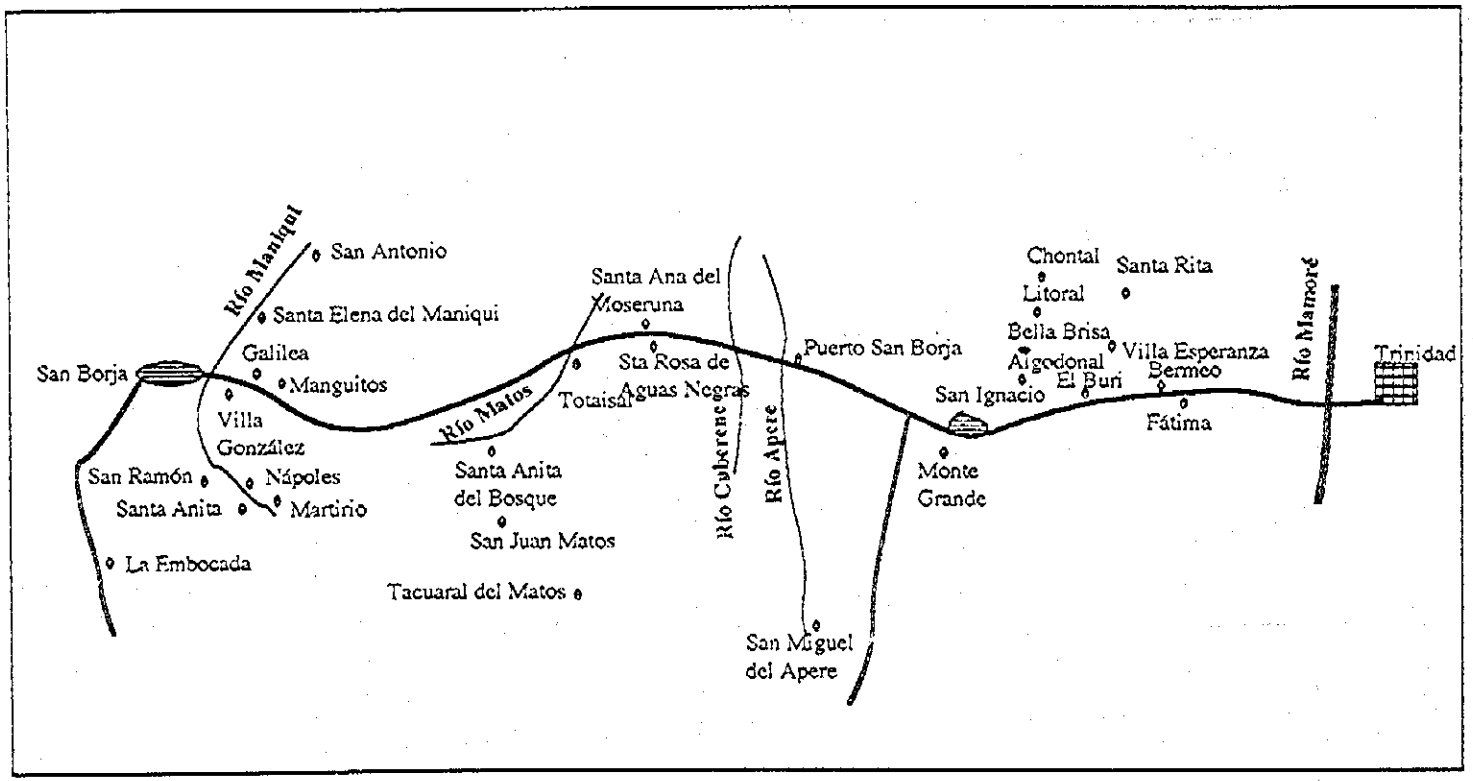
Table 6-8-2 Number of Families, Inhabitants and Inhabitants per Family in Each Community

Community	Number of Families	Inhabitants	Inhabitants per Family
San Ramón	n.a.	61	n.a.
Nueva Brisa	n.a.	89	n.a.
Santa Anita (San Miguel)	n.a.	94	n.a.
San Antonio	n.a.	212	n.a.
Fátima	n.a.	292	n.a.
La Emboscada	n.a.	412	n.a.
Manguitos	10	n.a.	0.0
Santa Ana de Moseruna	10	n.a.	0.0
El Buri	11	80	7.3
Monte Grande	13	106	8.2
Tacuaral del Matos	15	n.a.	0.0
Litoral	15	105	7.0
Santa Rosa de Aguas Negras	17	68	4.0
Algodonal	17	94	5.5
Villa Esperanza	17	107	6.3
Chontal	20	n.a.	0.0
Santa Anita del Bosque	20	150	7.5
San Juan Matos	25	114	4.6
San Miguel del Apere	25	140	5.6
Galilea	32	208	6.5
Puerto San Borja	36	n.a.	0.0
Nápoles	40	n.a.	0.0
Martirio	40	180	4.5
Santa Rita	40	240	6.0
Bermeo	50	260	5.2
Villa González	58	229	3.9
Totaizal	60	350	5.8

Source : Field work by the JICA Study Team, 1995

6.8.4 Place of Origin or Former Residence (Urban or Rural)

During the field survey work, the place of origin (since the foundation of the settlement) and the secondary origins of the visited communities were investigated. The results of such work are shown in Table 6-8-3 and 6-8-4, respectively. Regarding the original place of origin, mainly all the interviewed inhabitants are from San Ignacio; however, as a secondary origin, the majority of inhabitants have Ignatian and Chiman origins.



Plano General de Ubicación de comunidades visitadas en el trabajo de campo
Area Económico, Social y Cultural

Figure 6-8-3 Location of Communities

Table 6-8-3 Places of Origin of the Population

Community	Origin
Villa González	Borjian
Santa Elena del Maniqui	Borjian
San Miguel del Apere	Carmen del Cabitu
Manguitos	Chiman
Galilea	Near Yacuma
Santa Rosa de Aguas Negras	San Ignacio Canton, San Borja Canton
La Embocada	Ranches near a San Borja
Fátima	Ignatian
Bermeo	Ignatian
Villa Esperanza	Ignatian
Santa Anita (San Miguel)	Maniqui (downstream)
Nápoles	Chimán river
Tacuaral del Matos	Maniqui river
San Antonio	Maniqui river
Martirio	Maniqui river
San Ramón	Maniqui river (Puerto Lata)
San Juan Matos	San Borja, Reyes
Santa Ana de Moseruna	San Ignacio
Puerto San Borja	San Ignacio
El Buri	San Ignacio
Santa Rita	San Ignacio
Algodonal	San Ignacio
Litoral	San Ignacio
Chontal	San Ignacio
Nueva Brisa	San Ignacio
Monte Grande	People that are joined and live in the place
Santa Anita del Bosque	People that are joined and live in the place
Totaizal	Trinidad, San Borja, Santa Ana (3 families)

Source: Field work by the JICA Study Team, 1995

Table 6-8-4 Secondary Places of Origin of the Population

Community	Origin
La Embocada	Borjian
Santa Elena del Maniqui	Borjian, Pueblo Nuevo, North of San Borja
Totaizal	Borjian, Carmen del Matos, Iturralde
San Miguel del Apere	Carmen del Cabitu, Carmen del Aperecito, Pueblo Nuevo
Martirio	Chiman, Vuracare
Nápoles	Chiman
San Antonio	Chiman
San Ramón	Chiman
Tacuaral del Matos	Chiman
San Juan Matos	Collas, Reyes, Trinitarian, Ignatian
Galilea	Belong from here
Santa Anita del Bosque	16 families belong here, San Borja, Yacuma, San Ignacio
Manguitos	Belong from here
Fátima	Belong from here, San Ignacio
Monte Grande	From the area
Santa Rosa de Aguas Negras	Cantón San Ignacio, Cantón San Borja
Algodonal	Ignatian
Bermeo	Ignatian, Trinitarian
Chontal	Ignatian
El Buri	Ignatian
Litoral	Ignatian
Nueva Brisa	Ignatian
Puerto San Borja	Ignatian, Trinitarian, Movimas
Villa Esperanza	Ignatian
Villa González	San Borja, San Ignacio Apere (near)
Santa Ana de Moseruna	San Ignacio, Santa Ana (one family)
Santa Rita	San Ignacio, Trinitario
Santa Anita (San Miguel)	Yuracare

Source: Field work by the JICA Study Team, 1995

6.8.5 Year of Foundation of the Settlements

Table 6-8-5 shows the foundation year of some of the visited settlements. Most of them were settled before the construction of the existing San Borja - Trinidad road section (1976.)

Table 6-8-5 Foundation Year of each Settlement

Name of the Settlement	Foundation Year
Nápoles	1900
San Ramón	1930
El Buri	1939
Tacuaral del Matos	1945-1955
Bermeo	1950
Santa Anita (San Miguel)	1950-1960
Fátima	1955
San Miguel del Apere	1959
Monte Grande	1960
La Embocada	1960
Puerto San Borja	1963
Santa Elena del Maniqui	1963
Chontal	1967
Santa Rosa de Aguas Negras	1968
Martirio	1971
Villa González	1972
Totaizal	1972
Algodonal	1972
Nueva Brisa	1972
Litoral	1976
Galilea	1978
Santa Ana de Moseruna	1978
Villa Esperanza	1979
San Juan Matos	1986
Santa Anita del Bosque	1989

Source : Field work by the JICA Study Team, 1995

6.8.6 Total Area of Settlements

The area of the settlements was also investigated during the field survey. Table 6-8-6 reflects that the area of each settlement is quite variable, ranging from 10 ha to 6,000 ha. Some communities did not have a specified area because they were located in the Multiethnic Native Territory or the Chiman Territory.

Table 6-8-6 Area of Each Settlement

Name of the Settlement	Area of the Settlement (ha)
Fátima	10
San Ramón	35
Santa Elena del Maniqui	100
Santa Rosa de Aguas Negras	340
El Buri	350
Totaizal	450
Galilea	494
Martirio	800
Santa Anita del Bosque	1,000
Nápoles	1,000
Algodonal	1,180
La Embocada	2,051
Villa Esperanza	2,113
Santa Rita	2,250
Villa González	4,000
Bermeo	4,000
Nueva Brisa	6,000

Source : Field work by the JICA Study Team, 1995

6.8.7 Major Means of Subsistence

According to Salm and Flores (1994) the native people in Beni, despite historical pressures during the Jesuit and Republican periods, maintain their traditional elements, normally supplying themselves with the surrounding natural resources as their main means of subsistence. The following are typical elements shared by these native people:

- A slash-and-burn type of agriculture was practiced in small plots, with an average size of one hectare. This land was used for a 2-3 year period, before moving on to another site.
- Cattle raising was practiced during the period of the Jesuit Missions, but nowadays only some communities have some cattle, and there are no communities that own substantial herds.
- Fishing and hunting are also practiced as a means of ensuring a stable food supply. Vegetal species are used for construction, craftsmanship, medicinal and nutritional purposes, as well as honey, "piyo", and turtle eggs. Craftsmanship, cotton fabrics, vegetal fibers, and ceramics are also a means of support.

The main means of subsistence of each native group is summarized below in more detail:

(1) Moxean

The productive activities of this group are based on agriculture, hunting, fishing, collecting, craftsmanship, and stockyard animals such as cows and horses (COTIM, CIDDEBENT: 1992.)

(2) Chimanes

According to Estenssoro (1991), the Chimanes engage in agricultural activities on alluvial terraces, using the slash-and-burn type of agricultural system, which is a migratory system. Plots are used for a period of 3-4 years before rotating to a previous crop area. Major crops are rice, bananas, yucca, corn, fruits, etc. Production is mainly destined for self-consumption, with any surplus of some crops destined for the marketplace.

- The Chimanes have three systems for cultivating species: 1) family gardens growing medicinal plants and fruit trees, 2) fallow plots used as seed banks for yucca and banana, and 3) small farms ("chacos") mostly for agricultural production for subsistence and marketing (Piland, 1990.)
- Cattle-farming activities include the breeding of domestic animals mainly for consumption and, occasionally for sale at the marketplace.
- Hunting is the primary way in which the Chimanes obtain meat, eggs, and hides. They hunt every one or two weeks. The main hunting instrument is the bow and arrow, although there is now a tendency for men to use firearms. Women, meanwhile, build traps. According to Stearman and Redfold (1989), the Chimanes basically hunt 32 species, mainly mammals (18 species) and birds (11 species.) The hunting areas are near their homes, but may also be up to 15 km away, where they usually build temporary housing.
- Fishing is a traditional Chimane activity in streams and rivers, using instruments such as bows, arrows, traps and the barbasco (sarjania inebrans) plant as an organic toxin used to kill fish. This, however, causes the large-scale elimination of the fish. Among the consumed fishes are the "pacú", and the "surubi", which is sort of a big catfish, and others.
- Pick-up harvesting is another important subsistence activity of the Chimanes. This is done daily by women and children, based on knowledge of the species, and is used for food, medicine, fuel, construction, craftsmanship, and rituals.

- Craft items made by the Chimanes are basically for self-consumption. The men build canoes, flat-bottom boats, and hunting devices, while the women make cotton fabrics in vertical looms, mats from "chuchio", which is a sort of thin palm leaf, and fiber fans and bags. In recent years the Chimanes have entered the market with "Jatata" cloth. In 1989, with the establishment of the Chimane Self-management Committee, "Jatata" cloth was sold directly, without intermediaries, which allowed the natives to obtain higher earnings from their work.

(2) Yuracare

The main means of support for these people are hunting, fishing, pick-up harvesting and agricultural activities. The Yuracare area in the Multiethnic Native Territory is the poorest in resources. Hunting, fishing and pick-up harvesting activities are carried out in the central area (COTIM, CIDDEBENI: 1992.)

(3) Movima

The Movimas are fishermen and farmers. With the Jesuit Reduction they became cattle-farmers, and as skillful craftsmen they build canoes, cart-wheels, flat-bottom boats, "tacus" (typical wooden grinders) for grain and other products, and bundles. The women weave mats and make pottery.

6.8.8 Administrative Organizations in the Communities

The administrative organization of each community was investigated. The results are summarized as follows:

(1) Moxean

The Moxean relationship is made up of family ties and alliances. The political organization is centralized in municipal councils, with the Corregidor acting as the highest authority. The municipal council ("cabildo") is an organization inherited from the age of the Jesuit Missions in 1700 (COTIM, CIDDEBENI: 1992.)

(2) Chimanes

The Chimanes are organized around the family as the main social, political, and economic unit. They do not have any centralized function within the organization. Leadership is held by the family head. The old men are considered the patriarchs of the local residential group, and exert a certain influence on ensuring social ties within the ethnic group; the "chamán" or healer, is the spiritual leader of the group. In 1989 the Chiman Council was formed, consisting of four secretaries, seven zone heads and 24 community-guard heads. The Chiman Council represents 50% of the total population and does not include families located on the Biosphere Reserve-Biologic Station of Beni and the Multiethnic Native Territory (Estenssoro: 1991.)

(3) Yuracare

The Yuracare's social and political organization does not incorporate a general authority for all the Yuracare people because the organization of the Moxean and Movimas, which was focused on the native municipal councils or "cabildos", was adopted as a result of pressure from colonists. They have formed the Native Sub-Central of the Isidoro-Secure Park, with an active participation in the territorial management of both the Park and the Chimanes Forest (COTIM, CIDDEBENI: 1992.)

(4) Movimas

Their social and political organization is similar to the Moxean's native municipal councils ("cabildos"). Existing authorities in the investigated communities are shown in Table 6-8-7.

6.8.9 Distance and Ways of Transportation

During the field survey work, each community was surveyed to find out which towns are mainly used when services are required. In addition, the community was also asked about the town and marketplaces where the people go to sell or buy merchandise. The results show that people in each community go to the largest town nearby. The results are summarized in Tables 6-8-8 and 6-8-9, respectively.

Table 6-8-7 Authorities in Each Community

Community	Authorities
Algodonal	Corregidor, Chiefs ("Caciques"), President of family parents
Bermeo	Corregidor, Caciques
Chontal	Corregidor, Caciques, Big Captain, President of parents
El Buri	Big Captain, Cacique, Corregidor
Fátima	Corregidor, Caciques
Galilea	Labor Union, Municipal agents, (Field mayor)
La Embocada	Corregidor, Agricultural Council, Popular Guards
Litoral	Corregidor, Caciques, Sheriffs, President of parents
Manguitos	Corregidor
Martirio	Corregidor, School mayor, ORB
Monte Grande (1 or 2 persons)	Corregidor, Cacique, Sheriff
Nápoles	Corregidor, School mayor, ORB
Nueva Brisa	Corregidor, Caciques, Big Captain, President of parents
Puerto San Borja	Corregidor, Cacique (1 and 2), Sheriff
San Antonio	Corregidor, President of ORB, Vice-president, School mayor
San Juan Matos	Corregidor, Secretary General
San Miguel del Apere	Corregidor, Cacique, Sheriff
San Ramón	Corregidor, School Mayor, ORB
Santa Ana de Moseruna	Corregidor, Cacique, Secretary General
Santa Anita del Bosque	Corregidor, Labor union
Santa Anita (San Miguel)	Corregidor, School Mayor, ORB
Santa Elena del Maniqui	School Mayor
Santa Rita	Sheriff, Cacique, Corregidor
Santa Rosa de Aguas Negras	Corregidor, Cacique, Sheriff, School Mayor
Tacuaral del Matos	Corregidor, School Mayor, Chief of Area
Totaizal	Corregidor, Rural Mayor, Labor Union (ORB)
Villa Esperanza	Corregidor, Cacique
Villa González	Rural Mayor, Corregidor, Labor Union (ORB)

Source : Field work by the JICA Study Team, 1995

Table 6-8-8 Towns Resorted to for Services by Inhabitants in Each Community

Community	Origin
Monte Grande	San Ignacio
Santa Anita del Bosque	San Borja Timber Company
Galilea	San Borja
Santa Rosa de Aguas Negras	San Ignacio
Villa González	San Borja
Manguitos	San Borja (El Limoncito School, one day of travel)
Totaizal	San Borja
Santa Ana de Moseruna	San Ignacio
San Miguel del Apere	San Ignacio
Puerto San Borja	San Ignacio
Fátima	San Ignacio
Bermeo	San Ignacio
Villa Esperanza	San Ignacio
El Buri	San Ignacio
Santa Rita	San Ignacio
Algodonal	San Ignacio
Litoral	San Ignacio
Chontal	San Ignacio
Nueva Brisa	San Ignacio
La Embocada	San Borja
San Juan Matos	For health purposes, to the company (25 km) and to San Borja
Tacuaral del Matos	San Borja and Horeb
San Antonio	San Borja
Santa Elena del Maniqui	San Borja
San Ramón	San Borja
Nápoles	San Borja
Santa Anita (San Miguel)	San Borja
Martirio	Horeb and San Borja

Source: Field work by the JICA Study Team, 1995

Table 6-8-9 Towns Resorted to for Sale and Purchase of Merchandise by the Inhabitants in Each Community

Community	Market
Totaizal	(Occasionally they sell pigs and chickens in San Borja)
Monte Grande	San Ignacio (however, most of them sell on their farms)
Galilea	San Borja
La Embocada	San Borja
Manguitos	San Borja (El Limoncito School, one day of travel)
Martirio	Horeb and San Borja
Nápoles	San Borja
San Ramón	San Borja
Santa Anita del Bosque	San Borja
Santa Anita (San Miguel)	San Borja
Santa Elena del Maniqui	San Borja
Villa González	San Borja
San Antonio	San Borja (traders come to buy)
San Juan Matos	San Borja (cattle breeders come to buy)
Tacuaral del Matos	San Borja (come from ranches)
Algodonal	San Ignacio
Chontal	San Ignacio
El Buri	San Ignacio
Fátima	San Ignacio
Litoral	San Ignacio
Nueva Brisa	San Ignacio
Puerto San Borja	San Ignacio
San Miguel del Apere	San Ignacio
Santa Ana de Moseruna	San Ignacio
Santa Rosa de Aguas Negras	San Ignacio
Villa Esperanza	San Ignacio

Source: Field work by the JICA Study Team, 1995

The first column in Table 6-8-10 shows the distance in kilometers to San Borja. The second column shows the distance to the San Borja-Trinidad road section, while the third column refers to the distance from that road to the most commonly used towns. This Table also shows the method of transportation used as well as the corresponding fare, where such information could be obtained. Except for San Miguel del Apere, all the communities are located within a distance of 20 km from the San Borja-Trinidad road section.

6.8.10 Social Life of the Native People

(1) Housing

Based on the 1992 census, the type of housing located in the Canton along the San Borja and Trinidad road is summarized and shown in Table 6-8-11. Most of the native people live in bundles (junk-built houses), shacks, barracks, etc., without water and electricity.

Table 6-8-10 Distance to San Borja in km, Method of Transportation Used and Fare

Community	San Borja (km)	Distance to the Road (km)	Method of Transportation	Fare
Nápoles			Canoe	
San Ramón			Canoe, by foot	
San Antonio		14.0	By foot or canoe	
Santa Anita (San Miguel)		15.0		
Martirio		20.0	Horse	
Santa Elena del Maniqui		7.0	By foot, cart	Bs.40
Galilea	10		Bicycle, pick-up, truck	
Santa Ana de Moseruna	110		Truck	Bs.10
Santa Rosa de Aguas Negras	110	2.0	Pick-up, truck	Bs.30
Puerto San Borja	117		Truck	Bs.5
Manguitos	12		By foot, truck	Free
San Miguel del Apere	134	40.0	Unknown	
Algodonal	134	0.5		
Monte Grande	130	2.0	Pick-up, truck	Bs.6 (Express Bs.25)
Nueva Brisa	142	9.0		
Litoral	145	10.0		
Chontal	145	15.0	Little use	
Santa Rita	150	5.0	Cart	Bs.3
El Buri	165	1.0	Truck (loaded)	Bs.5 and Bs.10
Villa Esperanza	165	3.0	Truck	Bs.5
Bermeo	185	1.0		
Fátima	190		Truck, San Ignacio	Bs.5 to Bs.7
La Embocada	23			
Tacuaral del Matos	27	12.0		Bs.5
Santa Anita del Bosque	27	2.0	Truck	
San Juan Matos	27	7.0	Truck	Bs.5
Totaizal	50	0.3	Truck	Bs.20 and Bs.5 per quintal
Villa González	7	0.3	By foot or truck	

Source: Field work by the JICA Study Team, 1995

Table 6-8-11 Type of Housing

Type of Housing	Province/Canton Cercado/Zone 1	Ballivian/San Borja	Moxos/San Ignacio	Yacuma/Palacios
Total (A)	630	3,691	1,968	749
Independent house (B)	434	2,388	1,478	397
Apartment (C)	1	22	3	2
Bundle house (D)	49	232	67	7
Shack (E)	121	953	396	333
Barrack (F)	0	54	11	6
Provisional house(G)	25	42	13	4
(D+E+F+G)/A (%)	31.0	34.7	24.7	46.7

Source: INE

(2) Clothing

According to Reister (1993:121), the Chimanes traditionally used long dresses with short or long sleeves (similar to ponchos) made of cotton or tree-bark yarns. Both men and women wore these dresses, which were decorated with drawings. Nowadays, the

Chiman clothing has become Westernized, and is bought at markets, especially popular are second-hand or used garments. The other native groups also wear Western clothing.

(3) Nourishment

The nourishment of the native people is related to the products they cultivate, gather, hunt, and fish. The Chimanes obtain most of their food from forest resources. Trees supply them all kinds of fruits, in addition to the other goods they use, such as clothing, rope, and medicines. Gathering of fruits, honey, and eggs is one part of a varied diet. Hunted birds, mammals and reptiles are another part of their nourishment. Fishing in streams, lakes and rivers provides a source of protein and other nutritious substances. When the Chimanes have no fish in their meal, they consider that they have not eaten, which means that fishing plays a predominant role in their life, followed by hunting. The farm products they consume include yucca, bananas, corn, papayas, kidney beans, pumpkins, chili, and onions. Chimanes cultivate about 90 different crops, which form the basis of their nourishment (Piland, 1991.)

(4) Religion

According to the data from the census carried out by INE, 79% of the families living in Canton Zone 1, Ballivian, Yacuma and Moxos are Catholics, followed by Protestants (9.6%.) In the religion survey conducted during the study, it was found that most of the communities are Catholic, as shown in Table 6-8-12.

(5) Marriage

According to Riester (1993: 108), the Chimanes (the most studied ethnic group) marry cross cousins, as a preferential rule. Although it is taboo to marry parallel cousins, there is an interchange of women between the two lineages. The exogamy in marriage is also practiced because it is possible to interchange economic assets when people get married outside of their lineage. Marriage is a motive for reciprocal relationships, and it may take different forms:

① Marriage with the cross female cousins from the mother's lineage

The family giving a daughter cannot take as a spouse someone from the same group.

Table 6-8-12 Religions Professed in the Community

Community	Religion
Algodonal	Catholic
Bermeo	Catholic
Chontal	Catholic
El Buri	Catholic
Fátima	Catholic
Galilea	Protestant
La Embocada	Catholic and Protestant
Litoral	Catholic
Manguitos	Catholic
Monte Grande	Catholic
Nápoles	Protestant
Nueva Brisa	Catholic
Puerto San Borja	Catholic
San Antonio	Protestant
San Miguel del Apere	Catholic and 3 Protestant families (16 persons)
Santa Ana de Moseruna	Catholic and 3 or 4 families from the Assembly of God
Santa Anita del Bosque	Catholic
Santa Anita (San Miguel)	Protestant
Santa Rita	Catholic
Santa Rosa de Aguas Negras	Catholic and Protestant
Totaizal	Catholic
Villa Esperanza	Catholic
Villa González	Catholic and one Protestant family

Source: Field work by the JICA Study Team, 1995

② Marriage with the cross female cousins from the father's lineage

The interchange is direct with the group which receives the woman, which incurs a debt to be paid in the next generation to the ones who give.

③ Closed system of women-interchange

Small groups are created to achieve a collective harmony that results in the solidarity of the marriage alliance.

④ Compound marriage

One man has two wives and the children of both wives are used for the interchange of daughters.

⑤ Family guidance

This is carried out when the ego is born and grows, including the father, mother and the children.

The Chimanes believe that single people will marry in heaven, while married people will change partners in heaven. However, this is not believed by the Chimanes that marry under the Catholic faith, which is why it is not an incentive for accepting the Christianity.

The Chimanes maintain product-interchange relationships with other native groups such as the Yuracare, the Ignatian, and the Trinitarian. In some instances, Ignatian or Trinitarian women (mainly those who arrived in the Chiman territory with the Loma Santa Movement) marry men from the Chimanes.

(6) Traditional Cultural Heritage

The language is considered the most important element for the cultural identity of native groups because it is a traditional cultural heritage that persists, and with which the ethnic groups are identified in comparison with other social sectors.

During the field work survey, the most commonly spoken language of children, women and men was investigated. Most adults can speak both Spanish and their own language; however, the main language spoken by children is Spanish. The results are shown in Tables 6-8-13, 6-8-14 and 6-8-15, respectively.

Table 6-8-13 Languages Spoken by Children

Community	Language
Algodonal	Spanish
Bermeo	Spanish
Chontal	Spanish
El Buri	Spanish
Fátima	Spanish
Galilea	Spanish
La Embocada	Spanish
Litoral	Spanish
Monte Grande	Spanish
Nueva Brisa	Spanish
Puerto San Borja	Spanish
San Juan Matos	Spanish, Aymara, Trinitarian
San Miguel del Apere	Spanish, Trinitarian, Movima/Ignatian, Yuracare
Santa Ana de Moseruna	Spanish
Santa Anita del Bosque	Spanish, Yuracare, Chiman
Santa Anita (San Miguel)	Spanish
Santa Elena del Maniqui	Spanish
Santa Rita	Spanish
Totaizal	Spanish
Villa Esperanza	Spanish
Villa González	Spanish
Martirio	Chiman
Tacuaral de Matos	Chiman
Manguitos	Chiman
Nápoles	Chiman
San Antonio	Chiman
San Ramón	Chiman
Santa Rosa de Aguas Negras	Trinitarian, Yuracare, Spanish

Note : The first language is the predominant language
Source : Field work by the JICA Study Team, 1995

Table 6-8-14 Languages Spoken by Women

Community	Language
Algodonal	Spanish, ignaciano
Bermeo	Spanish, movima
Chontal	Spanish, ignaciano
El Buri	Spanish
Fátima	Spanish, ignaciano
Galilea	Spanish, reyesiano
La Embocada	Spanish
Litoral	Spanish, ignaciano
Monte Grande	Spanish, ignaciano
Nueva Brisa	Spanish, ignaciano
Puerto San Borja	Spanish, ignaciano
San Juan Matos	Spanish, trinitario, ignaciano, aymara
San Miguel del Alpere	Spanish, trinitario, movima/ignaciano, yuracare
Santa Anita (San Miguel)	Spanish, yuracare
Santa Elena del Maniqui	Spanish
Santa Rita	Spanish, ignaciano
Totaizal	Spanish, ignaciano, trinitario, movima
Villa Esperanza	Spanish, ignaciano
Villa González	Spanish
Martirio	Chimán, Spanish
Tacuaral de Matos	Chimán
Manguitos	Chimán, Spanish
Nápoles	Chimán, Spanish
San Antonio	Chimán, Spanish
San Ramón	Chimán, Spanish
Santa Ana de Moseruna	Ignaciano, Spanish, movima
Santa Rosa de Aguas Negras	Trinitario, yuracare, Spanish
Santa Anita del Bosque	Yuracare, chimán, Spanish

Note: The first language is the predominant language
Source : Field work by the JICA Study Team, 1995

Table 6-8-15 Languages spoken by Men

Community	Language
Algodonal	Spanish, Ignatian
Bermeo	Spanish, Movima (1)
Chontal	Spanish, Ignatian
El Buri	Spanish
Fátima	Spanish, Ignatian
Galilea	Spanish, Reyesian
La Embocada	Spanish
Litoral	Spanish, Ignatian
Monte Grande	Spanish, Ignatian
Nueva Brisa	Spanish, Ignatian
Puerto San Borja	Spanish, Ignatian
San Juan Matos	Spanish, Trinitarian, Igoatian, Aymara
San Miguel del Alpere	Spanish, Trinitarian, Movima/Ignatian, Yuracare
Santa Anita (San Miguel)	Spanish, Yuracare
Santa Elena del Maniqui	Spanish
Santa Rita	Spanish, Ignatian
Totaizal	Spanish, Ignatian, Trinitarian, Movima
Villa Esperanza	Spanish, Ignatian
Villa González	Spanish
Martirio	Chiman, Spanish
Tacuaral de Matos	Chiman
Manguitos	Chiman, Spanish
Nápoles	Chiman, Spanish
San Antonio	Chiman, Spanish
San Ramón	Chiman, Spanish
Santa Ana de Moseruna	Ignatian, Spanish, Movima
Santa Rosa de Aguas Negras	Trinitarian, Yuracare, Spanish
Santa Anita del Bosque	Yuracare, Chiman, Spanish

Note : The first language is the predominant language
Source : Field work by the JICA Study Team, 1995

(7) Security, Sanitation and Health

According to the results from the field work survey, it was found that most communities or settlements do not have health care services. The security, sanitation and health facilities found in the communities or settlements are shown in Table 6-8-16. The majority of communities have no water supply systems. Therefore, they depend on wells and rivers as their sources of water. Table 6-8-17 shows the sources of water in the communities that were investigated by the field survey.

Table 6-8-16 Security, Sanitation, and Health Facilities

Community/Settlement	Facilities
Galilea	Micro-hospital with permanent nursing services. Nurses work by shifts and come from San Borja.
San Miguel del Apere	Is not being used due to the lack of personnel, equipment and medicine (built by FIS.)
Fátima	Electricity and water are available, but equipment is lacking.
Bermeo	Nurses.
Villa Esperanza	Built by FIS, functions as a promoter and has no assigned budget.
Santa Rita	Built last year by FIS (with gutter tiles.) Electricity is available and only one budget item is assigned.
Algodonal	Reconstructed by FIS (without budget and equipment.)
La Embocada	At present not under operation. There is no budget.

Source : Field work by the JICA Study Team, 1995

Table 6-8-17 Water Sources of the Communities

Community	Water Source
Algodonal	(6 m chain-driven well) Wells in the dry season.
Bermeo	(78 m well.) They have piping.
Chontal	(8 m chain-driven well.)
El Buri	From the stream.
Fátima	(8 m chain-driven well.)
Galilea	From the chain-driven well.
La Embocada	From 4 public chain-driven wells.
Litoral	From the "curichi" (swamp.)
Manguitos	(Chain-driven well.)
Martirio	(From the Maniqui river.)
Monte Grande	("Curichi" and water pump-well with a depth of 26 m and 10 m of gravel.)
Nápoles	(From the Maniqui river.)
Nueva Brisa	(From the stream.)
Puerto San Borja	(From the Apere river.)
San Antonio	(From the Maniqui river.)
San Juan Matos	(From the Matos stream.)
San Miguel del Apere	From the river and a 20 m. well with pump.
San Ramón	From the Maniqui river.
Santa Ana de Moseruna	(From the river.)
Santa Anita del Bosque	From the river (Matos stream.)
Santa Anita (San Miguel)	From the Maniqui river.
Santa Elena del Maniqui	From the river (there is a chain-driven well, but is not operated at present.)
Santa Rita	From a 7 m chain-driven well; 36 m well with an elevated tank.
Santa Rosa de Aguas Negras	From the river (Aguas Negras stream.)
Tacuaral de Matos	(7 or 8 m chain-driven well.)
Totaizal	(5 and 3 m water levels chain-driven wells.)
Villa Esperanza	From a deep well.
Villa González	(5 m. chain-driven well and a 5 m elevated tank.)

Source: Field work by the JICA Study Team, 1995

(8) Education

According to the "Diagnóstico Etnoeducativo y Etnotecnológico del Oriente", the illiteracy rate of the native groups in the Beni Department is shown in Table 6-8-18. The Yuracare showed the highest illiteracy rate, 80%.

Table 6-8-18 Educational Indicators Among Ethnic Groups

Ethnic Group	Men	Women	Total	School Level	Quit Study	Bilingual
Chiman	n.a.	n.a.	n.a.	n.a.	n.a.	94.0
Trinitarian	90.0	15.0	11.8	56.7	34.0	55.0
Ignatian	18.0	16.0	10.6	52.3	32.0	56.0
Yuracare	75.0	86.0	80.0	50.0	87.0	91.0

Source : "Diagnóstico Etnoeducativo y Etnotecnológico del Oriente, Chaco y Norte de la Paz", INPRODES - 1990

Table 6-8-19 shows the level of educational services available in each community. It should be emphasized that the number of teachers is very small in each community, except for Santa Rita, La Embocada and Puerto San Borja.

Table 6-8-19 Level of Educational Services by Community

Community	Highest Level that was reached	Number of Students	Number of Teachers
Algodonal		22	1
Nueva Brisa		30	1
Bermeo	1st. Intermediate		
Fátima	1st. Intermediate		
Santa Rita	1st. Intermediate	130	5
San Ramón	3d. Basic	24	1
Villa Esperanza	3d. Basic	36	1
Santa Ana de Moseruna	3d. Basic	42	1
Galilea	3d. Intermediate	65	
Totaizal	3d. Intermediate	90	
La Embocada	3d. Intermediate	125	5
El Buri	4th. Basic		1
Nápoles	4th. Basic	39	1
Martirio	4th. Basic	65	2
Puerto San Borja	4th. Basic	65	4
Villa González	5th. Basic		
Santa Rosa de Aguas Negras	5th. Basic	16	1
Santa Elena del Maniqui	5th. Basic	20	1
San Juan Matos	5th. Basic	26	
Santa Anita del Bosque	5th. Basic	29	
Litoral	5th. Basic	45	2
Monte Grande	5th. Basic	52	3
San Antonio	5th. Basic	55	2
Tacuaral de Matos	5th. Basic	56	2
San Miguel del Apere	5th. Basic	60	2

Source: Field work by the JICA Study Team, 1995

6.8.11 Colonists

(1) Immigration Year

According to Veterinarians Without Frontiers (1994: 42-43), the migrating years are related to the opening of the road sections from the west towards the Beni area, that is, the La Paz-Trinidad road section connecting the Yungas Provinces of the La Paz Department with the Beni towns of Yucumo, San Borja, San Ignacio, and Trinidad.

The first Bolivian colonization projects date from 1961 in Alto Beni and Yungas. In 1975, the National Colonization Institute-INC (Instituto Nacional de Colonización) started the Rurrenabaque-Secure project. Starting with the Casarabe area, semi-controlled coloniza-tion began from the San Julián area during the 1970's. This was considered a modern colony.

Another Andean colonization front has been developed by people coming from Chapare, south of the Beni Department. A part of this colonization settled on the RBTI-Pilón Lajas, using a path abandoned by oil companies who were exploring this area during the 1960's.

In 1977, colonists, mostly Aymaran and Quechuan, settled on their own along the road between Yucumo and Rurrenabaque, as well as along the shores of the Quiquibey and Beni rivers. In 1980, the INC started a controlled colonization with 100 families.

The first big migration wave occurred after the drought in the Potosí area in 1983, and then with the relocation of mine workers in 1985. By 1985, 763 families (about 3,025 people) had been settled there.

The improvement of the Yucumo-Rurrenabaque road in 1987 brought a new wave of colonists. All groups immigrated to the area rapidly, of which 80% came from the Altiplano. Migrants also came from Yungas and Alto Beni of the La Paz Department, and settled near Rurrenabaque.

(2) Area of Origin of the Immigrants

According to the diagnosis on the Reserve of the Native Territory Biosphere (RBTI) Pilón-Lajas (Veterinarianst without Frontiers, 1994), in the RBTI Pilón-Lajas region, 38.1% of the total immigrating population has its origins from outside Beni, mainly from the South and North of the Yungas Provinces of the La Paz Department (29%) and from the Potosí Department (22%.)

Immigrants from the Yungas Provinces of La Paz show that the Yucumo-Rurrenabaque settlement was the second step after the colonization of the Alto Beni. On the other hand, immigration from Potosí occurred after prolonged droughts between 1983 and 1985.

Basically, there are three colonization areas. The first area is Rurrenabaque-Yucumo-San Borja, which formed a central network of migratory flows. The second area, influenced by colonization, is the Reyes/Maniqui River area, and the third area is Santa Rosa, Puerto Salinas and Vaca Diez.

The population of colonists is distributed in the center area of the RBTI-Pilón Lajas zone, as shown in Figure 6-8-4.

(3) Total Population of the Colony and Number of Colonizing Families

The study of the RBTI-Pilón Lajas area, particularly the Ballivian Province in Beni, carried out by Veterinarians Without Frontiers (1994: 16-17, 43, 45-47), has been taken as a source of information on the colonists.

The Province of Ballivian has a population of 47,420 (49.3% in urban centers and 50.7% in rural areas.) Yucumo has 1,404 inhabitants, while the rest of the population is spread around in ranches, communities and colonization centers along the Yucumo-Rurrenabaque road. The expansion rate of the population during the last 16 years was 4.5%, which made this province one of the provinces with the strongest migratory flows.

Most of the population in the Ballivian Province is male because migrations are mainly composed of males, and because there is a high female mortality rates.

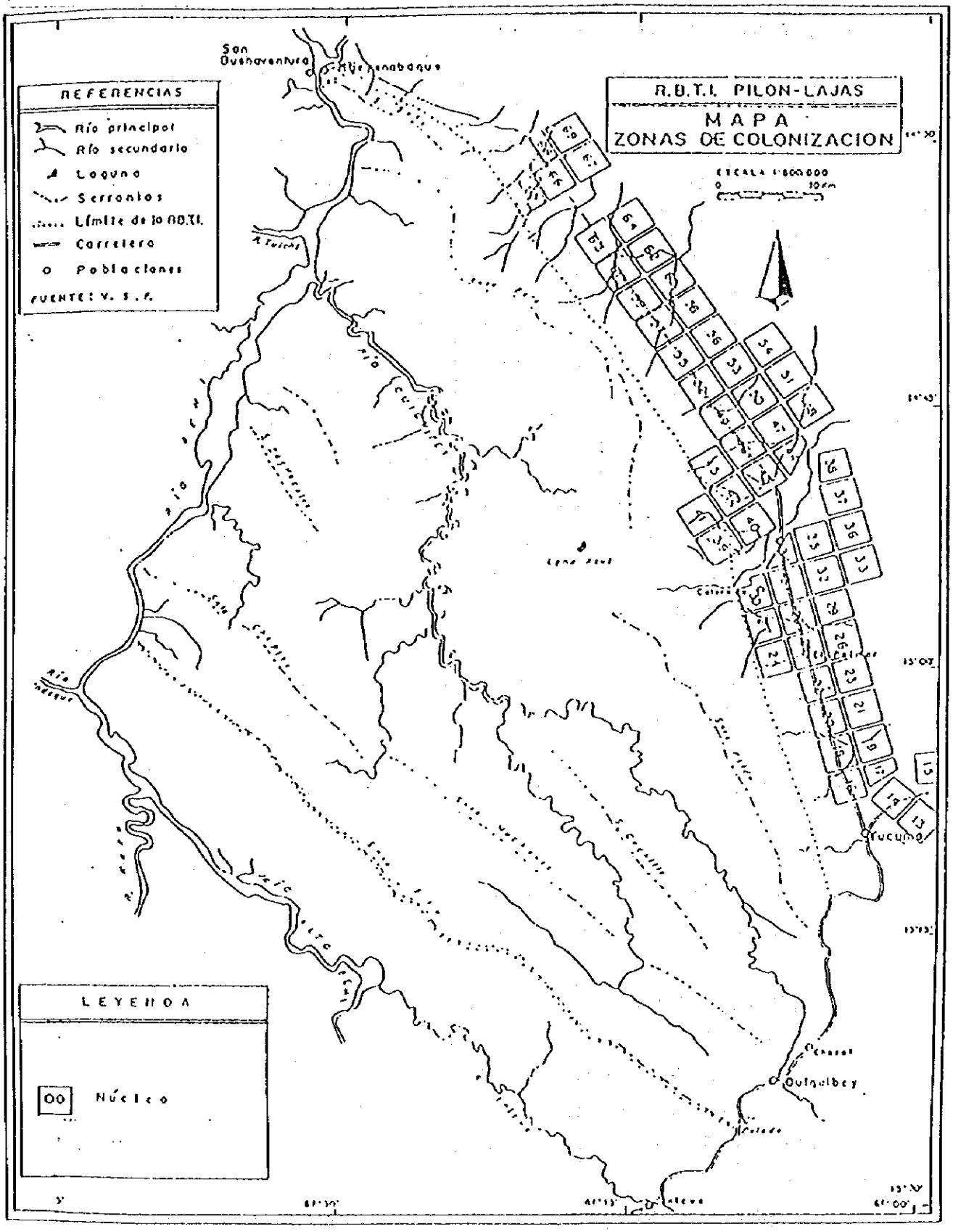


Figure 6-8-4 Distribution of the Population from the Colonization

Arrival of colonists to the Yucumo-Rurrenabaque zone occurred in the 1980's with the fast population growth. Most immigrants come from the Potosí Department and some from the valleys. The project for creating the new transoceanic road, which connects the Chilean and Peruvian ports on the Pacific Ocean with the Brazilian Atlantic ports, via Yucumo and Rurrenabaque, could provoke a new wave of colonists mainly to those two areas and to the northern part of La Paz.

According to information from colonists, the estimated population in the Yucumo-Rurrenabaque area is about 8,905 inhabitants (1,781 families.) According to INE, there should be 5,293 families. The difference is because INE carried out its census in the first colonization zones while the information from colonists is based on data from colony associations, cooperatives, etc. The average size of the interviewed colonist families is 4.2 members per family. The average composition is 55.7% for men and 44.3% for women, while the information confirmed by INE sources indicates 60% for men and 40% for women in the Yucumo-Rurrenabaque sector. These figures correspond to a predominance of single male migrants.

(4) Conflicts with Native People

According to Albo et al. (1990), there are inter-ethnic relations between the Cambas, who are a rural population that established themselves a long time ago in the rural areas, and the original native settlers. The relationship of the settlers with the Cambas is based on the fact that both groups have the same level of poverty. Therefore, it is rare to find friction between the two groups. Those born in the East think that the Collas (and Andean population of immigrating Aymara or Quechua origin) are intruders who are invading their territory and sometimes threaten their own businesses with their superior enterprising spirit. However, usually the Colla-Camba conflict is encouraged, not by themselves, but by their employers, in order to add an ethnic component to the conflict to achieve a greater regional hegemony.

On the other hand, people (both mestizos and Collas) treat the original native people with contempt. The original natives, in turn, see them as dangerous and abusive "whites" and refer to them specifically with words such as "karai", "karayana" or "schararch", depending on the ethnic group.

The Collas, who find themselves in a strange land, are cautious in the way they express their feelings about the local people. Every immigrant laborer lives with an internal tension between his original culture and the need for adapting to the new environment. Thus, those born in the East, but with Colla origin, pretend to be very Cambas.

The Collas have developed a dual attitude toward the original native people. In a number of instances they share similar situations when they settle in the same colony or work together at harvest time. Solid relationships may be created, especially when they both face problems with the employer. On the other hand, the Collas that came as traders or the colonists occupying the traditional lands of the native people, share with the whites and mestizos the same contempt for the native Cambas, who also treat them as whites, without making any distinction between them.

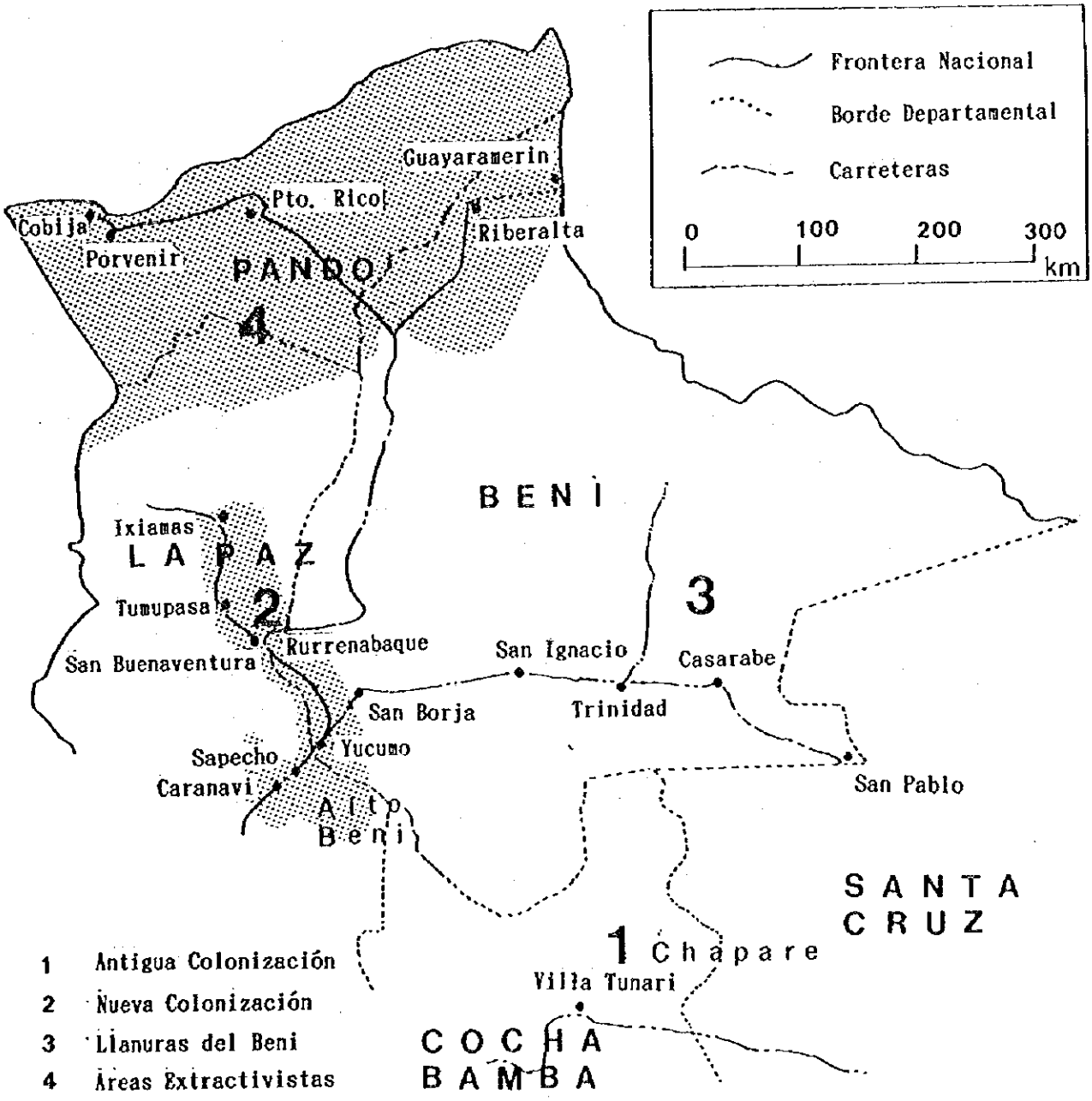
The Collas arrived as a result of demographic, economic and sometimes social pressures at their places of origin. Fighting for their survival, the Cambas live in the jungle. The experience with the Collas developed their competitive and enterprising spirit. The latter, however, tend to be more calm and hospitable. The arriving Collas are more trained in their relationship with the dominating society, while the Cambas have only recently started such relationships, beginning from 1990 with the March for Territory and Dignity. Moreover, they manage the sub-tropical ecology very well.

The above-mentioned factors could potentially create two conflicts. The first is related to methods of production. For the Collas, it is a monetary and agricultural production base, relatively connected to the market and with restricted access to the land. On the other hand, the original natives strongly maintain their hunting and fishing activities, and consider the land much more valuable than water or air, to which everybody has a shared access.

The Collas occupy a secondary position in a dual social-ideological structure. Because of their closer relationship with society they tend to feel superior, and because of their greater competitiveness, they tend to corner local groups.

(5) Distribution of Colonies

The colonization zones in northern Bolivia are shown in Figure 6-8-5.



Anexo B9 : Zonas de Colonización del Norte Boliviano.

Fuente : Thiele, Johnson & Walsworth, 1993.

Figure 6-8-5 Colonization Zones in Northern Bolivia

(6) Government Assistance

Although the government planned controlled colonization through the INC, the results show, in general, a lack of real government assistance to the colonists.

According to Veterinarians Without Frontiers (1994), in 1980 the INC provided the colonists with material assistance such as food and agricultural materials, but the colonists never received the promised loans, education, sanitary, technical, and commercial infrastructure.

Assistance to settlements by the INC did not take into account the areas inhabited by the original native people, which were lands more suitable for agriculture, cattle farming or forestry reservation. Many colonists returned to their places of origin, due to bad working conditions, disease, isolation, lack of markets, insecure land holdings, and low initial pro-duction results due to a lack of experience.

During the last 25 years, directed and spontaneous colonization increased as it was promoted by the INC, and benefited by the presence of roads. However, the colonization was done in a disorderly and uncontrolled way, with a lack of technical criteria. According to official data, 75,000 hectares were planned for colonization, but in 1993, 175,000 hectares were occupied. In many instances, these areas were promoted by INC local agents that did not guarantee a prompt property title registration of the land. Therefore, this has become one of the problems affecting many of the migrants.

(7) Agencies Offering Assistance

The following two agencies offer assistance:

- CORDEBENI (San Borja): Assisted by the Veterinarians Without Frontiers Project, it provides one veterinarian and one agronomist, both part-timers.
- CDF-RN (Centro de Desarrollo Forestal-Regional Norte): This agency (Center for Forestry Development-Regional North) started a widespread project for disseminating forestry and agricultural-forestry systems in the area, in cooperation with the Plan for Forestry Action PAF (Plan de Acción Forestal.)

The main assistance given to colonists and native people by the RBTI-Pilón Lajas (1994), comes from non governmental organizations, NGO's, which in 1986 began to develop assistance projects to both colonists and native people in order to improve services covering health, education, and agriculture. The NGO's are at present organized by the Yucumo Inter-institutional Committee. NGO's offer the following assistance in the RBTI-Pilón Lajas area:

① Colegio Técnico Agropecurio (Technical Husbandry School)

Agriculture-oriented educational assistance to colonists' children.

② Centro de Servicios Agropecuarios (Center for Husbandry Services)

Assistance supplying loans and techniques for animals and seeds; strengthening of labor unions and the Pilón Lajas Regional Chiman Council; mechanical and carpentry workshops, as well as adult education.

③ Servicio Alemán de Cooperación Social y Técnica

The German Service for Social and Technical Cooperation gives assistance in project follow-ups and evaluations, as well as analysis of social problems.

④ Veterinarios sin Fronteras (Veterinarians Without Frontiers)

Assistance with the supply of chickens and foodstuffs; information on cattle; training in animal health and implementation of agriculture-forestry-livestock systems; strengthening of women organizations, health support and support to the association of small agriculture-cattle farmers of the Yucumo-Rurrenabaque.

⑤ Comisión Episcopal de la Pastoral Social y Cáritas

The Episcopal Commission of the Social Pastoral and Caritas gives technical cattle-farming and agricultural assistance; loans for pork and cattle farming; support in health services to the Yucumo Micro-hospital; training of Chimanes in craftsmanship improvement and marketing; establishment of a Chiman cultural center in Yucumo.

⑥ Centro de Experimentación y Asistencia Técnica Agrícola

The Center for Experimentation and Agriculture Technical Assistance gives assistance in the production of plants for future timber yields, fruit and forage trees; experimentation of agricultural-forestry systems; support to the regional Chiman organization, and inventory of resources in the colonization zone.

⑦ Programa de Asentamientos Humanos (Program for Human Settlements)

This program gives assistance to the El Palmar Micro-hospital.

(8) Living Outlook

During the field work, the Study Team interviewed some people about the development, especially development related to the improvement of the road. Almost all of the answers were in favor of improvement of the road between San Borja and Trinidad. The following were the main answers given:

- The road will pass nearer the community, which will enable local people to reach San Ignacio much more quickly.
- Most people see the future with optimism. They are applying for a telephone box and potable water.
- The road will decrease transportation costs, so the community will grow because sales will increase.
- The road is important for the transportation of agricultural products.
- The improvement of the road is beneficial, as much larger markets will be established.
- The improvement of the road is important for agricultural products.
- During the rainy season it is not possible to go to San Ignacio because transportation prices rise. After the road improvement, this problem will disappear.
- People from the localities desire the improvement of local roads. During the rainy season, they have to carry their products on their backs along the local roads.
- The road is necessary to deal with emergencies.

6.9 Economic Activities

6.9.1 Economic Activities in the Communities

In the communities visited during the field work, a survey that included questions regarding their main economic activities was conducted. The results, shown in Table 6-9-1, show that their main economic activity is agriculture.

Table 6-9-1 Results from the Survey on Main Economic Activities in the Communities

Community	Economic Activities
Algodonal	Agriculture, sale of "chive" and fire-wood
Bermeo	Agriculture
Chontal	Agriculture
El Buri	Agriculture
Fátima	Agriculture
Galilea	Agriculture, craftsmanship, hunting and fishing
La Embocada	Agriculture, cutting timber
Litoral	Agriculture
Manguitos	Agriculture
Martirio	Agriculture, hunting and fishing
Monte Grande (1 ó 2 personas)	Agriculture, pig, chicken and cow raising
Nápoles	Agriculture, hunting and fishing
Nueva Brisa	Agriculture, sale of fire-wood
Puerto San Borja	Agriculture
San Antonio	Agriculture, hunting and fishing
San Juan Matos	Agriculture
San Miguel del Apere	Agriculture
San Ramón	Agriculture, hunting and fishing
Santa Ana de Moseruna	Agriculture, pig and cow raising
Santa Anita del Bosque	Agriculture
Santa Anita (San Miguel)	Agriculture, hunting and fishing
Santa Elena del Maniquí	Agriculture
Santa Rita	Agriculture, hunting
Santa Rosa de Aguas Negras	Agriculture, pig raising and poultry
Tacuaral del Matos	Agriculture, hunting and fishing
Totaizal	Agriculture
Villa Esperanza	Agriculture
Villa González	Agriculture

Source: Field work carried out by the JICA Study Team, 1995

The survey also inquired into what kind of work the members of the community engaged in on a temporary basis. The results show that most of them have experience with working on ranches, as shown in Table 6-9-2.

Table 6-9-2 Temporary Work for Members of the Community

Community	Temporary Job	Working Place
Chontal	No	
Monte Grande	No	
San Ramón	No	
Santa Ana de Moseruna	No	
Algodonal	Yes	Cattle ranches
Bermeo	Yes	Cattle ranches, and occasionally to San Ignacio
El Buri	Yes	Neighboring cattle ranches (grass cutting or cleaning)
Fátima	Yes	Ranches in the south
Galilea	Yes	Ranches, timber companies
La Embocada	Yes	Sawmills, nearby ranches
Litoral	Yes	San Ignacio and ranches
Manguitos	Yes	Ranches (by foot)
Martirio	Yes	Companies
Nápoles	Yes	Woodland
Nueva Brisa	Yes	For cleaning in San Ignacio
Puerto San Borja	Yes	Where they are transported to work for 2 or 3 weeks
San Antonio	Yes	San Borja, companies looking for timber
San Juan Matos	Yes	Companies (El Triunfo and northern Forests)
San Miguel del Apere	Yes	To the timber company
Santa Anita del Bosque	Yes	Sawmill, "robbing" timber, ranches
Santa Anita (San Miguel)	Yes	Company
Santa Elena del Maniquí	Yes	San Borja, ranches
Santa Rita	Yes	Triunfo, ranches on the road
Santa Rosa de Aguas Negras	Yes	Ranches, companies (towards San Borja)
Tacuaral del Matos	Yes	Sawmill
Totaizal	Yes	Ranches
Villa Esperanza	Yes	Nearby ranches
Villa González	Yes	Sawmills

Source: Field work carried out by the JICA Study Team, 1995

6.9.2 Average Income

The average daily wage of the natives was determined during the field survey. The average daily wage ranged from Bs.10 to Bs.25, as shown in Table 6-9-3. Taking into consideration that the average wage per month in the private sector was Bs.958.2 in 1993 (Source: Anuario Estadístico 1993), it can be said that the wages of natives are very low. A comparison of wages including meals and those without meals showed that the latter were Bs.5 higher, although there were some exceptions.

During the field work, the prices of some of the main products in the area were also investigated. The results were compared to prices in La Paz. Table 6-9-4 shows the comparison results.

Table 6-9-3 Average Wage of Native People

Community	Daily Wage (Bs.)	
	Including Meals	Without Meals
Monte Grande	10.0	15.0
Fátima	10.0	
Bermeo	10.0	
Villa Esperanza	10.0	
El Buri	10.0	
Santa Rita	10.0	
Litoral	10.0	
Chontal	10.0	
Nueva Brisa	10.0	
San Juan Matos	10.0	
Nápoles	10.0	
Santa Anita (San Miguel)	12.0	
Santa Anita del Bosque	12.5	20.0
Galilea	15.0	20.0
Santa Rosa de Aguas Negras	15.0	20.0
Santa Ana de Moseruna	15.0	10.0
Puerto San Borja	15.0	10.0
Algodonal	15.0	10.0
Tacuaral del Matos	15.0	
Santa Elena del Maniquí	15.0	
Villa González	20.0	25.0
Totaizal	20.0	13.5
La Embocada	20.0	15.0
San Antonio	20.0	12.5
Manguitos	25.0	15.0

Source: Field work carried out by the JICA Study Team, 1995

Table 6-9-4 Prices of the Main Products in the Area

Product	Price
Beans	Bs.25 per arroba
Rice	Bs.8 to Bs.15 per arroba
Corn	Bs.6.50 per arroba
Banana	Bs.5 per bundle
Yucca	Bs.5 per arroba
Pigs	Bs.50 to Bs.100 per live pig
Cows	Bs.6 per kilogram

Note : * One arroba = 25 pounds
Source : Own estimations based on the field work carried out by the JICA Study Team, 1995

According to the Social-Economical Study for the Fátima-San Ignacio de Moxos Influence Area, (Masueto, Enrique, 1992:42), 148 farmers of Ignatian origin, who were interviewed, obtained their income in the following way:

- 12 selling their manpower (8.11%)
- 17 selling agricultural products (11.49%)
- 19 combining the sale of agricultural products and manpower (80.41%)

6.9.3 Main Means of Subsistence

"The Diagnosis of the Biosphere Reservation from the Native Territory Pilón-Lajas (1994: 5-58)" was used as a reference to study the main means of subsistence because it is related to the influence area, and includes the most complete information on the means of subsistence of the colonizing population in the area.

The following six major colonist production systems can be identified:

① Settlers who raise livestock, with a diversified extensive production system, where the pastures for cattle farming are predominant. Most of the settlers immigrated before 1987 and have 2.5 ha for rice fields, a 0.4 ha orchard with citrus and other trees, which are essentially cultivated by family manpower, and minimal agricultural materials. Livestock consists of cattle (1 to 15 heads) for food, poultry and sometimes, pigs for self-consumption.

② Settlers who work on arboriculture, with an intensive system of fruit-tree production, having 1 to 3 hectares with bananas, citrus, coffee and orchards. They count with little uncultivated land available for the planting of trees. They also use family manpower and minimal agricultural materials. They have domestic animals, such as hens for self-consumption, and sometimes, pigs.

③ Unstable settlers, with a poorly developed and stagnant agricultural production system, cultivating less than 0.2 ha of rice fields since the establishment of the plot, less than 3 hectares of "kudzu" fallow, about 0.4 to 1.1 ha of banana, citrus and orchards, and less than 2 ha of fallow partially used for rice. They use family manpower and a minimal agricultural materials.

These unstable settlers migrated 3 to 9 years ago to the zone, especially in Rurrenabaque, to abandoned land that already had small orchard. Settlers try to limit the fallow and only those having property titles remain as fallow parcels. Perhaps 30% of the trees on their land have already been cut down. Moreover, unstable settlers are not always accompanied by their families when they move, and are sure to return to their original plots. Therefore, it is not sure whether they will settle down anywhere specific.

④ Settlers that cultivate rice with a single production system. These cultivate rice in plots of 0.75 to 1 ha and bananas in 0.06 ha, leaving less than 1 hectare of fallow. They do not have animals. The settlers that cultivate rice came less than 3 or 4 years

ago, settling along the forest zone of Quiquibey. They are still temporary settlers. The settlers living outside their place of origin prefer to accept jobs as agricultural or forestry workers, and many of them plan to settle permanently. They do not receive any assistance whatsoever.

⑤ Settlers with large farms, who are land speculators with a little diversified agricultural production system. These cultivate over 1 ha of rice fields, less than 1 ha of mahogany, over 0.4 hectares of banana and between 3 to 15 ha of fallow, progressively using these hectares for rice followed by perennial crops. Both family and hired manpower are used. These settlers may have arrived 2 to 8 years ago, settling in the spontaneous colonization areas along the road that goes from Yucumo to the Quiquibey bridge, in the Pilón-Lajas Native Territory Reservation. A number of relatives group together to apply for a large area of land. These generally have forestry or urban jobs. These people plan to sell their land at a high price even though they obtained it for free, or prepare new timber or cattle projects.

⑥ Motor-saw operators and rice settlers, with a limited production system, cultivate less than 0.4 ha of bananas or orchards, 2 to 8 ha of fallow, rotating it with rice crops or abandoning the land, and less than 0.5 ha of rice. These settlers raise domestic animals such as hens and, sometimes, pigs. They came quite some time ago, but acquired land 5 years ago, which is mainly located in the wooded and isolated zones, near the sawmills, mainly toward Rurrenabaque. Their main means of subsistence is timber, and they clearing from 0.5 to 5 ha of land for rice crops. Many of the settlers are single. The married wish to settle with their families, and would eventually devote themselves to agricultural production, while the rest want to continue as motor-saw operators and would abandon their lots to move on to richer wooded areas.

The settlers practice agricultural activities in alluvial terraces with a slash-and-burn agricultural system, periodically opening new lots. The main crops are banana, rice, corn and yucca, and the areas average about 4 hectares. Production is more integrated with the regional market.

6.9.4 Settlements and Work

According to Veterinarians Without Frontiers (1994), the colonists in the RBTI-Pilón Lajas region have settlements that were granted by the INC. These settlements are lots

of 3.6 km², subdivided into 40 parts of 25 ha each. This division was done without considering the type of land on the lots, or the presence of native communities.

Besides the planned plots, spontaneous colonists settled near the roads. In the planned areas, the INC distributed 25 ha to the colonists, which became their property after two years of exploitation. In some spontaneous colonies, such as Charal, Quiquibey, and Inucua, the individual lots have only 10 to 12 ha, and in 1993 less than 30% had legal property titles.

Likewise, cooperatives and associations obtained 2,000 hectares of land. During the 1970's the National Agrarian Reform Council (Consejo Nacional de Reforma Agraria) granted extensive concessions, but as there was no coordination with the INC, there were cases where plots from the colonists overlapped those owned by earlier landholders. This created serious problems.

6.9.5 Experience in Tropical Agriculture

According to Albo et al. (1990), the experience of colonists in tropical agriculture is linked to both ecological and market possibilities. The existence of a stable road is important for productivity. Without roads, the majority of the production is destined for self-consumption and the only goods that can be traded are those that can be preserved, stored, and processed such as coca. On the other hand, products such as fruits, require stable roads, since they are difficult to preserve.

The slash-and-burn agricultural system, used by both colonists and native, is limited to colonists who own small lots. These people must abandon the land and move to other more distant colonies. As a results, the earlier colonies remain with only the few families that founded them.

According to Palm and Flores (1994), the production of colonists is more bound to a market with a system of cultivating a single crop, usually rice, as is the case of the Yucumo-Rurrenabaque colonization zone and the Southern region of Isidoro-Secure. The cultivation system starts with the clearing and opening of the forests.

6.9.6 Lumber Industry

(1) Relationship Between the Forest and Its Inhabitants

a) Native people and the forest

The relationship between the native people and the forest is a tradition of their culture. The forests meet all economic needs for the subsistence of the natives, and additionally, there is a spiritual relationship with the forest because therein exists the magic world that creates and reproduces those resources.

The forest provides resources for nourishment, clothing, medicine and housing. It is an ecosystem where animals live with their food sources. According to Riester (1993), the Chimanes are convinced that the nature surrounding them is the residence of non-human beings, amongst others, living in the mountain ranges, the forest, and in the water. The acquisition of forest products is regulated. Even the Chimanes do not have total freedom to obtain forest products. It is believed that every tree or plant has an owner that cares for it.

b) Lumberjacks, colonists, and the forest

According to Veterinarians Without Frontiers (1994: 73), the major activity in the forest is carried-out by small contractors and groups of local independent lumberjacks, who are contracted by lumber companies or colonists.

The main problems related forest colonization are deforestation, atmospheric pollution, and the degradation of the ecosystem by the practice of slash-and-burn agriculture. Many of the colonists abandon their plots and move to other zones, such as the forestry concessions. Colonization moves along with the opening of new roads and the extension of services. The interdepartmental auxiliary roads and road networks for lumber extraction, to which the companies contribute, provide the major access for colonists wishing to enter the forests.

Lumberjacks devote themselves to illegally felling trees in the forests, according to the Forestry Diagnosis of the Beni Department (1994). This illegal practice consists of

felling trees as quarter-sawed timber ("cuartones") with a motorized saw, and then selling them to the sawmills, or trading with intermediaries who have "sole exploitation contracts" awarded by the CDF-RN. The lumberjacks fell trees in forestry concessions, protected areas and in native territories, in an illegal and secret way, taking advantage of the poor control by the companies and forest keepers.

Motorized sawing is carried out by both the colonists and the peasants, because it provides greater economic benefits than those obtained from agricultural production.

Unfortunately, such an activity causes the exhaustion of lumber resources, as the lumberjacks and colonists hurry to exploit them, felling trees without considering the long-term effects, such as the loss of genetic material (particularly mahogany), or the reduction of the animal population due to the noise of the motor saws and indiscriminate hunting. These facts are also supported by a report prepared by Veterinarians Without Frontiers (1994). In addition, the proliferation of access roads favorable for colonization increases erosion.

(2) Concerns over Accelerated Deforestation due to Road Improvement

During the field work, the Study Team interviewed the inhabitants about their concerns and expectations regarding the road improvement project. The answers are discussed under the issue of "Future Life Outlook", in the section dedicated to the colonists (Section 6-8-11.)

(3) Distribution, Number and Size of Sawmills
(Capital, Sale Volumes, Number of Employees, etc.)

There are twenty-nine (29) forestry concessions in the Beni Department of, as shown in Figure 6-9-1. Most of them are distributed along the northwest border and in the southern part of Beni. The total area of the forestry concessions is almost 2.2 million ha, as shown in Table 6-9-5. Table 6-9-6 shows the trend of lumber production by year and species. The production of mara is increasing every year, with a total of approximately 7,000 m^3 in 1992. The companies legally working in the zone are:

- Madre Selva
- Bosques del Norte

- Bolivian Mahogany
- Fátima
- Monte Grande
- Hervel

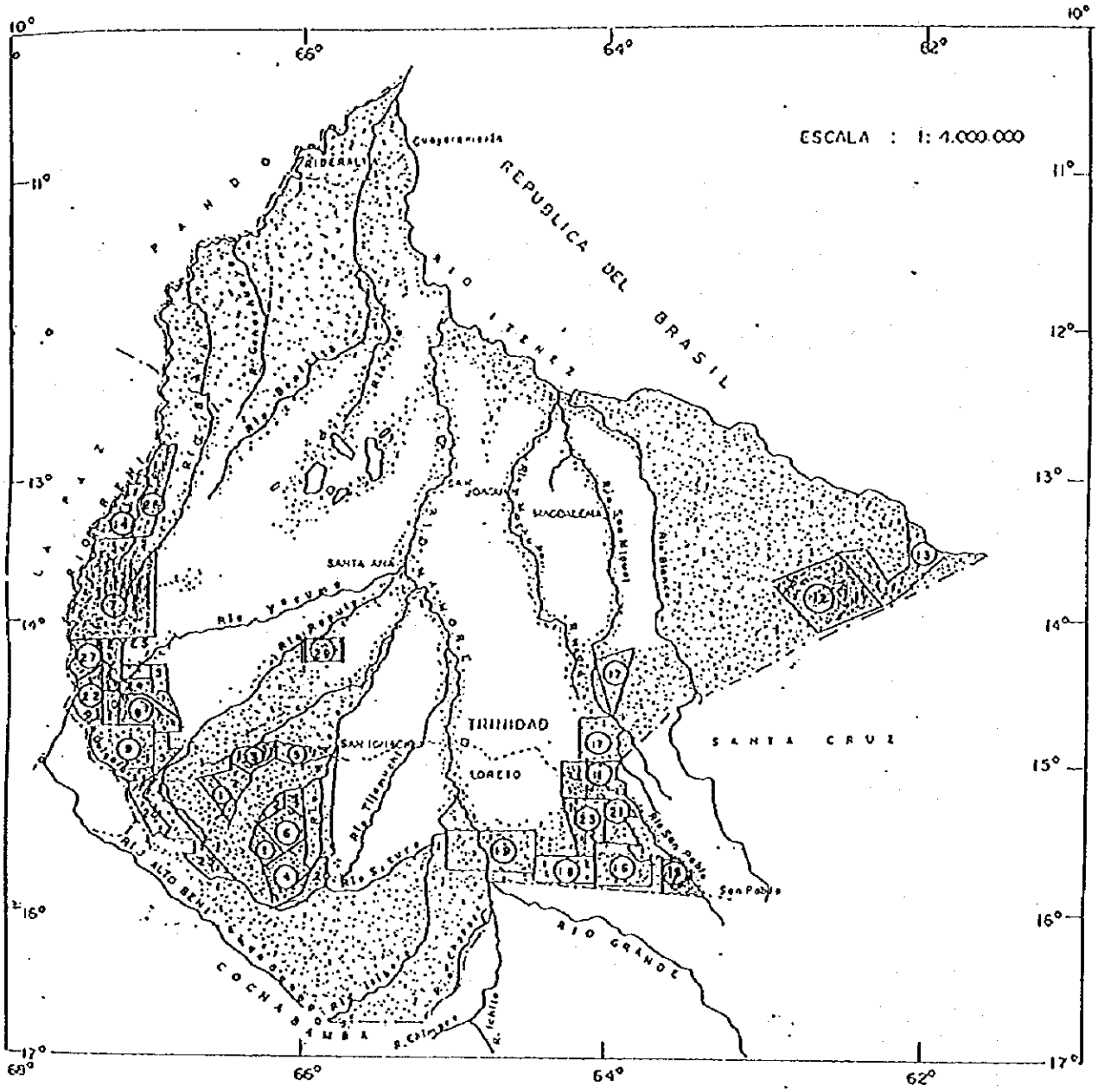
According to the Corporation for the Development of Moxos (Corporación de Desarrollo de Moxos) CORDEMOXOS, the Monte Grande company paid for the extraction of 1,886,875 cubic feet of timber in 1994. The Hervel company paid for 215,000 cubic feet, only during September and October, since they were moving.

Table 6-9-5 Forestry Concessions

(Unit : ha)

No.	Timber Company	Approximate Surface	Province	Contract No.	Date
1	Fátima a/	46,378.59	Ballivian, Yacuma	001/91	9/20/91
	Fátima b/	32,292.41	Yacuma	001/91	9/20/91
	Fátima (total)	78,671.00	Ballivian, Yacuma	001/91	9/20/91
2	Bolivian Mahogany a/	41,682.84	Yacuma y Ballivian	004/91	9/23/91
	Bolivian Mahogany b/	11,842.00	Yacuma	004/91	9/23/91
	Bolivian Mahogany (total)	53,524.84	Yacuma y Ballivian	004/91	9/23/91
3	Bosques del Norte	54,574.00	Yacuma	005/91	9/25/91
4	HERVEL	109,236.43	Moxos y Yacuma	006/91	9/25/91
5a	Madre Selva (Chimanes)	32,071.00	Yacuma	010/91	9/24/91
5b	Madre Selva (Chaparina)	60,000.00	Ballivian	017/92	2/12/92
6	Monte Grande	66,074.00	Ballivian	008/91	9/27/91
7	San Ignacio				
8	San Martín				
9	Forestal Ltda.	67,000.00	Ballivian	003/91	9/23/91
10	Berna	185,000.00	Ballivian + F. Tamay	012/91	10/6/91
11	Monte Redondo	30,400.00	Ballivian	023/93	8/18/93
12	INMABOL	120,000.00	Marban	015/91	1/15/91
14	San Luis Ltda.	251,750.00	Itenez	021/92	9/27/92
16	San Matías Srl.	140,000.00	Itenez	013/91	12/11/91
18	Mamore Cabrera Ltda.	80,200.00	Ballivian	022/93	1/13/93
19	Rurrenabaque Ltda.				
20	Laminadora S. Miguel	103,850.00	Marban	002/91	9/23/91
21	Guillet Ltda.	133,745.00	Marban	014/92	1/15/92
22	Quebrada Blanca				
23	Guapay Srl.				
24	CIMAGRO	48,440.00	Moxos y Yacuma	007/91	9/25/91
25	Nuño Chávez				
26	Selva Negra	130,000.00	Ballivian	009/91	9/27/91
29	Benigno				
31	Santa Isabel	87,500.00	Ballivian	020/92	9/2/92
34	Yucumo	112,120.00	Ballivian	016/92	2/12/92
36	Destre Ltda.	72,500.00	Ballivian	018/92	4/22/92
39	Sagusa	50,000.00	Ballivian	011/91	10/24/91
40	Bella Vista	42,611.00	Ballivian	019/92	7/16/92
Total		2,241,463.11			

Source : CDF-RN, 1993. Elaboration taken from Salm and Flores, ed (1994)



1. Fátima Ltda.
2. Bolivia Mahogany SRL.
3. Bosque del Norte
4. Hervel
5. Madre Selva SRL. (Chimanes)
   Madre Selva(Chaparrina)
6. Monte Grande SRL.
7. San Martín del Beni SRL.
8. Forestal Ltda.
9. Berna Sucesores SRL.
10. Monte Redondo
11. Inmabol
12. San Luis Ltda.
13. San Martino SRL.
14. Nemorá Cabrera SRL.
15. Coop.Rurrenabaque Ltda.
16. Laminadora San Miguel
17. Guillet Ltda.
18. Quebrada Blanca
19. Guanay SRL.
20. Cimagro.
21. Nuflo de Chávez
22. Selva Negra
23. San Benigno
24. Santa Isabel Ltda.
25. Yucumo Ltda.
26. Oestre Ltda.
27. Sapuse SRL.
28. Bella Vista SRL.
29. Ecereje.

Fuente : COF-AN. Opto. Ingeniería 1994

Figure 6-9-1 Forestry Concessions in the Beni Department

Table 6-9-6 Yearly Evolution of the Production of Timber by Species

(Unit : cubic feet, %)

Specie	1988	%	1989	%	1990	%	1991	%	1992	%
Ajipa					371.34	0.77				
Almendrillo			34.25	0.08	215.24	0.45	202.19	0.39	415.46	1.90
Amargo			0.20	0.00	125.10	0.26	9.57	0.02		
Bibosi			690.23	1.51			51.53	0.10	686.17	3.13
Cachichira	663.42	1.59							314.48	1.44
Cedrillo			0.82	0.00						
Cedrar	3,288.18	7.86	3,295.50	7.22	4,781.12	9.98	3,150.30	6.02	4,436.61	20.25
Colomero			64.24	0.14			7.76	0.01		
Copaibo					27.07	0.06	547.78	1.05	261.35	1.19
Cuchi					12.10	0.03				
Flor de Mayo							4.52	0.01	176.30	0.80
Gabun	472.68	1.13	286.74	0.63	150.46	0.31				
Wood for Construction	2421.16	5.78	50.21	0.11	103.26	0.22	49.78	0.10	134.84	0.62
Manicillo							19.15	0.04	49.15	0.22
Mapajo					30.31	0.06	118.48	0.23		0.00
Mara	29,895.91	71.43	37,132.44	81.31	36,745.87	76.67	43,577.50	83.28	7,153.72	32.65
Mara Macho					51.29	0.11			1,159.72	5.29
Mascajo					983.50	2.05	36.36	0.07		
Walnut					12.52	0.03				
Ochoó	2,282.25	5.45	2,758.73	6.04	2,176.44	4.54	279.85	0.53	3,979.93	18.17
Oje							20.26	0.04		
Palo María	569.30	1.36	518.07	1.13	583.09	1.22	1,854.18	3.54	711.34	3.25
Papayón							3.34	0.01		
Paquio							63.83	0.12		
Quecho	1,923.51	4.60								
Quina Quina							8.95	0.02	8.95	0.04
Oak	338.23	0.81	286.34	0.63	1,387.68	2.90	2,073.85	3.96	1,086.77	4.96
Mora									296.20	1.35
Isigo									221.78	1.01
Simayo							14.85	0.03	303.13	1.38
Tajibo					17.92	0.04				
Tarara					54.64	0.11	26.61	0.05	365.88	1.67
Tolfo							129.26	0.25	140.12	0.64
Verdolago			548.35	1.20	96.89	0.20	75.26	0.14	5.38	0.02
Total	41,854.64	100.00	45,666.12	100.00	47,925.84	100.00	52,325.16	100.00	21,907.28	100.00

Source : CDR-RN; 1993. Own elaboration taken from Salm and Flores, ed (1994)

(4) Employment Rate of New Residents or Native People in the Sawmills at the Bosque del Norte

a) Bosque del Norte Sawmill

The company was established in the zone 20 years ago. The plant employs 42 people, mainly from San Borja, with only two (2) or three (3) persons from La Paz. Fifteen of the workers live with their wives and children. During the harvest (lumber cutting), there are up to 100 workers, of whom 15% are from La Paz and Santa Cruz, 42% from the Sawmill Plant, and the remaining 43% (between 20 and 30 workers) Chimanes. The minimum wage is Bs.350 per month. Specialized workers, (mechanics) earn more

money. In 1994 the Bosque del Norte Sawmill extracted 150,000 cubic feet of wood (40% mahogany and 60% "palo maría".) The machinery used was two (2) D7 Caterpillars, two (2) John Deere 640, two (2) loaders and two (2) motor graders.

b) Monte Grande Company

The Plant has 90 employees, of whom 70% are local workers and 30% are workers from Santa Cruz and San Borja. The latter are machine-shop and administration staff. During the harvest, this company hires up to 200 employees. The basic wage is supposed to be Bs.400 by contract; however, informants from San Miguel (located two kilometers from the company) stated that the wages paid by the company were only Bs.350, and sometimes, only Bs.150. In 1993 and 1994 the company took out 1.5 million cubic feet of lumber. The machinery used was four (4) Caterpillars, two (2) motor graders, four (4) loaders, and five (5) skidders.

c) Bolivian Mahogany

During the harvest season, the Company hires 250 yard workers, 50 employees for transportation, and 30 (Chimanes) to search for the wood and contractors. The harvest season is from May to December, and from January to April, maintenance work is carried out. The Bolivian Mahogany concession originally was of 110,000 hectares, but 50% was affected by recognition of the Multiethnic Native Territory. This company has two installed sawmills with a capacity of 1,200,000 square feet each. The share is 4,400 cubes (1 cube = 424 square feet), the rest comes from third parties. Of the 2,400,000 square feet, 80% corresponds to long lumber, of which 75% is destined for export; the remaining part is second- and third-quality lumber. The approximate cost of each sawmill is US$40,000. The machinery used is 15 Caterpillars, skidders, and loaders. The company also provide basic services such as food, which is supplied by neighboring ranches.

(5) Felling Volume

Table 6-9-7 shows the authorized volume of lumber extraction, as well as the balance and surplus of lumber companies for the fiscal year 1994. Some companies cut much more mara than was authorized. Table 6-9-8 shows that the exploitation volume of mara is more than 50% of the total of the most exploited species in Beni. On the other hand,

Table 6-9-9 shows the potential and exploitable volume by species and groups of industrial species in the Chimanes Forest. Table 6-9-10 shows the volume of exploitation to date, and the future exploitation plan for mara in the permanent forest and the Chiman Forest. Tables 6-9-7 to 6-9-10 show a tendency for the felling of mara (which is more expensive) to increase over time.

Table 6-9-7 Volume of Timber Extracted by Timber Companies in 1994

(Unit: m³)

Timber Company	Specie	Authorized Volume	Total Volume	Extracted Volume	Missing Volume	Remarks
Fátima Ltda.	Mara	3,800.00		4,660.50		A surplus of 860.50 m³
	Other Species	1,200.00	5,000.00		1,200.00	
Hervel	Mara	3,900.00		867.00	3,033.00	
	Other Species	1,700.00	5,600.00		1,700.00	
Bolivian Mahogany	Mara	3,400.00		9,584.08		A surplus of 6,184.08 m³
	Other Species	1,500.00	4,900.00		1,500.00	
Bosque del Norte				1,489.74		Does not have authorization

Source: Alberto Tapia (1994)

Table 6-9-8 Volume of Exploited Species in the Beni Department

(Unit: m³)

Species	1992	1993	Total (1987-1993)	Volume (%)
Mara	9,188.27	54,887.01	275,011.23	61.06
Cedar	5,062.18	9,235.51	58,906.40	13.08
Ochoó	7,432.11	1,227.03	31,587.46	7.01
Bibosi	9,330.55	926.04	29,609.07	6.57
Gabun	3,562.72		12,882.07	2.86
Oak	1,597.94	1,817.53	11,576.45	2.57
Total of species	36,173.77	68,093.12	419,572.45	93.16
Total	45,220.76	72,606.97	450,386.02	100.00

Source : Forestry Diagnosis of the Beni Department, 1994

Table 6-9-9 Potential and Present Volume of Species

(Unit : 1000 m³)

Species	Potential Volume	Present Volume	Total
Fine species	945.90	435.70	1,381.60
- Mara	28.80	218.00	246.80
- Cedar	44.00	109.10	153.10
- Sangre de Toro	74.40	29.10	103.50
- Palo Marfa	798.50	79.50	878.20
Species used for door plates and drawers	2,454.60	2,301.00	4,755.60
- Ochoó	859.70	1,758.70	2,618.40
- Other species	1,594.90	542.30	2,137.20
Species used for construction	2,765.50	1,115.30	3,880.80
Species used for beams, columns and parquet flooring	1,281.70	982.30	2,264.00
Total	7,447.70	4,834.30	12,282.00

Source : Forestry Project FAO/CDF FO: BOL/74/031
Sachtler, Bascope (Rojas: 1985, 62-63)
Salm and Flores, ed (1994)

Table 6-9-10 Past and Future Exploitation of Mara Species in the Chimanes Forest

(Unit : m³)

Item	Lumber Companies						
	Fátima	Bolivian Mahogany	Hervel	Bosques del Monte	Monte Grande	Madre Selva	Total
Initial Volume in 1987 (m³)	186,260	185,601	140,364	582,000	64,920	13,375	1,172,520
Assigned Volume in 1980 (m³)	130,382	92,800	140,364	294,238	64,920	10,700	733,404
Yearly Fee for Plans	10,000		10,000	6,500	6,492	6,500	39,492
Past Exploitation							
- 1987	5,650	2,201	78	51	0	0	7,980
- 1988	4,875	2,300	3,365	6,287	0	0	16,827
- 1989	4,487	4,010	5,301	4,598	0	0	18,396
- 1990	6,635	4,188	3,362	4,666	4,378	1,527	24,756
- 1991	5,134	4,222	4,049	185	6,947	0	20,537
- 1992	2,716	828	1,512	0	894	0	5,950
- 1993	6,271	7,701	432	2,510	6,644	1,509	25,067
Total Carried Out	35,768	25,450	18,099	18,297	18,863	3,036	119,513
Recommended Exploitation							
- 1994	3,800	3,400	3,900	800	3,300	800	16,000
- 1995	3,500	2,900	3,800	500	2,700	600	14,000
- 1996	3,200	2,500	3,700	300	1,900	400	12,000

Note : Goitia (1988), Synott and Cassels (1991), Pinedo (1991), Ross (1992)
Source: Forestry Diagnosis of the Beni Department, 1994

(6) Conflicts with Native People and Resolution

According to Estenssoro (1991: 69-70), the change of status of the Chimanes Forest from a Immobilization Reservation to a Permanent Production Forest had several social and economic consequences for the region.

Forest exploitation by the lumber companies introduced heavy machinery, road openings, bridge constructions, and sawmill installations, and increased the number of people in the forest, causing conflicts with native populations. It was initially considered that the lumber companies would bring economic benefits by hiring the Chimanes as mahogany searchers; however, the contractual relationship was unequal to the detriment of such native groups and other workers.

Moreover, contractors tend to use the forest resources without the proper legal authorization. The selective extraction of lumber, such as mahogany, cedar and others, as well as the lack of management and reforestation plans, cause worries to the native population as they saw their forest wealth diminish. The contractors and companies benefited from these activities, while the natives got nothing.

The Chimanes joined the market by selling their labor power in agricultural works, as rowers, stringers, guides, etc., under unequal trade relationships. The value of their

labor, that is, their knowledge and experience in the use of wild and forestry resources was not acknowledged.

The Chiman Native Territory, which is legally approved, does not have regulations to define their rights and duties, and to manage and make use of their territory. This has caused the social conflicts, summarized below:

- There is conflict with the timber company owners, since they exploit forestry resources in the territory without granting benefits to the Chimanes, and with the contractors, since they hunt animals, and exploit the Chimanes.
- There is conflict with the motor saw operators, who extract wood illegally since they have no authorization from the CDF.
- There is conflict with the settlers, who enter the Chiman Territory in order to create new crop plots, and exploit the forest resources.
- There is some tension between the natives and the forestry concessions. For example, according to Reister (1993), the Chimanes consider that white men, whom they call "haiba", are haughty (arrogant), crooked people who cheat, and cannot be trusted. In general, this is a consequence of the unequal labor relationship in the sawmills.

According to Sylvia Estenssoro (1991), future actions to be taken to benefit the native people, depend on the role that these people will be assigned to play, locally, regionally, and nationally. In the case of the Chimanes, the present strategy is to strengthen their social and political organization by increasing their regional representation in the Chiman Council; training of human resources; implementation of a comprehensive participation of domestic units, formation and training of committees in the fields of management, research, communication, health and other social groups with equal relations and a fair distribution of benefits. At a regional level, it is expected that the participation of Chimanes in the development plans of the Beni region will be promoted.

(7) Reforestation Activities after the Felling of Trees

Table 6-9-11 summarizes the present situation of the forestry and agroforestry projects. To improve the situation in affected forests, a wide variety of forestry projects are expected to be implemented soon.

Table 6-9-11 Present Situation of the Forestry Projects (1)

Name of the Project	Location of the Project	Objectives of the Development	Components and/or Activities	Executing Entity	Stage of the Project	Financing (thousands of US$)			Duration of the Project
						Domestic	Foreign	Total	
Preservation, management, sustenance and integral exploitation of the Chimanes Forest	Chimanes Forest, Ballivian, Moxos and Yacuma Provinces	- To reach a sustainable production of goods through management plans for forestry production and indigenous lands	- Execution of plans for experimental forestry management	CDF-RN	Under Execution	860.2	2,697.2	3,557.4	60 months
Preservation and management of the river turtles	Moxos, Marban and Cercado Provinces	- Study, protection, preservation, rational use of the Chelonia (turtle family) in the Mamor é river	- Installation of signals and protection of nests - Recollection and displacement of turtles - To achieve the understanding of the river communities	CDF-RN	Under Execution	161.4	421.0	582.4	36 months
Agricultural and forestry models, influence area of Pil ón-Lajas	Yucumo-Rurrenabaque, Ballivian Province	- To reduce human pressure on the reservation resources of the Pil ón-Lajas Biosphere - To promote communal self-management for the use of forestry resources	- Promotion, training and extension - Forestry management - Forestry and agricultural models and practices - Commercialization and industry	CDF-RN	Evaluation of the Project	240.0	1,717.5	1,957.5	48 months
Program for training and forestry actualization	Beni Department	- Continuos training of professionals and technicians from the CDF-RN - Training of forest keepers	- Elaborate training programs for professionals, mid-level technicians and forest keepers from the CDF-RN	CDF-RN	Outline of the Project	111.8	220.0	331.8	36 months
Control of protected areas by using mobile units on rivers	Beni Department	- Control and protection of protected areas	- Control and effective supervision of protected areas	CDF-RN	Outline of the Project	496.4	582.6	1,079.0	60 months
Forestation of green areas using native species	City of Trinidad	- Improve the city's ornamentation	- To reforest the city with native species - To achieve the understanding of the population in order to take care and preserve such species	CDF-RN	Outline of the Project	29.8	115.2	144.0	60 months
Strengthening of the CDF-RN and supervision of the renewable resources from the Beni region	Beni Department	- Institutional strengthening for a better control of forestry resources - Application of an effective program for the protection and control of forests and protected areas	- Improve the efficiency and control of the fauna and flora - Avoid the illegal exploitation of forestry resources - Intensify the control on the exploitation of wood by the timber companies	CDF-RN	Outline of the Project	1,014.3	1,305..1	1,079.0	60 months

Table 6-9-11 Present Situation of the Forestry Projects (2)

Name of the Project	Location of the Project	Objectives of the Development	Components and/or Activities	Executing Entity	Stage of the Project	Financing (thousands of US$)			Duration of the Project
						Domestic	Foreign	Total	
Protection and repopulation of Sauria in the National Park of Isidoro-Secure	National Park Isidoro-Secure, Moxos Province	- Protection, repopulation and management of Sauria - Incorporation of indigenous villages in programs for control and management of Sauria species	- Development of semi-intensive management models - Establishment of control programs - Education and achievement of the population's understanding	CDF-RN	Formulation of the Project	116.9	467.4	584.3	60 months
Agricultural and forestry systems for the recuperation of degraded areas	Influence area of Trinidad-Santa Cruz, Marban and Cercado Provinces	- Recovery of arboreal mass in deforested areas - Improve the living level of the population in the zone by implementing agricultural and forestry systems	- Reforestation of plowing areas - Combination of agricultural and forestry cultivation - Installation of green houses	CDF-RN	Formulation of the Project	367.4	829.1	1,196.5	60 months
Educational programs and achievement of the population's understanding of renewable natural resources	Beni Department	- Achievement of the population's understanding regarding the importance, conservation and protection of natural resources - Education of children and young people regarding renewable natural resources	- Development of forestry educational programs, potentiality and the need to maintain such natural resources for the present and future benefits of the region	CDF-RN	Outline of the Project	382.4	771.6	1,154.0	60 months
Agriculture and forestry, National Park of Isidoro-Secure	National Park Isidoro-Secure, Moxos Province	- Avoid degradation with better alternatives regarding the use of land - Improve the living level of the population that lives in the park	- Implementation of suitable agricultural and forestry systems	CDF-RN	Outline of the Project	105.1	220.5	325.6	36 months
Preliminary Integral Study of the Regional Park Pedro Ignacio Muiba	Cercado and Itenez Provinces	- Stratification of forest areas - Classification of flora and fauna species - Gathering of demographic, social and economic information	- Carry out preliminary studies regarding the stratification and classification of forests	CDF-RN	Outline of the Project	10.9	25.4	36.3	4 months

6.10 Ruins and Cultural Assets

6.10.1 Introduction

The archeological sites in the Moxos Plains have long been considered some of the most important in South America because of the technological heritage they reveal.

Living under adverse climatic conditions, the pre-Hispanic cultures of the Moxos Plains of the Beni Department, developed a notable but little known civilization. The Beni plain, where the Moxos culture was developed, is annually flooded during the rainy season from May to October, but also suffers drought from November to April. This plain is very flat, with minimal elevation differences, except for some earth elevations created for agricultural, communication, habitat, or other purposes. The Moxos Plains, therefore, have a highly developed artificial earth construction.

The history of archaeological studies of the artificial earth elevations in the Moxos Plains is very short, compared with the Bolivian Altiplano and valleys, where architectural structures are made of stone. Therefore, initial research projects are being planned. In recent years, the challenge of entering an unknown place, like these lowlands, promised many surprises and created unusual interest (Denevan, 1991; Erickson et al., 1991, 1993, 1994; Roosevelt ,1980, 1989, 1991, 1992, 1993; Meggers 1991, 1992, 1993, 1994; and others.)

Some scientists believe that the lack of preserved archaeological material is due to the moist climate or to the impossibility of finding ceramic remains under the luxuriant vegetation. Others believe that the jungle could never sustain large populations; therefore, no civili-zations developed there, (Meggers, 1954, 1971; Esteward and Farom, 1959; Esteward 1949 a & b; Meggers and Evans, 1957, 1983; and others). However, contrary to these beliefs, the pre-Hispanic agricultural infrastructure of the Moxos Plains shows that culture did develop there, and these people showed a higher knowledge of the habitat. Moreover, their development of suitable technologies destroyed the criteria of the classic deterministic ecological theories.

The remains of canals, sawhorse borders, earthworks (embankments), water reservoirs, and a series of past environment transformation strategies, have been shown to be highly productive alternatives that do not harm the environment.

An archaeological team from the University of Pennsylvania and investigators from the Technical University of Beni ("UTB, Universidad Técnica del Beni") are rescuing the ridges in experimental plots. The results, so far, have been superior to the normal production of small farms using the traditional slash-and-burn technique.

6.10.2 Archaeological Sites and Units Found on the Trinidad-San Borja Road and Its Branches

During the construction of the road between Trinidad and San Borja, which was concluded in 1978, a number of archaeological sites were destroyed because the necessary measures for their rescue were not organized in time. This carelessness caused the loss of the archaeological unit, since the area was destroyed by trucks and the road was constructed through an important complex of hills.

Fortunately, the intervention of archaeologists rescued one part of the lost information, allowing urgent explorations and excavations to be conducted after the road construction. Over the past few years, the road was also used to study the agricultural units that were destroyed and cut. A summary of the locations investigated so far is presented below.

Archaeological rescue missions will provide information on many places that are still unknown for future archaeological studies.

(1) San Borja-Trinidad Road

In 1978, Faldin and Erickson conducted the first archaeological survey between Trinidad and San Borja, along the road connecting these towns, as shown in Figure 6-10-1. Most of the archaeological sites were discovered in areas cut by the road (Erickson and Faldin 1978.) The following sites were surveyed:

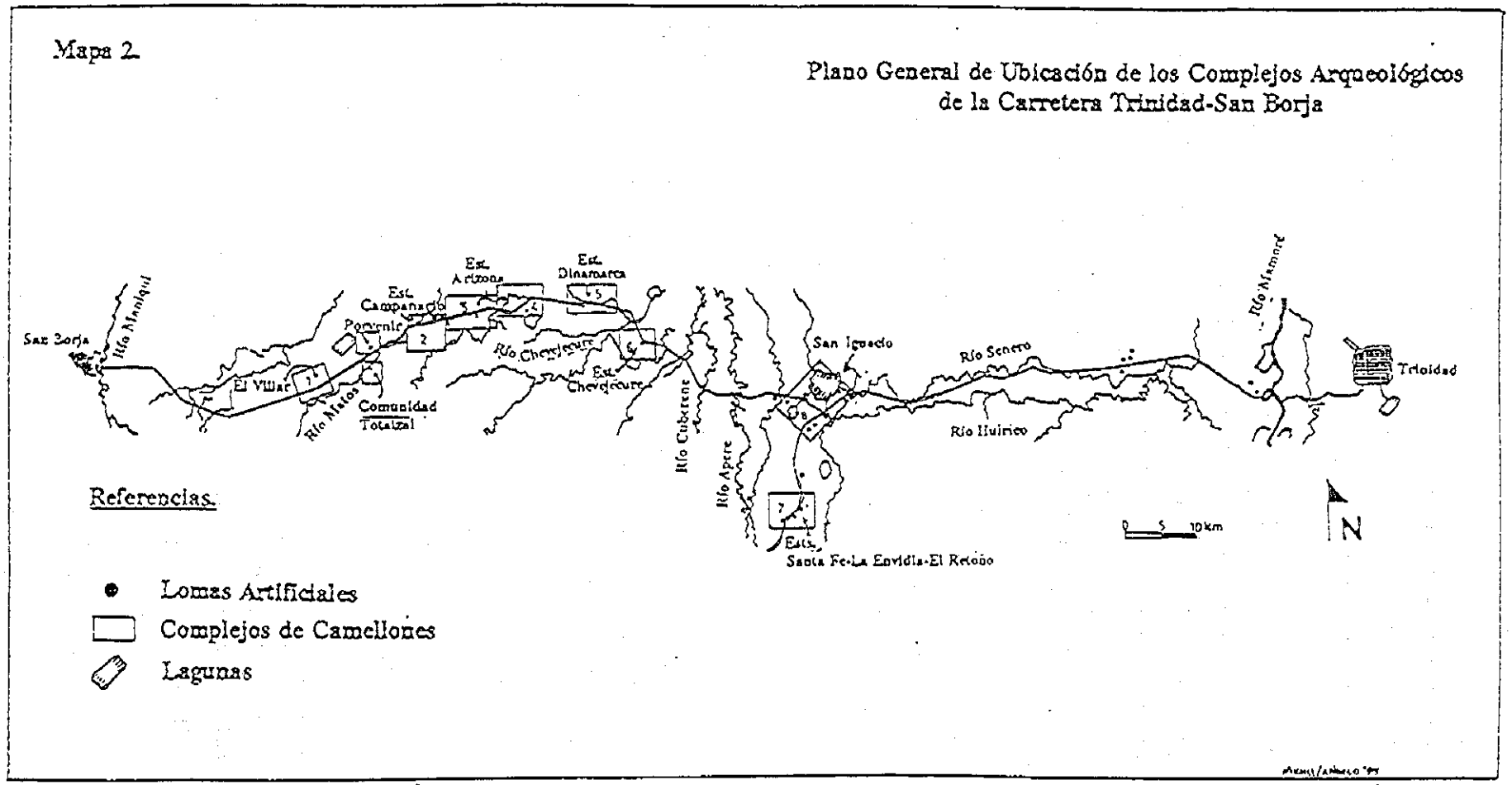


Figure 6-10-1 Map of the Archaeological Complex of the San Borja-Trinidad Road

a) Sites located on the road west of San Ignacio

- Road intersection, Km. 1.6 southwest of San Ignacio.
- Cruz de Caminos, Km. 5.6 southeast of San Ignacio.
- Loma Pinto, Km. 12 west of San Ignacio.
- Road to Cochabamba, sites 1 and 2, located in the Kms. 8.2 and 10.6 southwest of San Ignacio, respectively.

b) Sites located on the road near to San Borja

- Half kilometer from the post of the National Road Direction near San Borja.
- Totaizal, Km. 4 west of the Matos River.
- El Porvenir, in El Porvenir Ranch.
- San Luis, Km. 1.5 east of the Matos river. It corresponds to the first Jesuit Mission of San Luis.
- Site on the road, between San Luis and Campanarios Ranch.
- Arizona Ranch, Km. 6 east of the Matos River.
- Dinamarca Ranch, Km. 20 east of the Matos River.

The discovered sites are characterized by having an average separation of 2 to 3 km between them, located between San Ignacio and the Matos River. The area of dispersion of the cultural material varies from 300 to 400 m. According to the authors, no causeways or canals connecting the islands were found. In a subsequent work, Erickson indicates that the ceramics found at of the site usually represent characteristics of multi-component units for a long time (Erickson 1980.) Regarding the earthworks, the calculation made by Denevan of about 10,000 km of earthworks in the San Ignacio region, appears to be less than the calculation made by Erickson, who considers that these approximations may not include earthworks covered by the jungle, which are not visible in aerial photographs.

According to Erickson, "the causeways generally cross the low pampas between the elevated zones of the woods, running parallel to the river or stream shores, frequently crossing the riparian meandering (point bar formations) or extending from the lakes, especially from the Isirere and Mausa lagoons" (Erickson, 1980.)

A number of hypothesis were presented about the possible functions of the earthworks and trenches, besides being used as communication roads and waterways, as was already mentioned by Denevan (1980.) Other persons suggest that some functioned as water gates, controlling the stream to connect the pampas with the river shores, and therefore functioning as dikes (Erickson 1980.)

(2) Archaeological Complex of El Villar

The team of the Agricultural and Archaeological Project of the Beni Department ("Proyecto Agroarqueológico del Beni") investigated the made investigations in El Villar Region, in 1990. The location was 40 km East of San Borja and was cut by the San Broja-San Ignacio road, as shown in Figure 6-10-2. Several archaeological units were found in the area, and pre-Hispanic modifications in the zone are impressive. The following five sites were studied:

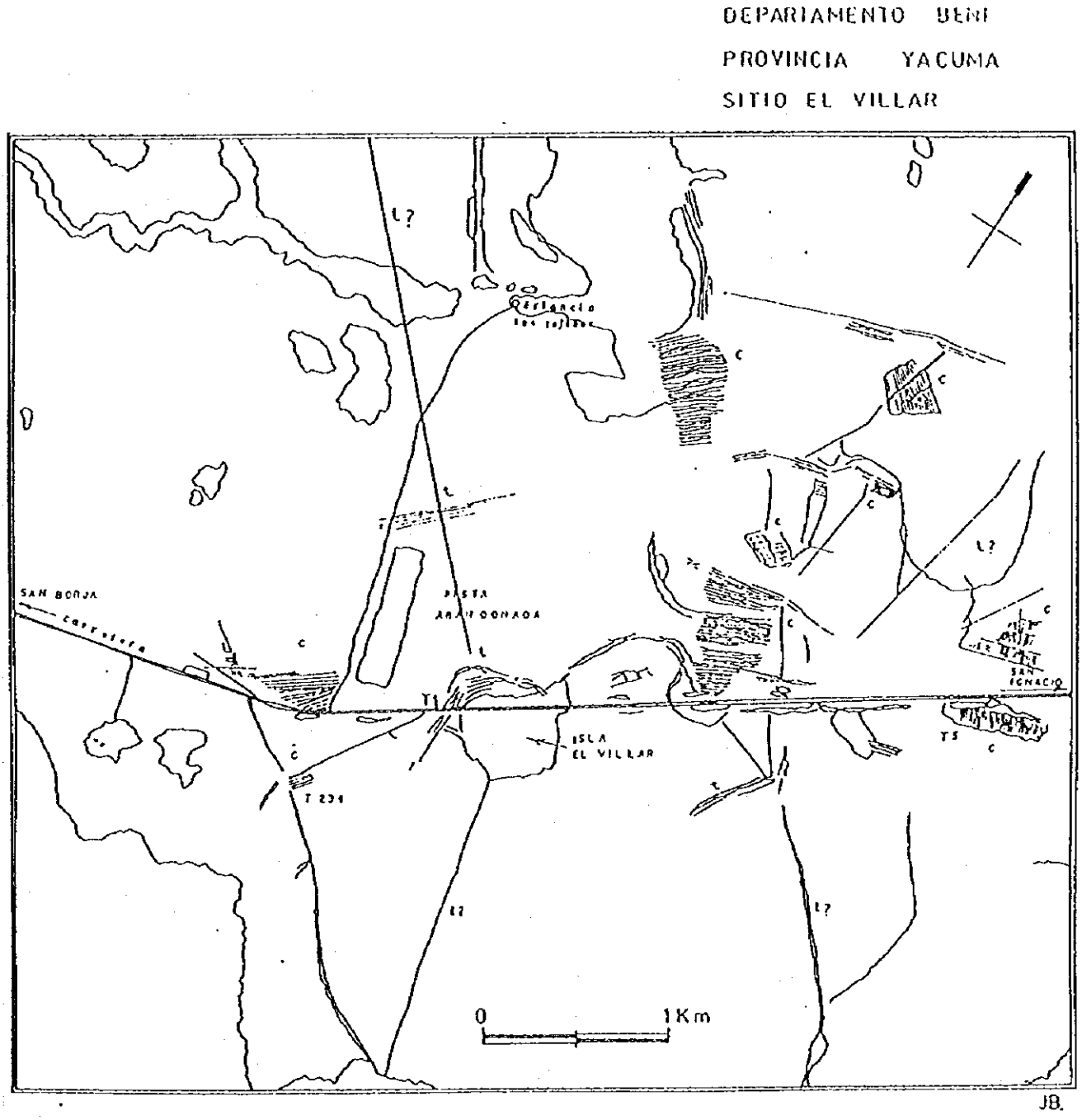
- El Villar island and its complex of earthworks and canals.
- Complex of ridges and canals, located in the southwest part of El Villar Island.
- Complex of canals and ridges, located in the northeast part of El Villar Island.
- Earthworks and ridges in the periphery of the landing strip of El Villar Ranch.
- Ridges and canals in Los Tajibos ranch.

(Summarized from Erickson et al. 1991)

At the El Villar Island site, the ridges, canals, and the ridge complexes located in the southwestern and northeastern part of the island were cut by the road.

(3) Archaeological Complex of Santa Fe, La Envidia and El Retoño

During 1992 and 1993, as part of the Archaeological Project of the Beni Department, the archaeological complex of Santa Fe, La Envidia and El Retoño was investigated in an area including among the Apere River, San Vicente lagoon, the port of San Broja and the San Miguel community, in the southern part of San Ignacio de Moxos and the northern part of the road which will be built toward Cochabamba, as shown in Figure 6-10-3.



REFERENCIAS

t. TERRAPLENES CANALES
C. CAMELLONES CANALES

T. TRINCHERA EXCAVADA

Tomado de Michel, 1992

Figure 6-10-2 Archaeological Complex of El Villar

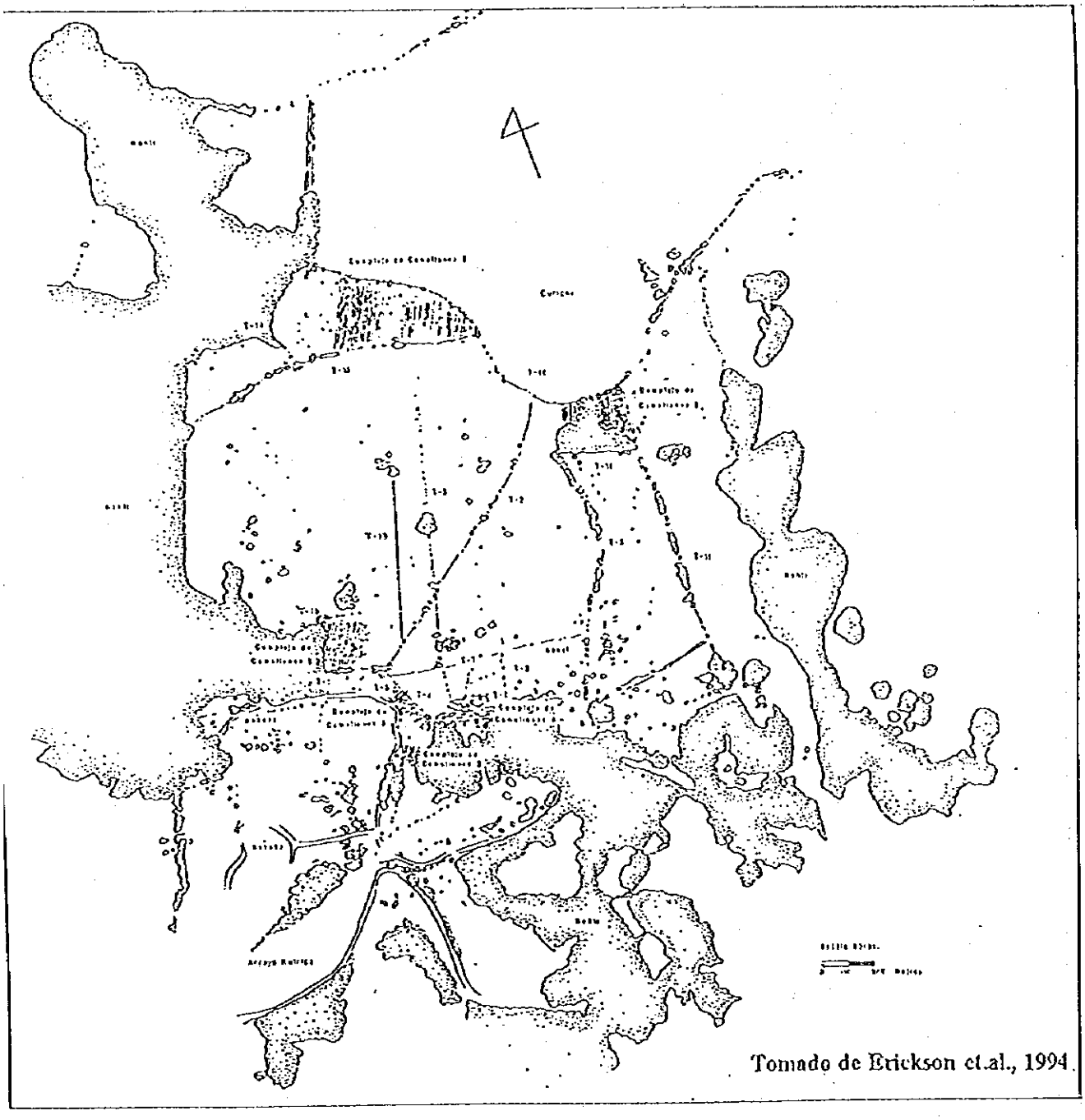


Figure 6-10-3 Archaeological Complex of Santa Fe, La Envidia and El Retoño

The Santa Fe and La Envidia Ranches were defined as the main points for the archaeological surface mapping, survey and excavations (Erickson et al 1992.) Seven complexes of ridges joined by a complex network of earthworks and canals were found.

In 1993, the investigation continued in Santa Fe and La Envidia, one of the best preserved zones of artificial earthworks. The San Ignacio-Cochabamba road, which is under construction, crosses the southern part of the complex, and cuts through two large housing sites, Santa Fe and La Asunta. Broken remains of ceramics and bones of a funeral urn were obtained from the second of these sites. The site could not be saved in time, due to road extension works, which proceeded without considering the archaeological rescue works.

(4) Archaeological Complex of Chevejecure

The archaeological complex of Chevejecure is located in the south-southwestern part of the ranch of the same name, as shown in Figure 6-10-4. There is a broad variety of fields of ridges, canals, and embankments in a relatively small area between the Chevejecure and Matos rivers. These fields are concentrated between the river meandering. Because the San Borja-Trinidad road cuts the meandering zone, many of the elevated fields were destroyed during the construction of the road.

The most impressive remains are the blocks of a linear ridge located 1 km south of the ranch, which was built on a canal of an abandoned meandering (Erickson et al., 1994.) A number of ridge units and the linear earthworks in this zone were mapped in the above-mentioned figure, but this study was not completed.

(5) Archaeological Complex of San Ignacio de Moxos

The archaeological complex of San Ignacio de Moxos is located between the Isirere and Mausa lagoons, in the southern part of the Iserere lagoon near San Ignacio de Moxos, as shown in Figure 6-10-5. Only part of this unit of large dimensions was studied.

The sections affected by the road can be summarized as follows:

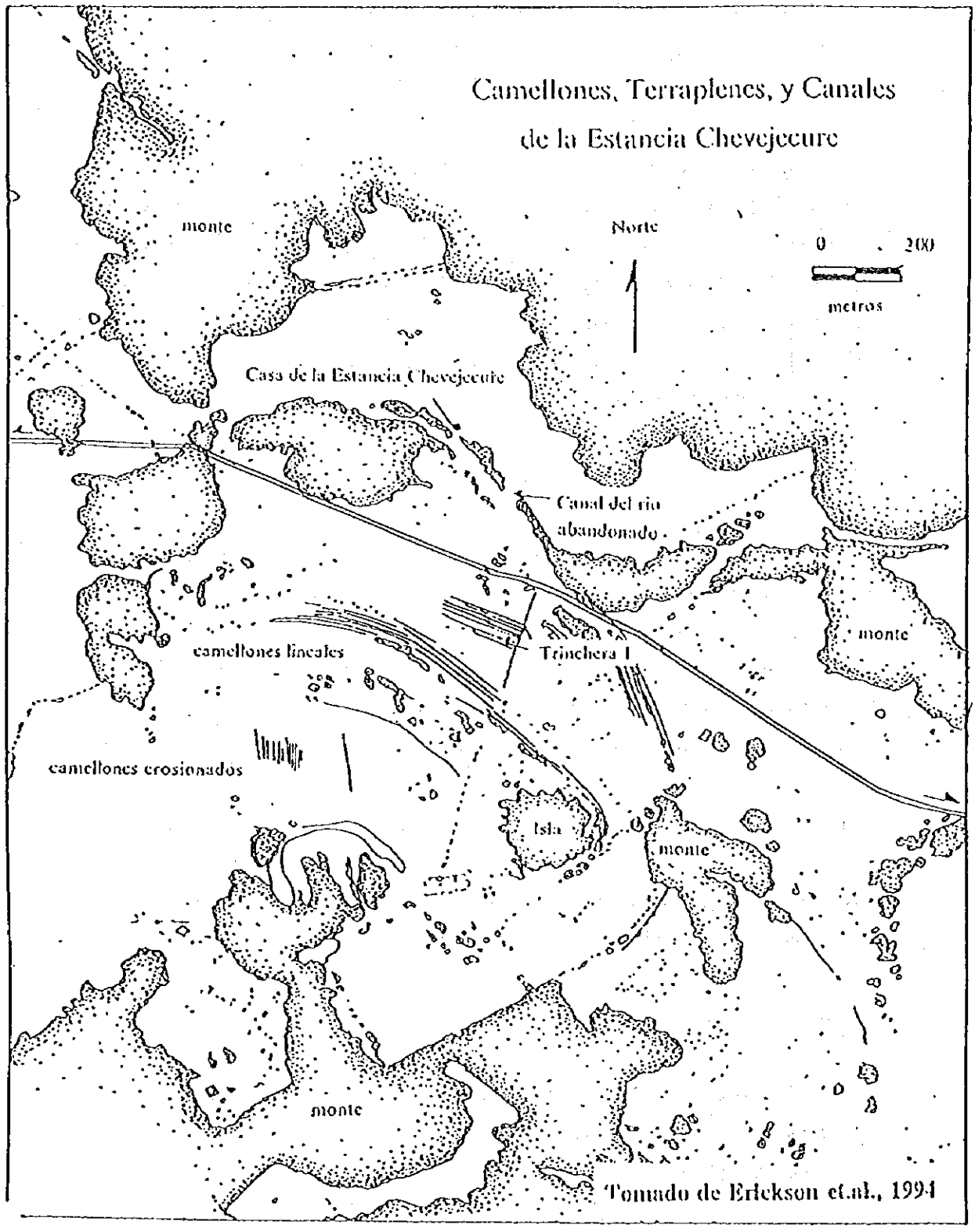
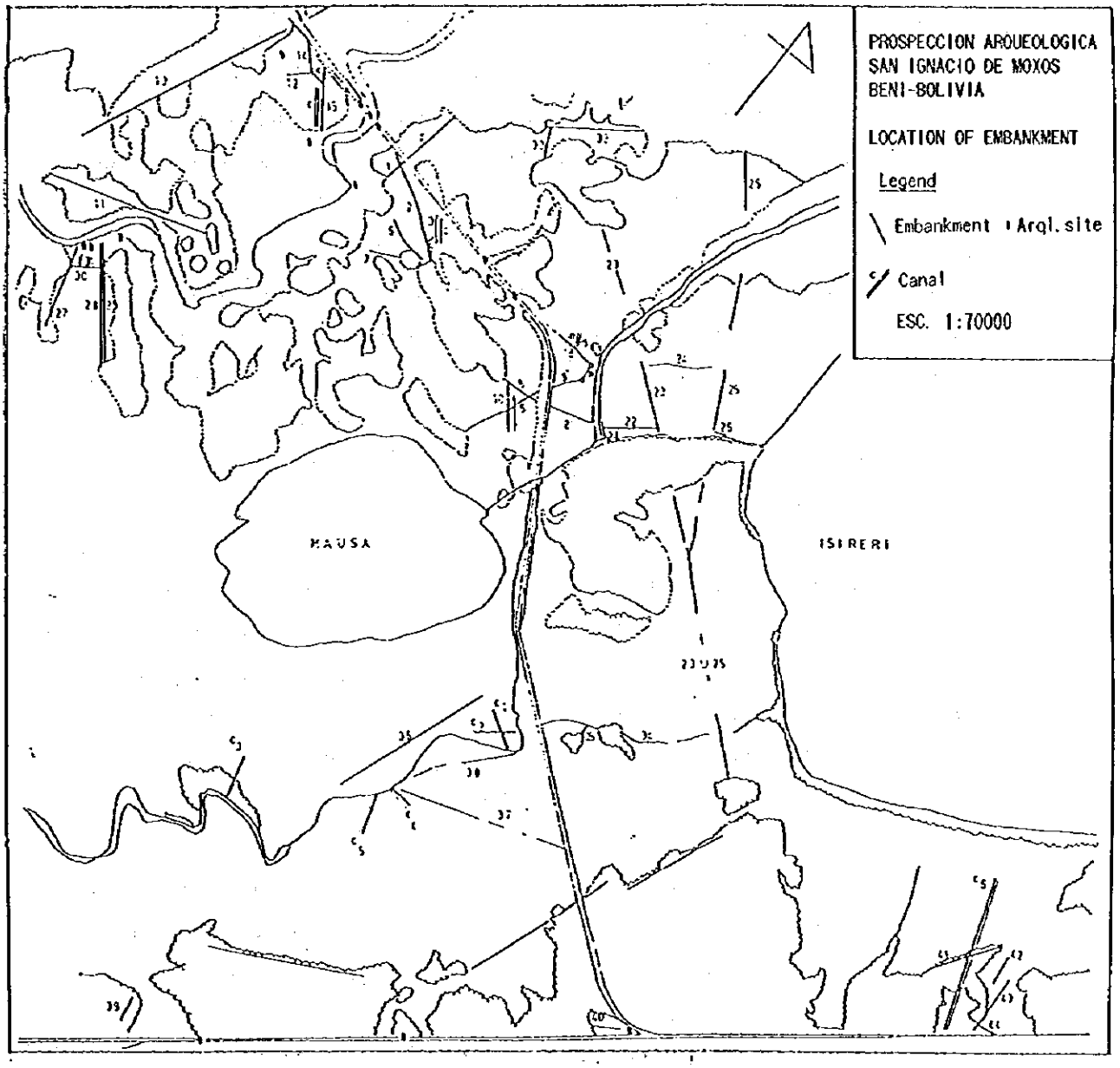


Figure 6-10-4 Archaeological Complex of Chevejecure



Obtained by Michel, 1993a

Figure 6-10-5 Archaeological Complex of San Ignacio de Moxos

La Vfbora Ranch is located 11 km Northeast of San Ignacio de Moxos, as shown in Figure 6-10-6. A complex of ridges in this section was studied. This complex was built between large earthworks that connect an island with a corridor of woods. The San Ignacio-San Borja road crosses two pre-Hispanic habitats. The first one is located along the banks of the Matire River and the second one, on the first island along the road, in the eastern part of the Matire river. According to Michel (1993 a), several earthworks were also cut.

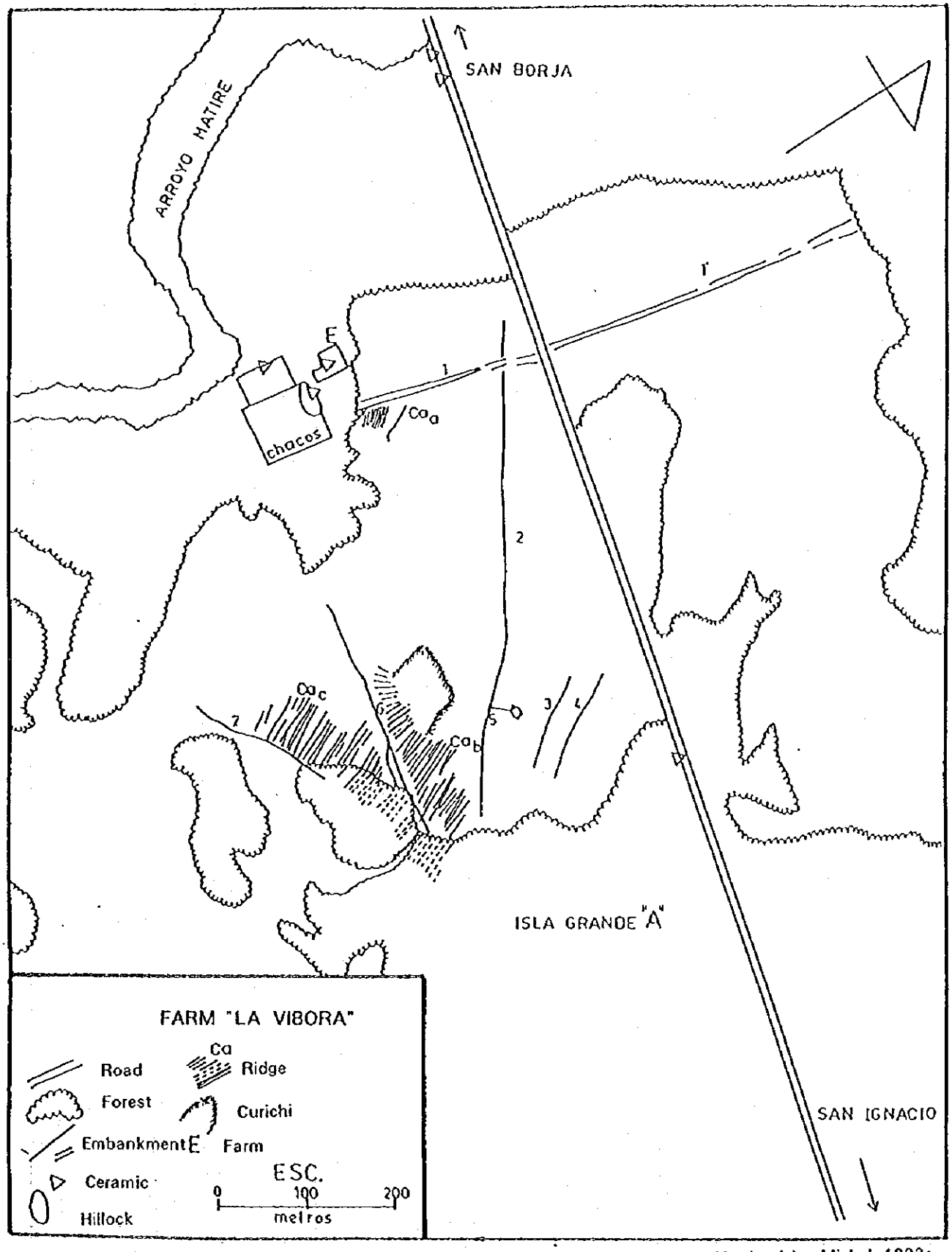
The La Vfbora and La Viborilla Ranches are located between the Isirere and Mauxa Islands, about 9 km from San Ignacio de Moxos, as shown in Figure 6-10-7. This archaeological unit is one of the biggest to have been discovered.

Unfortunately, it was cut in half when the Trinidad-San Borja road was constructed. It was a complex consisting of large crossed earthworks forming triangles, with a series of ridges of different types in the center. This technology helped to regulate water control between the Isirere and Mausa lagoons. Unfortunately, this unit was also cut by the road in the Mausa Island housing site, in the southeastern part of the archaeological complex (Michel 1993 a.)

Another complex that suffered because of the road construction was a complex known as Estancia La Estrella, located 12 km east of San Ignacio de Moxos, as shown in Figure 6-10-8. A quadrangular unit of ridges was found in this complex. This complex was framed by large embankments coming out obliquely to the meandering of the Matire stream. The road cut a number of embankments, ridges, and a large housing site located along the shores of the Matire River (Michael 1993 a.)

The ridge complex of Mausa Ranch is located in the southern part of the Mausa and Iserere lagoons, about 6.5 km from San Ignacio de Moxos, as shown in Figure 6-10-9. This complex is formed by a series of embankments, though no ridges can be observed. Seemingly, these were destroyed by cattle.

Several of the embankments and canals in this section are crossed by the road, as well Mausa Island, the Cruz de Caminos housing sites, and one on the road to Cochabamba (Erickson 1978; Michel 1993 a.)



Obtained by Michel, 1993a

Figure 6-10-6 Complex of Ridges near La Vfbora

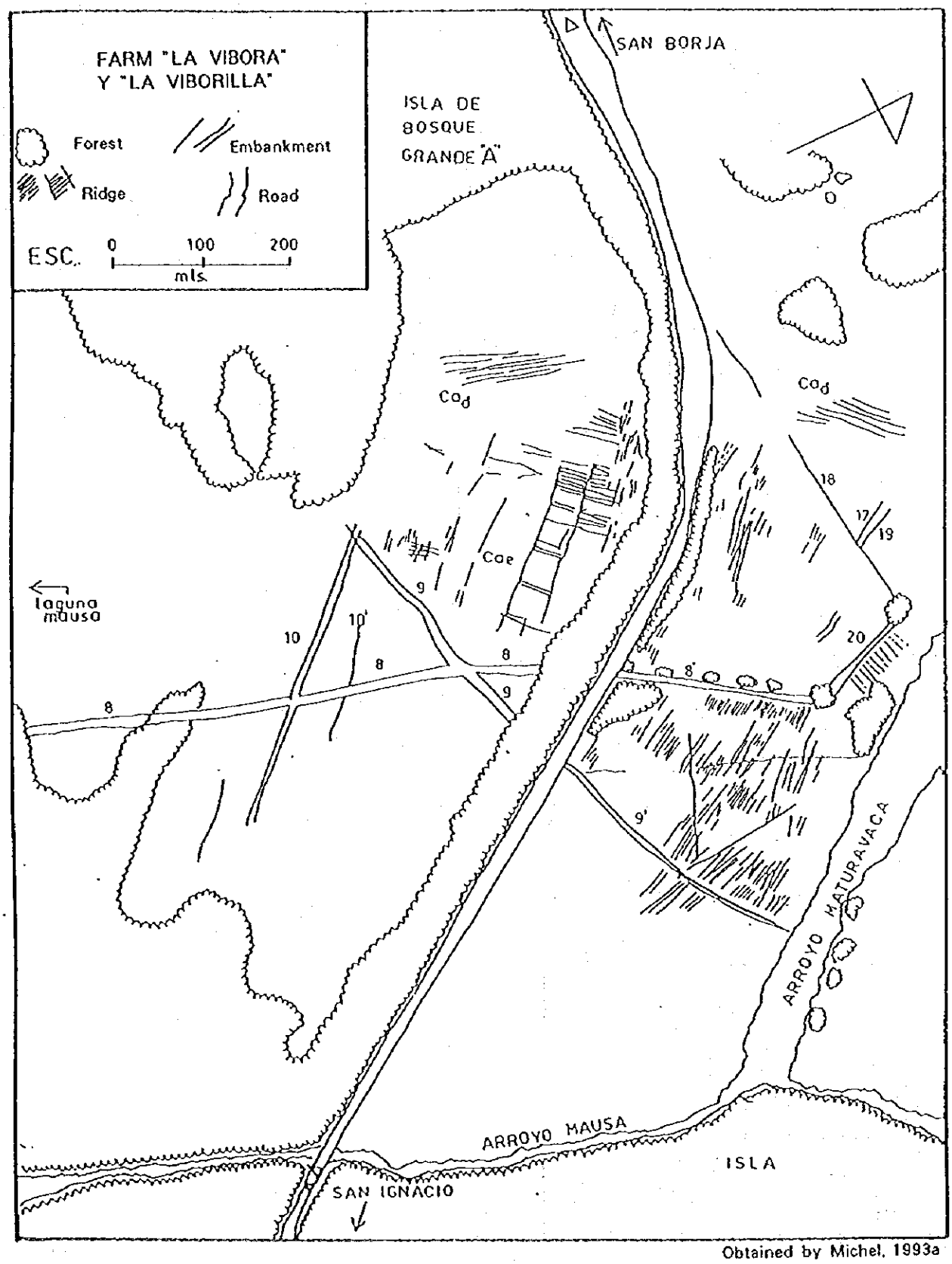


Figure 6-10-7 Archaeological Complex Near La Viborilla Ranch

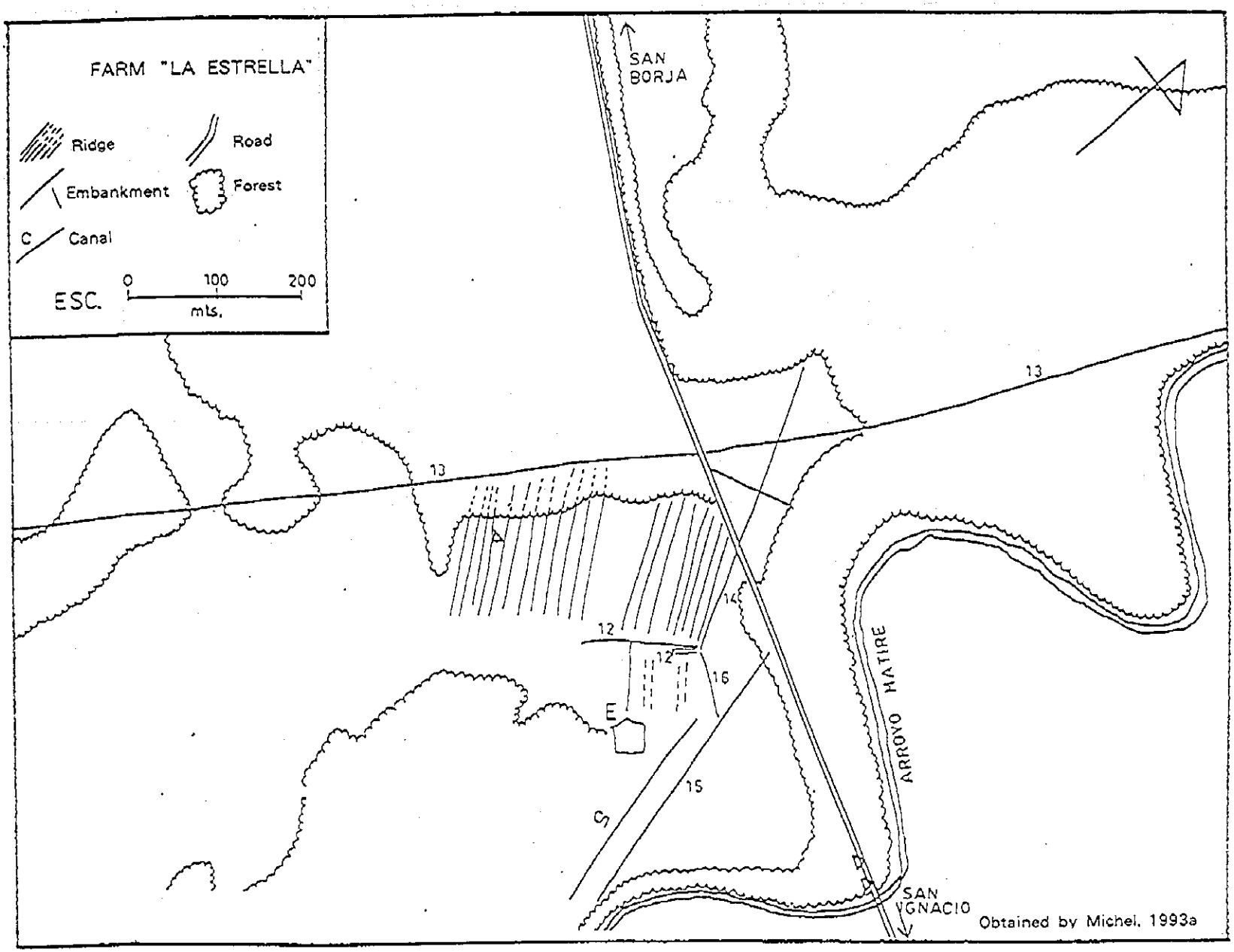
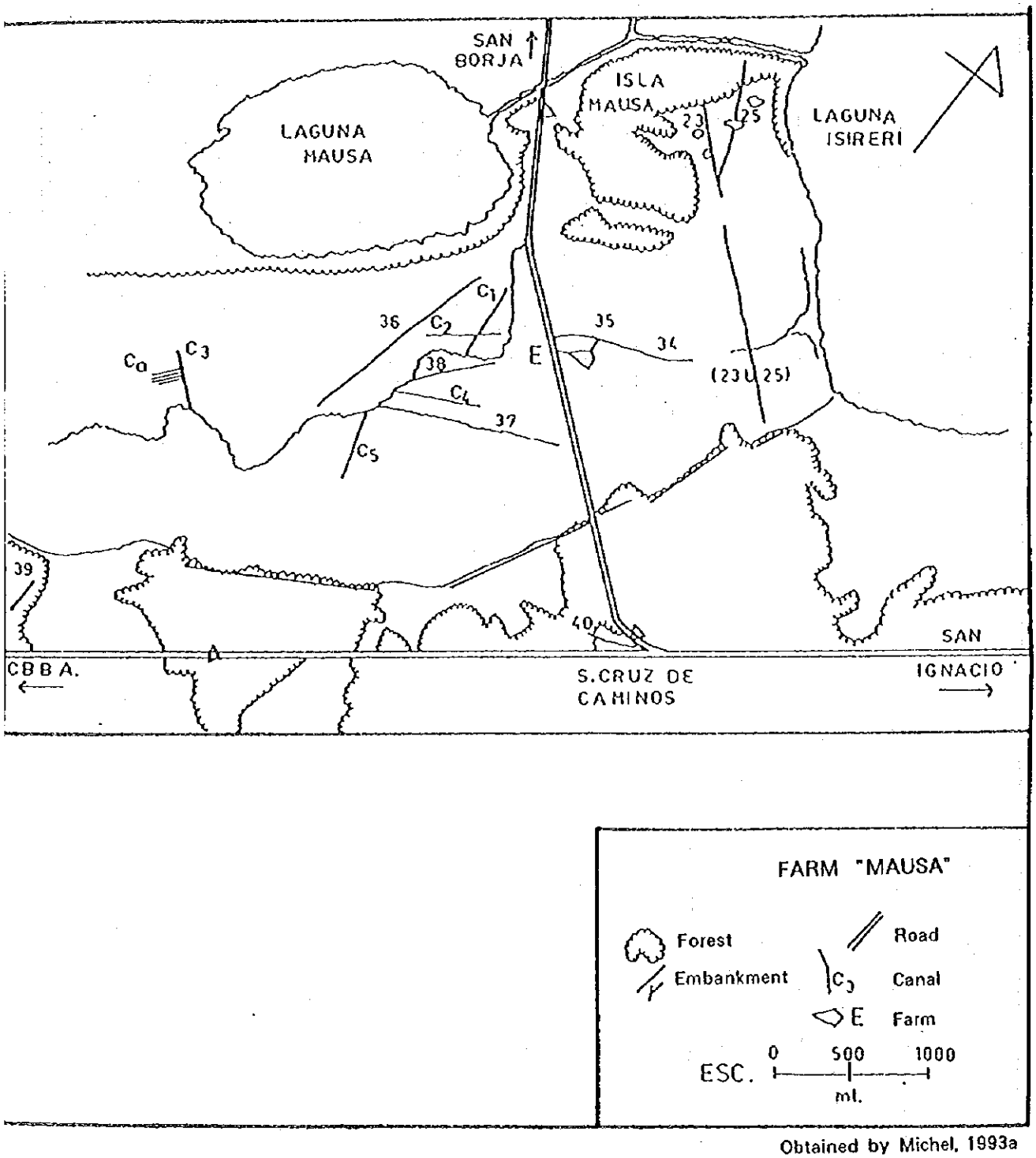


Figure 6-10-8 Archaeological Complex Near La Estrella Ranch



Obtained by Michel, 1993a

Figure 6-10-9 Ridge Complex of the Mausa Ranch

A series of canals and embankments was found about 3 km West of San Ignacio de Moxos, which were associated with ridge camps, as shown in Figure 6-10-10. This complex is located in a ranch owned by Mr. Sabala, which, although it does not have the characteristics of a complex, shows a unique technology (Michel 1993 a.)

The Companario, Arisona, Florida and Dinamarca Ranches have a number of embankment and ridge units that were cut and destroyed by the construction of the Trinidad-San Borja road (Figure 6-10-1). Archaeological excavation and mapping determined that this zone is also important because of its archaeological wealth (Erickson et al. 1995, under preparation.)

6.10.3 Hispanic Cultural Wealth of the Beni Department

The cultural wealth of the Moxos Plains, from pre-Hispanic times to the present, is extensive. The following is a brief review of the Jesuit relics, considering their pre-Hispanic characteristics and their technological value.

The arrival of the Jesuits and the foundation of the Missions between 1670 and 1770, when they were expelled, created the basis for extensive craftsmanship and artistic development of a new native generation. These missionaries brought with them the Spanish language, music, spinning, weaving techniques, carving, metal smelting, sowing, etc. All these works were widely supported by the Moxean basic knowledge and craftsmanship techniques, which impressed the Spanarids during their first incursions in the 17th century.

The ability of the native people to learn and imitate greatly impressed the Jesuits, who took advantage of these characteristics to develop music skills, musical instrument manufacture, carving, and drawing.

Native creativity was directed toward the production of religious art and fine textiles, which gained a national reputation, and became prized in the Sucre and Santa Cruz markets. Agricultural production was also largely developed. One of the most admired products were the bells smelted in Moxos, whose sound could be heard several kilometers away. Many of the bells bear the names of the native smelters.

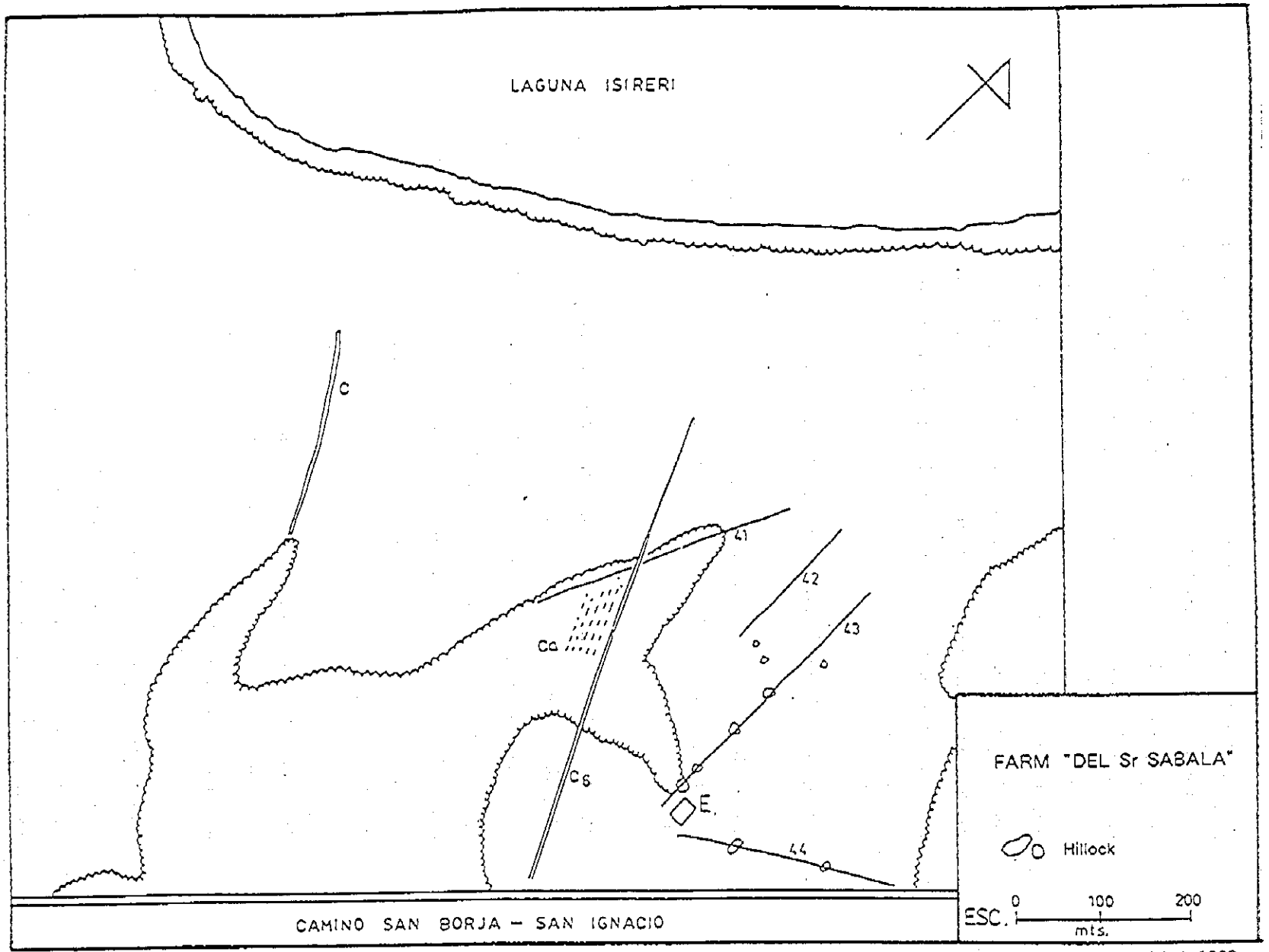


Figure 6-10-10 Ridge Complex at Mr. Sabala's Ranch

Obtained by Michel, 1993a

Also well known are the beautiful shrines, ciboriums, candles, processional candlesticks, crosses, incense burners, and silver-plated altars, as well as the wooden pulpits, doors, litters and arm chairs with carvings and bas relieves in bright colors which were created at this time (Becerra Casanovas 1977.) The traveler Del Castillo provides a sample of this wealth in the following short descriptive narration:

"Kept in wood arks, already corroded by time, somewhat bruised, with arms for 50 candles, medallions were found with a series of scenes representing the Passion of Christ repoussé in engraved silver by the hands of a noteworthy silversmith ..." "... There also existed a silver chest, bruised, keeping wrapped in rags an artistic holy cup, notable for its workmanship and size, made of gold weighing about 1 kilo, with find encrusted stones, emeralds, rubies, and precious brilliants" (Del Castillo, Marius 1912-1928.)

A number of factors led to the loss of these relics:

- The expulsion of the Jesuits, after which the churches and Jesuit properties were plundered or burned.
- Bishop Belisario Santiesteban's attitude of withdrawing all gold and silver from the Moxos churches to contribute to the construction of the Santa Cruz Cathedral.
- The Wars for Independence, during which where both the guerrillas and the defenders of the crown took these religious works as a plunder.

Nowadays, only a few remain, and can be seen in Trinidad, where there is a highly colored wooden bas relief representing Christ's Agony on the cross. There is a small museum in the Church of San Ignacio de Moxos, exhibiting, even now, the mortal remains of Father Marban, who was killed by the Canichanas.

6.10.4 Age of Archaeological Ruins

Tables 6-10-1 show a summary of Bolivian Amazonian archaeology. A brief explanation regarding this matter is given below:

Table 6-10-1 (1) Age of the Bolivian Amazonian Archaeology

Depto.	La Paz	Santa Cruz	Cochabamba	Beni	Pando
Región	Alto Beni Futuro	Guarayos Pailón Sansipata	Chapare	San Ignacio - San Borja Trinidad Santa Ana Riberalta Bajo Maniqui	Alta Gracia
I N V E S T	E. Nordenskiold M. Portugal O.	J. Riester V. Bustos H. Prumers A. Mayer	D. Brockington D. Pereira	Nordenskiold/ M. Hunter/ E. Ryden/ H. Kela V. Bustos/ Dougherty y Calandra C. Erickson y J. Faldin Erickson/ K. Candler/ J. Walker/ M. Michel V. Viatler/ D. Angelo Lenoir y Michel	M. Michel
Año					
2000				Bajo Maniqui	
1600			Sequencas Valle Ibirra		
1000					
800				El Villar	
500				———	
a.C		Culturas Amazónicas		———	
0		———		———	
d.C		———		———	
500		———		———	
550		?		Casarabe	
700	Chiray Covendo San Buenaventura	Guarayos Pailón		Barrancabique Laguna Honda Velarde Inf.	
1000	Futuro				
1050	Caranavi Sapecho Inicua	Inka			
1500					

Table 6-10-1 (2) Age of the Bolivian Amazonian Archaeology

Región	Trinidad	El Villar	Bajo Maniqui	Santa Fé - La Cuvidia El Retoño	Chevejecure	Santa Ana	San Ignacio
Año							
2000			Complejo del Bajo Maniqui				
1600							
1000		El Villar					
		1ra ocupación					
500		humana					
120		¿Conjetura					
		del uso					
a.C		de cuellones					
0							
		Uso continuo					
d.C		de cuellones					
300	¿Fase						
500	Casarabe						
		¿Const. terraplen					
700	Velarde						
				Uso de cuellones	Uso de cuellones ?		
800	¿Fase						
1100	San Juan			?			
	y fase						
	Mamoré						
	Hernmark?						
1150	Mocilo	¿Fin de uso					
1500							

¿ Con fechado radiocarbónico

__ Uso de cuellones

The archaeology of the Moxos Plains dates from the beginning of this century, when the pioneer Erland Nodenskiold (1913) made the first excavations in the Velarde, Hermack, and the Macisito hillocks, located in the southern region of Trinidad. This task was continued by Stig Ryden (1941), who made excavations near Casarabe, in the eastern part of Trinidad. Subsequent reports were made, based on the collections of archaeological material, mainly found out of the context (Erickson 1980.)

Systematization of the archaeological sites in the Beni Department began with the explorations and excavations of foreign professionals of the National Institute of Archaeology. Initially, the archeologist, Víctor Bustos, (1976 a, 1976 b, 1976 c, 1978 a, 1978 c, 1978 d) conducted surveys and test excavations in the artificial hillocks near Trinidad. These works were regionally supported many times by experts familiar with the area (Lee, 1979) or enthusiastic professionals than worked together with the archaeologists (Pinto Parada, 1987.)

The archaeological explorations of Erickson and Faldin along the newly constructed Trinidad-San Borja road, (1978, 1980), and some soundings carried out in the same stretch by the Argentinean Mission, were the first archaeological expeditions to take advantage of the construction of the new road. Therefore, the works extended beyond Trinidad (Dougherty and Calandra, 1984.)

Most of the investigations verified that the number of forest islands and pre-Colombian habitat settlements is astounding (Erickson et al 1991; Bustos 1976 c, 1978 a, 1978 c, 1978 d), as are the extended fields of ridges (Denevan 1980.)

Although only some progress had been made in the investigation methodologies up to that time, Nodenskiold established a base for chronologically classifying ceramics by creating a timetable and cultural table organized on four levels (see the chronological table), which were: Velarde Inferior, Velarde Superior, Hermack and Masicito. Later on, the Argen-tinean Mission conducted a series of excavations in the housing hills, in order to obtain more accurate information about the ceramics and to date them using the radio-carbon method (Dougherty and Calandra 1981-1982; 1983; 1984-1985.) Although these investi-gations obtained an absolute chronology for the Mamoré, San Juan and Casarabe phases, it was concluded that most of the sites were multi-component sites, showing a great statistical variety (Dougherty and Calandra, 1981-1982.)

One obvious aspect of the first archaeological works in the Beni Department during the 1980's was the little attention given to this immense archaeological potential. A number of pre-Hispanic cultivation complexes were hardly mentioned and studied during the first investigations. Although evidence of these systems was provided by Nordenskiold (1910) and Metraux (1942), the importance of such system was questioned by the geographers Denevan (1963) and Plafker (1963.)

One of the studies focusing on the prehistory of the Beni Department was conducted by William Denevan in his "Aboriginal cultural geography of the Moxos Plains," a doctoral thesis illustrating the origin, the construction of artificial works, and the general features of the Moxean culture (Denevan 1996, translated into Spanish by Denevan 1980.)

The first news about the immense complexes came as a result of aerophotogrametric studies and brief field surveys (Denevan, 1963, 1966 a, 1980 a; Plafker, 1963.) These studies located large complexes of works built with earth, which were abandoned later on: including sawhorse borders (cultivation fields in elevated platforms), canals, embankments, water reservoirs, lagoons, and heavily occupied sites on hills.

Denevan made a conservative estimate that about 100,000 ridges are located in an area of 72,000 km², and approximately 503 linear kilometers of embankments in an area of 3,900 km². These estimates are limited, due to the effects of sedimentation, massive erosion, deforestation, and cattle farming. Other natural effects that did not permit simple surface surveys are related to the fast growth of the wooded layers located at the remains of the ridges.

The regional archaeology of San Ignacio de Moxos was investigated in a licentiate-degree thesis of the Universidad Mayor de San Andrés (public university of La Paz), (Michel, 1993), where elevated fields, embankments, canals, and habitat hills were systematically investigated. Since the technology of elevated fields and embankments is still unknown, their protection and rescue from possible destruction is very important.

6.10.5 Cultural Chhorology of the Moxos Plains

The cultural chronology of the Bolivian Amazon is still in an embryonic stage due to the few investigations conducted in the country. As shown in Table 6-10-1, the earliest phase of cultural development with a presence of ceramics (with Barrancoidean influence

from North of the Amazon basin) is located in Bajo Maniqui (Michel and Lemuz 1922; Michel 1993 a). This has been determined by stylistic similarities. Other more recent investigations have used the Carbon 14 method. This village is composed by Sequenca and the Ibirza Valley (Percyra and Brockington, 1993.) The towns of Sequenca, Valle Ibirza and Bajo Maniqui were small and self-subsisting villages.

The archaeological site of El Villar has the deepest and the most continuous chronological series. Radio carbon tests have shown that here was the first human occupation in the Beni Department, around the year 800 BC. The ridges in this area show continued use from 200 BC to 1050 AC, providing that the ridges in the zone have been used and developed over a long period of time.

Former cultures of the hills near Trinidad, dated by the Carbon 14 method, are related to the Casarabe, San Juan and Mamoré phases, where traces of corn and other crops still remain. Other regions like Alto Beni and Santa Cruz have been tentatively dated, through a comparison of typological ceramics.

Table 6-10-1 shows a general estimate of the age of the El Villar archeological site, while other sites are dated according to their type. This chronology will be improved after new investigations are conducted.

6.10.6 Preservation Conditions

The artificial earth constructions of the Beni Department are now being destroyed by human activity and erosion. The following are some of the adverse influences:

- The cattle is eroding the surface of the ridges and embankments.
- The construction of roads and paths are cutting through embankments and sawhorse units.
- Land plowing with tractors is destroying large artificial structures (Erickson et al. 1992.)

According to aerophotographic studies, extensive calculations of the pre-Hispanic cultivation fields have been made assuming the existence of ridges in the pampas. These new discoveries show that these calculations are very low. It is extremely important to

investigate the forest areas in the future in order to make a real calculation of the ridge areas as well as the flatlands, where apparently no ridges exist. Although it seems that they may are actually be covered by sediment (Erickson et al., 1993.)

Table 6-10-2 includes a general overview of the preservation conditions of the known ridges. Both, the calculated area and the preservation conditions are approximations based on field work and the study of aerial photographs.

Table 6-10-2 Preservation of the Known Ridges

Region	Area (ha)	Conservation Grade
Trinidad	10	Bad
El Villar	90	Good
Santa Fe - La Envidida - El Retoño	156	Good
Chevejecure	100	Good
Santa Ana	Unclear	Regular
San Ignacio	100	Good

6.10.7 Investigation Result

Investigations conducted reached the following conclusions:

(1) Conclusions of the Archaeologist, V. Bustos:

- An important culture familiar with agriculture flourished in the Moxos Plains. Agriculture was practiced in enormous sawhorse fields with embankments and artificial habitat hillocks. The entire area occupied by this culture has not yet been calculated, but its highest concentration is in the Beni Department.
- Some lithium samples prove contact with the regions where stones were obtained, such as the Brazilian Shield and the Andean Cordillera, since this material is scarce in the Beni Department.
- The zone may have held a large population of over 100,000 natives. The construction of huge works implies a social stratification with a central mechanism capable for administering and organizing the work, as well as carrying it out.
- Clark Erickson (1980) concluded that the actual extension and characteristics of the pre-Hispanic remains of ridges and earthworks (especially the embankments) could not be analyzed in their real dimensions and characteristics based on aerial photographs, since most of them were not visible during the field surveys. In the future, new techniques will have to be implemented.

(2) Conclusions of the Archaeologists, Dougherty and Calandra

- A question was asked regarding the artificiality of the housing hillocks.
- A complete revision of the previous ceramics chronology was proposed based on a the establishment of a new study of systematic series.
- Some ceramic links were detected, among these, the beginning of the Argentinean northwest with the Masicito Style. The incised and pointed horizon of the Amazon, partially correlates with the incised and pointed style of the Cumancaya tradition.
- The painted pottery is more diversified than was previously assumed, and some correlate with the polychromatic styles of the Mizque Valley.

(3) Conclusions from the Team of the Beni Archaeological Project (1991-1993)

- It was proved that the agricultural areas were not very far away from the housing sites.
- The sites destined for housing are presently covered by a great deal of vegetation known as "Isla" (island) or "Monte" (woodlands, woods.) The area of these sites is more elevated than the surrounding areas.
- The impressive number of embankments and canals on the borders of the Trinidad-San Borja road are clearly visible in aerial photographs, where it can be seen how they were cut.
- It is common to place embankments and canals as part of ridge fields, forming extensive groups, but there are also isolated canals and embankments.
- The results from the radio-carbon dating indicate that the artificial earthworks of Moxos are pre-Hispanic and have a long history.
- Much of the landscape of the Moxos Plains is anthropogenic. In the Santa Fe, La Envidia and El Retoño Ranches, for example, most of the forest islands are located on embank-ments and ridges.
- The variety of the forms of the ridges in the central part of the Moxos Plains is impressive.
- Most of the ridge complexes are surrounded by embankments and canals to regulate the optimal water level. The ridges were designed to allow free water circulation within a complex. A great number of large embankments seem to have blocked the natural flow of the rivers, possibly forming small, deep reservoirs or dams.

6.10.8 Understanding the Inhabitants

During the field work, the study team interviewed the inhabitants about the existence of ruins or other ancestral sites. The answers and comments of the natives by area and their attitude towards them, are summarized in Table 6-10-3.

Table 6-10-3 Answers and Comments of the Native People

Area	Answers and Comments
Santa Rosa de Aguas Negras	Arrows were found. Theses are not very interesting, but they keep them.
Santa Ana de Moseruna	Things are thrown near the forest. They do not mind.
Fátima	Low hills to the north. They do not mind.
Bermeo	Almost near the community. They do not use it very much.
Villa Esperanza	They cultivate rice and yucca in ancient ridges by initiative of the priests from PRODEMO. That helps the people to stay, but doing the work is arduous.
El Buri	There are low hills to the north. They are not interested.
Santa Rita	Used as breach and "chaco" (small farm.)
Algodonal	To the north and south. They sometimes sow.
Litoral	To the east. They see them when clearing the plot (making "chacos"); sometimes sow on them.
Chontal	Embankment, but is far away.
San Juan Matos	To the east. They are not interested.
Martirio	To the east.

Source : Godínez Armando and Oviedo Gonzalo: Own estimates, based on field work from the JICA Study Team, 1995

6.10.9 Institutional System

(1) National Archaeological Institute - INAR (1976-1980)

The National Archaeological Institute (Instituto Nacional de Arqueología), a public institution, is responsible for regulating archaeological investigations in Bolivia. It has participated in investigations since 1976, formulating a series of projects and sending to Trinidad the Chilean archaeologist, Victor Bustos Santelices, as a regional investigator. Subsequently, in 1978, the Center for Archaeological Research of Beni CIAB (Centro de Investigaciones Arqueológicas del Beni) was created with its headquarters in Trinidad, however, operations ceased upon the withdrawal of Bustos that same year.

INAR has supported, as much as it could, the implementation of subsequent projects, which have been developed to date.

① 1976

Archaeological investigations in Trinidad, Beni Department. Excavations were started in the low hills near Trinidad (Bustos, 1976.)

② 1977-78

Archaeological exploration in the Riberalta Zone, Beni Department and the Las Piedras Archaeological site (Bustos, 1977.) Eight artificial low earth hills near Trinidad were systematically excavated. Furthermore, 20 flight-hours of aerial surveys were dedicated to checking the crop fields of the ridges near Trinidad (Bustos, 1978.)

③ 1978

Formulation of the Archaeological investigation project between the towns of Trinidad and Riberalta on the basis of the design of this road section (Bustos,1978c.) Execution of the Trinidad-San Borja archaeological excavation project (Erickson and Fal-din ,1978; Erickson, 1980.)

(2) Mamoré Ecosystem Project

The projects described below were developed from 1977 to 1984, by agreement between INAR and the La Plata National University and Museum (Argentina), represented by Dr. Bernardo Dougherty. The University of José Ballivian from Beni, the University of San Simón from Cochabamba and the Smithsonian Institution of Washington, D.C., also participated.

① 1981

Archaeological investigations in the plains of the Beni Department. Excavations in the artificial low hills near Trinidad (Naranjalito, Chuchini, Kiusiu, Los Aceites, Loma Mari, Casarabe, Carranza, Palmasola), and between Trinidad and San Ignacio de Moxos (no report.)

② 1982

Archaeological exploration in Loma Alta de Casarabe (Dougherty and Calandra 1981-1982.) Exploration and excavations in the Itanez Province of the Beni Department (Dougherty and Calandra 1983-1984.) Archaeological Exploration Project in San Ignacio de Moxos by the Major University of San Andrés and the University of La

Paz. Marcos Michael López wrote his master degree thesis on this subject from 1991 to 1993.

③ 1990-1992

Systematic exploration and excavations in the town of San Ignacio de Moxos, between the Isirere and Mausa Lagoons. An archaeological survey was conducted in the Estrella, La Lágrima, La Víbora, La Viborilla, Mausa, Estancia del Español ranches, and on Mr. Sabala's ranch.

(3) Beni Agricultural - Archaeological Project (Proyecto Agroarqueolóico del Beni)

Created by a 5-year agreement between Dr. Clark Erickson, representative of the University of Pennsylvania (Philadelphia, Pennsylvania, USA) and the office of the National Secretary for Culture, through the National Archaeological Institute. This project has the full cooperation of the Major University of San Andrés, the University of La Paz, and students from the Agronomy School of the Technical University of Beni.

Planned excavation campaigns and laboratory studies were carried out during 1990, 1992, 1993 and 1994, in following regions:

① 1990

Biological Station of Beni, El Villar Ranch, located 60 km East of San Borja, and the San Carlos Ranch, located South of Trinidad.

② 1992

Ranches: Santa Fe and La Envidia; San Vicente Lagoon, San Borja Port and the San Miguel community (Matire and Huirico Rivers.)

③ 1993

- Brief survey in El Progreso Ranch, located 5 km North of San Borja.
- Chevejecure Ranch, located 50 km West of San Ignacio de Moxos; Achachairuzal and San Pedro Ranches, located 50 km East of San Ignacio de Moxos.
- Research carried out in the ranches of Santa Fe, La Envidia, Candelaria, Retoño and Manchuria, located 30 km Southwest of San Ignacio de Moxos. Agricultural-archaeological investigations were also carried out at the Biological Station of Beni and in the native communities of Benneo and Villa Esperanza.

④ 1994

- ♦Biological Station of Beni, Normadia Lagoon, Platanillo, ranches Arizona, Campanario, Dinamarca, Matto Grosso and near San Borja, the Infierno Verde zone.
- ♦In the Apere sector: Lazaro hill, ranches of San Juan, Villa Judith, the Santa María Community, ranches Nuevo Berlín, Progreso, San Clemente, the Desengaño Community, ranches of Luján, La Esperanza, the Chaguaya Community, ranches Jerusalem, La Ibérica and San Luis. In the Santa Ana de Yucuma region, the El Cerro Ranch.
- ♦Near Trinidad, the Ibiato hill in Casarabe and Ibitate on the road to Santa Cruz.

It should be pointed out that experimental archaeology has been developed since 1990 through this project by analyzing the archaeological features of the pre-Hispanic crop fields in the Moxos Plains, and through several systematic exploration studies at the borders of the Trinidad-San Broja road and other regions.

Exploration, excavation, carbon and pollen analysis works are being carried out in the agro-archaeological project of Beni, in the regions of El Villar (Erickson et al., 1991; refer also to the chronological table), ranches of Santa Fe, La Envidia, El Retoño, South of San Ignacio and Chevejecure near the Matos River (Erickson et al., 1992-1993), in the ranches Los Pauros, Campanario, Dinamarca, Arizona (Erickson et al., preparation stage.)

The above explorations are complemented by the pioneer experimental constructions of elevated fields, such as those of the Biological Station of Beni, where calculations have been made since the beginning of the construction works, and where a field evaluation was carried out (Erickson 1992; Michel, 1990.)

The results achieved by this project have caught the attention of Beni students, who are now preparing various these on this subject. More than one hectare of elevated fields was constructed using the patterns obtained from the exploration and archaeological excavation carried out in the central plains of Moxos (Erickson et al., 1991.) Construction works are being carried out in flooded pampas, about 200 meters from the operational base of the Biologic Station of Beni. Fields were sown in March 1991 (Estévez, 1991) and harvested in June of the same year. The results can be considered a success for Cuban corn varieties and hard corn. The yield was over 1,900 kg/ha,

higher than the general average annual production of this same type of crop in the Beni Department, which is 1,830 kg/ha, and similar to the production obtained in the Mexican Chinampas (Project MACA/FAO/UNDP, 1991; Erickson, 1992b.)

The interest of international institutions in the Beni Department is evident, especially in the acquisition of permits related to agro-archaeology activities, which will allow in the future, further assessments and the extension of the technique to other regions.

Recently, Arce (1993) comparatively analyzed the type of crop and width of the ideal ridge by the construction of 0.25 ha of ridges with standard dimensions. Roman (1995) is comparing the yield of the ridges with the commonly used slash-and-burn technique on small farms (chacos.) Pérez and Pérez (1995) are studying in detail the formation of organic mud in the canals of the ridges, and have built 0.25 ha. The results of this agronomic thesis have been encouraging giving a yield of 27 ton/ha of yucca in the work of Arce (Arce, 1993.)

The applicability of these techniques by the native communities is being studied at present. New sawhorse fields have been built in the Moxos communities of Bermeo (two plots of 0.5 ha) and Nueva Esperanza (one plot of 0.5 ha) with the cooperation of the local people and agencies such as PRODEMO, Pro-Development of Moxos (Pro Desarrollo de Moxos). Financing for these projects is being provided by the Agro-Archaeological Project of Beni (Erickson and Jorda, 1992; Matareco, 1993; Erickson et al., 1992.)

A program has also been developed for the implementation of sawhorses in the Native Territory, addressing the minimal requirements for the proper use of this technology (Michel, 1993b.)

6.11 Air Pollution

6.11.1 General

(1) Sources of Air Pollution

The main sources of air pollution are classified as fixed sources such as factories, residencies, etc., and as moving rambling sources such as vehicles, trains, ships, etc. Air pollutants expelled from these sources generally consist of nitrate oxides (NO_2), sulfate oxides (SO_2), carbon oxide (CO), suspended particular matter (SPM:<10 um), etc.

In the project area, fixed sources consist of several brick-burning factories and houses in residential areas including San Borja, San Ignacio, and Trinidad, while vehicles are considered as the main moving source.

(2) Existing data

No analytical data for air quality was obtained in the project area.

6.11.2 Field Investigation

(1) Measurement Components

The chemical analysis items for assessing air quality are nitrate oxides (NO_2), sulfate oxides (SO_2), carbon oxide (CO) and total suspended particular matter (TSPM), as well as meteorological measurements including temperature, atmospheric pressure, wind, and wind direction.

Two measurements per day were taken during the dry and rainy seasons, one between 7:00 and 11:00 hrs (a.m.), and the other between 15:00 and 19:00 hrs (p.m.)

(2) Location

Air quality was measured at four points inside the project area, that is San Borja, the Maniqui river, San Ignacio and Trinidad, as shown in Figure 6-11-1. These points were limited to relatively urban areas.

The measuring points were located at the edge of the existing road at a height of 1.5 m from the surface. The period of measurement was four hours.

(3) Chemical Analytical Method

The chemical analytical methods for NO_2 , SO_2 , CO and TSPM are as follows:

a) Methodology of the chemical analysis of air

To analyze the air quality, the methods utilized were adopted from those determined by the Conference of Industrial Hygienists (ACGIH - USA.)

① NO_2 (P-CAM 231)

This is based on the colorimetric reaction between 1-naftilamine ethilendiamine chloride and NO_2, which is then assessed by spectrophotometry at 555 nu.

② SO_2 (P-CAM-160)

SO_2 is absorbed and measured in a tetramercury of sodium (TCM) solution. It is formed by a complex of dichloride of sulfate mercuric (oxidation in the air.)

③ CO (MSA-USA)

CO is analyzed by colorimetric indicator tubes manufactured by MSA (Mine Safety Appliances Co. - USA.)

④ TSPM (UMSA)

The total suspended particulate matter is captured on filters made by special MSA-FW-B (PVC) membranes, by using air suction batteries calibrated in a continuous flow, and then analyzed by infrared spectro-photogrametry in order to determine the particle size and its concentration in free silica.

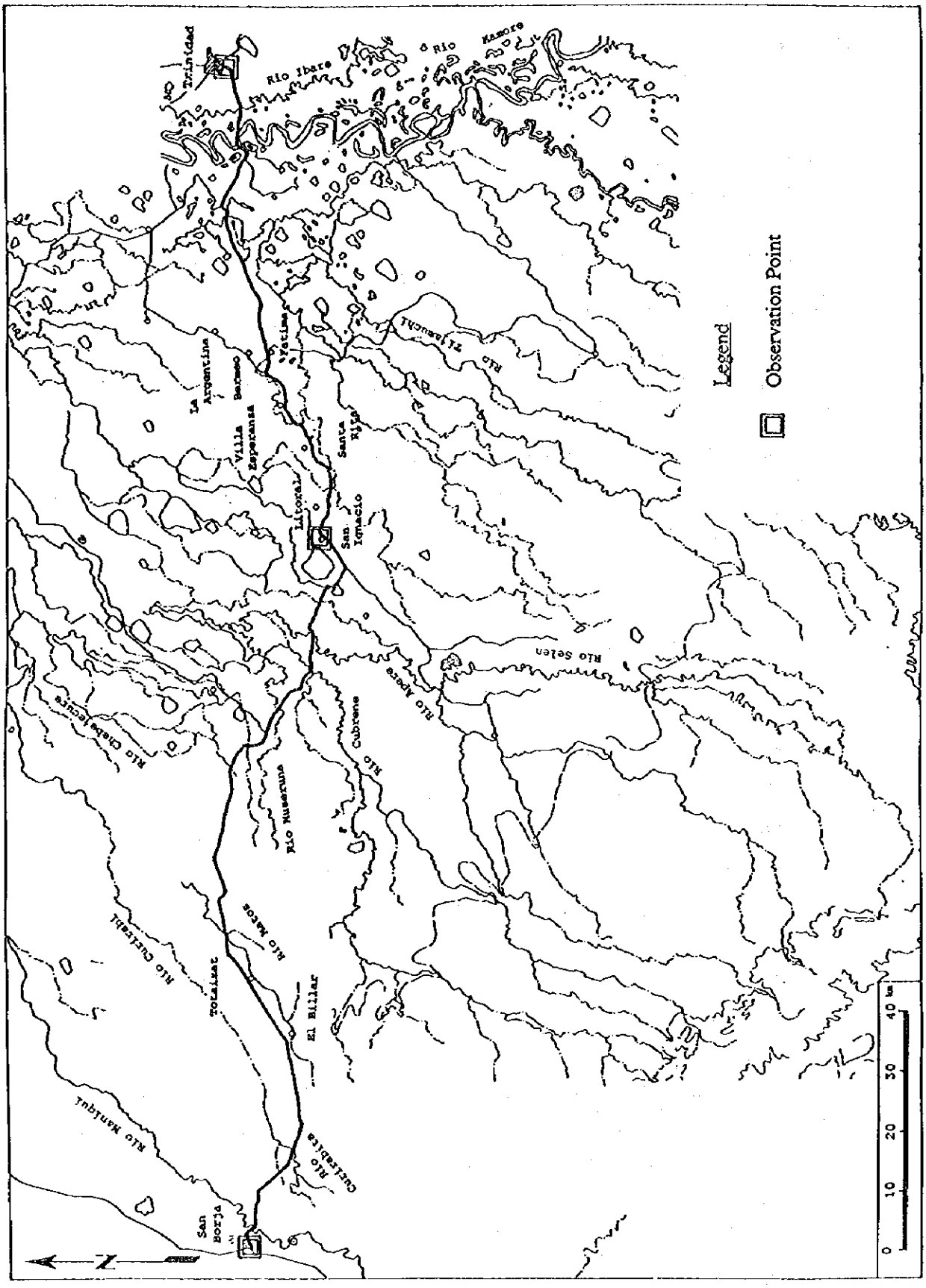


Figure 6-11-1 Location of the Air Quality Measurement Points

6.11.3 Measurement Results

The chemical analysis results of the air are shown in Table 6-11-1. The concentration value of each item represents the average value per hour.

The concentration of nitrate oxides (NO_2) in the project area ranges from 7.35 to 22.50 ug/m³. Sulfate oxides (SO_2) range in concentrations from 0.10 to 1.29 ug/m³. Carbon oxide (CO) is always less than 0.4 ug/m³. Total suspended particular matter (TSPM) during the rainy and dry seasons ranges in concentrations that vary from 0.00 to 5.00 ug/m³ and from 7.00 to 18.00 ug/m³, respectively. Therefore, the results of air quality measurements in the project area indicate that the air is very clear and clean.

Table 6-11-1 Results of the Chemical Analysis of the Air

(1) Rainy Season

Location	Date*1	Time	NO_2 µg/m³	SO_2 µg/m³	CO µg/m³	TSPM µg/m³
San Borja	19/1/1995	7-11	10.29	0.95	0.33	1.50
	19/1/1995	15-19	7.84	1.13	0.11	1.40
Rfo Maniqui	18/1/1995	7-11	7.35	0.48	0.14	2.30
	18/1/1995	15-19	8.57	0.48	0.13	0.00
San Ignacio	16/1/1995	7-11	9.80	0.32	0.17	0.00
	16/1/1995	15-19	12.25	0.32	0.15	0.00
Trinidad	14/1/1995	7-11	18.23	1.29	0.24	5.0
	14/1/1995	15-19	17.10	0.97	0.22	3.0

Note - *1 Meteorological conditions: 1. San Borja 1/19/1995, 28°C, 980.0 mb
2. Rfo Maniqui 1/18/1995, 30°C, 980.0 mb
3. San Ignacio 1/16/1995, 35°C, 985.0 mb
4. Trinidad 1/14/1995, 29°C, 992.0 mb

(2) Dry Season

Location	Date*1	Time	NO_2 µg/m³	SO_2 µg/m³	CO µg/m³	TSPM µg/m³
San Borja	8/7/1995	8-12	11.23	0.73	0.21	12.80
	8/7/1995	14-18	17.30	0.65	0.15	16.20
Rfo Maniqui	7/7/1995	8-12	11.40	0.17	0.10	12.30
	7/7/1995	14-18	12.30	0.16	0.10	9.73
San Ignacio	6/7/1995	8-12	7.60	0.15	0.00	7.0
	5/7/1995	14-18	8.50	0.10	0.00	8.50
Trinidad	4/7/1995	8-12	18.63	0.25	0.23	15.00
	3/7/1995	14-18	22.50	0.27	0.27	18.00

Note - *1 Meteorological conditions: 1. San Borja 6/19/1995, 28°C, 980.0 mb
2. Rfo Maniqui 6/18/1995, 30°C, 980.0 mb
3. San Ignacio 6/16/1995, 35°C, 985.0 mb
4. Trinidad 6/14/1995, 29°C, 992.0 mb

6.12 Water Quality

6.12.1 Water in the Project Area

(1) Water

The water in the project area consists of rivers, swamps, lakes, back swamps (and marshes), and water wells. Detailed information on the conditions of the water in the project area can be found in Section 6.4.

The rivers in the project area belong to the fluvial system of the Mamoré River, which is a main stream. The tributary rivers include the Maniqui, Curirabe, Curirabita, Matos, Chebejecure, Cuberene, Apere, Tijamuchi and Ibare Rivers. Each tributary river flows in a northeast direction, joining the Mamoré River (Figures 6-4-1 and 6-4-2.)

The rivers in the project area are subdivided into five river basins : the Maniqui, Apere, Tijamuchi, Mamoré and Ibare River basins.

The catchment areas of the Maniqui, Apere, Tijamuchi, and Ibare River basins range from 3,000 to 7,000 km². The lengths of these rivers range between 220 and 280 km. The topography of the upper reaches of the river basin is different; namely, the upper reaches of the Mamoré and Maniqui River basins are mountainous, the one from the Apere River basin is a hill, and those of the Tijamuchi and Ibare are plain lands. The conditions of the lower reaches of rivers are strongly affected by tractional and suspended loads; specifically, the river water from mountainous regions, including the Maniqui and Mamoré Rivers, is turbid water containing a large volume of loads and SS. On the other hand, the river water from the plains and hill regions is generally clear or brownish in color (humic color.)

(2) Existing Data

No analytical data of the water quality in the project area was obtained.

6.12.2 Field Investigation

(1) Components of the Physical Measurements and Chemical Analysis

The 18 items involved with the measurement and chemical analysis of the water quality are the following: hydrogen-ions (pH), temperature (Temp.:°C) conductivity (Cond.:uS/cm), dissolved oxygen (DO:mg/l); total dissolved solids (TDS:mg/1), suspended solids (SS: mg/l), biochemical oxygen demand (BOD:mg/l), chemical oxygen demand (COD:mg/l), Ca (mg/l), Mg (mg/l), Mn (mg/1), T-Fe (total iron; mg/l), Na (mg/l), K (mg/l), HCO_3 (hydrocarbonates; mg/l), SO_4 (sulfates:mg/l); Cl (mg/l); NO_3-N (nitrate nitrogen:mg/l). In addition, hydrogen-ions (pH), temperature (Temp.:°C), conductivity (Cond.:uS/cm), dissolved oxygen (DO: mg/l), turbidity (Turb.:mg/l) and salinity (Sal.: mg/l), which were detected by using a subaqueous measuring instrument at rivers, creeks and water wells. Measurements and analyses were carried out twice, once in the rainy season and once in the dry seasons.

(2) Location

Water quality was measured at five points inside the project area, in the Maniqui, Matos, Apere, Tijamuchi and Mamoré Rivers, as shown in Figure 6-12-1. Measurements were carried out with the subaqueous instrument at 35 points.

(3) Physical Measurement Method and Chemical Analysis

The physical measurement methods and chemical analyses that were applied are described below:

a) Methodology of the chemical analysis of water

① Hydrogen-ions (pH)

- Method used : Electrometric
- This method is based on the potential difference between a glass electrode and a reference potential measured by using a pH meter and an electrode HACH Cat. N° 44300-21.
- Sensibility=0.01 Range=0~14

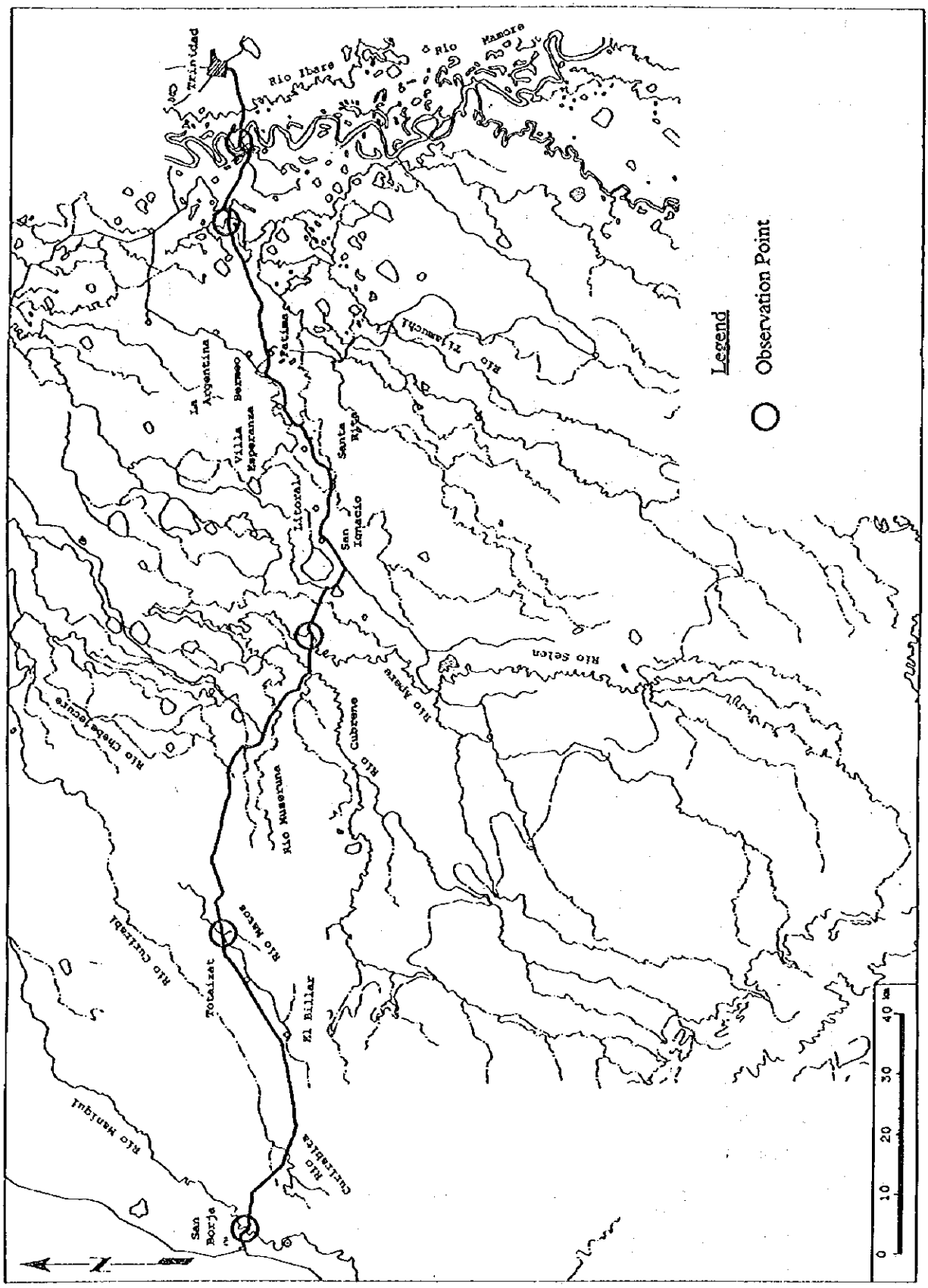


Figure 6-12-1 Location of Measurement Points for the Analysis of Water Quality

② Temperature (Temp.:°C)

♦ Measured with an electro-thermometer HACH, Model 44600.

♦ Sensibility=0.1°C Range=0~100°C

③ Conductivity (Cond.:uS/cm)

♦ The conductivity is calculated by means of the principle of the Whetstone or Kohlrausch bridge, which is used by applying AC current between electrodes consisting of two platinum shells covered with black platinum. A conductometer HACH, Model 44700 is used for this purpose.

♦ Sensibility=0.1 uS/cm Range=0~160 g

④ Dissolved oxygen (DO:mg/l)

♦ This consists of colorimetric analysis of free iodine with thiosulfate of Na 0.025N. The Winkler method is applied with a starch solution used as an indicator.

♦ Sensibility=0.1 mg/l Range=0~10 mg/l

⑤ Total dissolved solids (TDS:mg/l)

♦ The total dissolved solids are automatically measured with the HACH TDS meter.

♦ Sensibility=0.1 mg/l Range=0~200 mg/l

⑥ Suspended solids (SS:mg/l)

♦ These are measured by gravimetric methods after being filtered by the vacuum or centrifugalization methods.

♦ Sensibility=0.1 mg/l Range=0~160 mg/l

⑦ Biochemical oxygen demand (BOD:mg/l)

♦ According to the Standard Methods for the Examination of Water and Waste Water, 14th. Edition, APHA (1975), pp. 534-550, this demand is defined as the amount of oxygen consumed by some matter present in the water during assay conditions, i.e., during five days after the incubation period, at 20°C and in darkness to avoid biological degradation.

♦ Sensibility=0.5 mg/l Range=0~150 mg/l

⑧ Chemical oxygen demand (COD:mg/l)

♦ According to the Standard Methods for the Examination of Water and Waste Water, 14th. Edition, APHA (1975), pp. 534-550, this demand is defined as the amount of oxygen in mg/l that is consumed by oxidized matter during assay conditions.

♦ Sensibility=0.5 mg/l Range=0~150 mg/l

⑨ Ca (mg/l)

- Atomic absorption using the Perkin Elmer 2380 spectrophotometer. The wavelength that was used was 442 nm for Ca^{2+}, with an air-acetylene flash burner with an aperture and 10 cm of pitch.
- Sensibility=0.012 mg/l Range=0~5mg/l

⑩ Mg (mg/l)

- Atomic absorption using the Perkin Elmer 2380 spectrophotometer. The wavelength that was used was of 285.5 nm for Mg^{2+}, with an air-acetylene flash burner with an aperture and 10 cm of pitch.
- Sensibility=0.008 mg/l Range=0~1.5 mg/l

⑪ Mn (mg/l)

- Atomic absorption using the Perkin Elmer 2380 spectrophotometer. The wavelength that was used was of 279.5 nm for Mn^{2+}, with an air-acetylene flash burner with an aperture and 10 cm of pitch.
- Sensibility=0.052 mg/l Range=0~0.5 mg/l

⑫ T-Fe (total iron:mg/l)

- Atomic absorption using the Perkin Elmer 2380 spectrophotometer. The wavelength that was used was of 248.3 nm for Fe^{2+}, with an air-acetylene flash burner with an aperture and 10 cm of pitch.
- Sensibility=0.1mg/l Range=0~0.5 mg/l

⑬ Na (mg/l)

- Atomic absorption using the Perkin Elmer 2380 spectrophotometer. The wavelength that was used was of 766.5 nm for Na^{+}, with an air-acetylene flash burner with an aperture and 10 cm of pitch.
- Sensibility=0.012 mg/l Range=0~1 mg/l

⑭ K (mg/l)

- Atomic absorption using the Perkin Elmer 2380 spectrophotometer. The wavelength that was used was of 589 nm for K^{+}, with an air-acetylene flash burner having an aperture and 10 cm of pitch.
- Sensibility=0.043 mg/l Range=0~1 mg/l

⑮ HCO_3 (hydrocarbonates; mg/l)

- Method used : Potentiometric titration with a HCl 0,01N.
- According to the graphic method from Gran, which is explained by W. Stumm and J. Morgan (1970), the functions F1 and F2 were calculated. F1 corresponds to the

first inflection point of the titration curve, i.e., the carbonates. F2 corresponds to the second inflection point, i.e., total alkalinity (bicarbonates.)

♦Sensibility=0.1 mg/l Range=

⑯ SO_4 (sulfates:mg/l)

♦This measurement is based on the chemical precipitation in HCl (hydrochloric acid.) The precipitate that is obtained is stabilized in a "TWEEN 20" solution. The homogenous suspension that is obtained is measured in a Hitachi, Model 200 spectrophotometer, using a wavelength of 650 nm.

♦Sensibility=0.1 mg/l Range=0~30 mg/l

⑰ Cl (mg/l)

♦The measurement of this item is based on a colorimetric determination of the $Fe(SCN)_3$ compound. By utilizing thiocyanate of Hg, a thiocyanate ion is liberated by the creation of a HgCl solution in the presence of ferric ions. During this process, the free thiocyanate ions form colored ferric thiocyanate which is detected at a wavelength of 480 nm in a Hitachi, Model 200 spectrophotometer.

♦Sensibility=0.01 mg/l Range=0~100 mg/l

⑱ NO_3-N (nitrate nitrogen:mg/l)

♦The measurement of this item is based on a colorimetric determination of NO_3-N, which, by using sulfanilamide, creates a diaxonic salt that is coupled with N-1 naftil-etilendamine dihydro-chloride. This complex compound has a rose-violet color, which is measured with a Hach Drel, Model 2000 spectrophotometer, by using a wavelength of 543 nm.

♦Sensibility=0.1 mg/l Range=0~4.5 mg/l

⑲ Subaqueous measuring instrument

♦Type of instrument : U-10 (Horiba)

a. Hydrogen-ions (pH)

Principle : Glass electrode

Range : pH 0 ~ 14

Resolution : Standard : 0.1 pH

Expanded : 0.01 pH

b. Temperature (Temp.:°C)

Principle : Thermal resistance (Thermistor)

Range : 0~50°C

Resolution : Standard : 1°C

Expanded : 0.1°C

c. Conductivity (Cond.:uS/cm)

Principle : 4-electrode

Range : 0~100 mS/cm

Resolution : Standard : 0.1 mS/cm

Expanded : 0.01 mS/cm

d. Dissolved oxygen (DO:mg/l)

Principle : Galvanic membrane cell

Range : 0~19.9 mg/l

Resolution : Standard : 0.1 mg/l

Expanded : 0.01 mg/l

e. Turbidity (Turb.:mg/l)

Principle : Scattered/Transmitted light

Range : 0~800 NTU

Resolution : Standard : 10 NTU

Expanded : 1 NTU

f. Salinity (Sal.:mg/l)

Principle : Conversion based on conductivity

Range : 0~4%

Resolution : Standard : 0.1%

Expanded : 0.01%

6.12.3 Results of the Physical Measurement and Chemical Analysis

Table 6-12-1 shows the physical measurement and chemical analysis results.

The pH value ranges from 5.75 to 7.79, with values obtained in the dry season being slightly higher than those obtained in of the rainy season.

The water temperature during the rainy and dry seasons varies between 25.4° and 29.4°C, and between 21.8° and 24.9°C, respectively. The difference between the two seasons is approximately 4°C. The water from the Apere and Tijamuchi Rivers always showed higher temperatures than the other rivers.

Table 6-12-1 Results from the Physical Measurement and Chemical Analysis of Water

(1) Rainy Season (February 8 to 11, 1995)

Chemical Component	Unit	Location (River)				
		Maniqui	Matos	Apere	Tijamuchi	Mamoré
1. pH		5.75	6.45	6.82	5.85	6.76
2. Temp.	°C	25.4	27.1	28.3	29.4	28.5
3. Cond.	µS/cm	56.3	31.2	52.5	47.3	83.0
4. TDS	mg/l	28.2	15.6	26.3	23.7	41.6
5. SS	mg/l	864.9	48.2	60.3	53.7	146.7
6. BOD	mg/l	4.4	1.9	5.1	3.2	3.2
7. COD	mg/l	42.1	15.8	50.5	37.4	19.8
8. Ca	mg/l	6.8	3.1	6.3	4.2	6.8
9. Mg	mg/l	1.2	0.8	1.3	1.7	2.8
10. Na	mg/l	7.4	2.4	3.1	2.3	3.6
11. K	mg/l	1.3	5.0	1.9	2.3	2.1
12. HCO_3	mg/l	23.7	10.4	25.7	22.9	28.1
13. SO_4	mg/l	17.0	6.0	7.0	6.0	16.0
14. Cl	mg/l	3.7	8.0	4.3	4.0	4.0
15. Fe-T	mg/l	0.1	0.3	0.4	0.3	0.2
16. NO_3-N	mg/l	0.8	0.7	0.9	0.5	0.1
17. DO	mg/l	8.7	6.0	8.7	3.6	3.9
18. Mn	mg/l	<0.05	<0.05	<0.05	<0.05	0.18

(2) Dry Season (June 24 to 26, 1995)

Chemical Component	Unit	Location (River)				
		Maniqui	Matos	Apere	Tijamuchi	Mamoré
1. pH		7.63	7.54	7.67	7.10	7.79
2. Temp.	°C	23.2	21.8	24.9	23.5	22.9
3. Cond.	µS/cm	132.6	130.5	129.0	76.6	217.0
4. TDS	mg/l	66.5	65.4	64.6	38.3	109.0
5. SS	mg/l	52.7	20.9	31.8	180.2	89.4
6. BOD	mg/l	3.4	3.3	4.9	2.8	3.0
7. COD	mg/l	38.0	34.0	51.0	32.0	25.0
8. Ca	mg/l	17.8	42.5	13.2	86.5	20.0
9. Mg	mg/l	2.9	3.7	2.7	1.7	7.0
10. Na	mg/l	4.3	6.7	9.8	7.1	10.4
11. K	mg/l	4.8	6.6	6.3	5.6	4.4
12. HCO_3	mg/l	72.6	82.8	82.7	30.9	85.8
13. SO_4	mg/l	8.0	32.0	2.0	4.0	28.0
14. Cl	mg/l	4.3	6.0	5.1	6.0	7.8
15. Fe-T	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
16. NO_3-N	mg/l	0.9	2.2	0.9	7.0	0.9
17. DO	mg/l	8.7	6.6	8.3	4.0	6.1
18. Mn	mg/l	< 0.05	0.16	0.23	< 0.05	< 0.05

Note - Temp. : Temperature
Cond. : Conductivity
TDS : Total dissolved solids
SS : Suspended solids
BOD : Biochemical oxygen demand
COD : Chemical oxygen demand
DO : Dissolved oxygen

The conductivity of the river water ranged between 31.2 to 217.0 uS/cm. During the dry season, the value was higher than during the rainy season. In addition, the conductivity of the Mamoré River always showed higher values than did the other rivers. Conductivity generally represents the volume of dissolved substances in the water, which

is why it is has a good correlation with the total value of dissolved substances. The water from the Matos, Apere and Tijamuchi Rivers, which are short rivers with brownish water (so-called "agua negra"), flows to the plain and contains less dissolved substances than the much longer rivers, the Maniqui and Mamoré Rivers.

The amount of suspended solids (SS) varies between 20.9 and 864.9 mg/l. The SS in the Maniqui and Mamoré Rivers generally showed higher values than in the other rivers. The value during the rainy season was higher than during the dry season. The amount of dissolved oxygen varied between 3.6 and 8.7 mg/l. In other words, all the rivers in the project area contained a large amount of it.

The biochemical oxygen demand (BOD) and chemical oxygen demand (COD) varied between 1.9 and 5.1 mg/l and between 15.8 and 51.0 mg/l, respectively. Generally, the value of COD was approximately ten times higher than that of the BOD. In other words, all the rivers in the project area contained a relatively large amount of organic matter.

The amount of NO_3-N (nitrate nitrogen) ranged between 0.1 and 7.0 mg/l. During the dry season, the registered value was higher during that of the rainy season. Particularly, the value from the Tijamuchi River showed 7.0 mg/l during the dry season. Generally, the amount of NO_3-N shows the contamination level of the waste water and excretions from domestic animals. According to living conditions in the project area, the value during the dry season presumably shows a level of contamination by domestic animals under natural low precipitation conditions corresponding to a low dilution.

The concentration of Fe and Mn was very low, with values of less than 0.4 mg/l. The results and the hexagonal and tri-linear diagrams indicating the concentrations of Na, K, Mg, Cl, HCO_3 and SO_4 are shown in Table 6-12-2 and Figure 6-12-2.

The river water in the project area during the rainy season is V type water (neutral type), since it is diluted by a great deal of rainfall. During the dry season, the river water is I type water (type $Ca[HCO_3]_2$). The water from the Maniqui and Mamoré Rivers show almost the same type on the hexagonal diagram. However, the water from the Tijamuchi River contains more Ca than do the other rivers.

Table 6-12-2 Proportion of Ions in the River Water

(1) Rainy Season

Chemical Component	River Water Samples									
	Maniqui		Matos		Apere		Tijamuchi		Mamoré	
	mg/l	%	mg/l	%	mg/l	%	mg/l	%	mg/l	%
<Cation>										
Na^+	0.32	40.6	0.10	23.1	0.14	22.3	0.10	19.7	0.16	20.1
K^+	0.03	4.2	0.13	28.2	0.05	8.0	0.06	11.6	0.05	6.9
Ca^{2+}	0.34	42.8	0.16	34.2	0.31	52.0	0.21	41.2	0.34	43.5
Mg^{2+}	0.10	12.4	0.07	14.5	0.11	17.7	0.14	27.5	0.23	29.5
<Anion>										
Cl^-	0.10	12.3	0.23	43.3	0.12	17.6	0.11	18.4	0.11	12.4
HCO_3^-	0.39	45.9	0.17	32.7	0.42	61.2	0.38	61.2	0.46	50.8
SO_4^{2-}	0.35	41.8	0.13	24.0	0.15	21.2	0.13	20.4	0.33	36.7

(2) Dry Season

Chemical Component	River Water Samples									
	Maniqui		Matos		Apere		Tijamuchi		Mamoré	
	mg/l	%	mg/l	%	mg/l	%	mg/l	%	mg/l	%
<Cation>										
Na^+	0.19	13.0	0.29	10.1	0.43	29.0	0.31	6.3	0.45	21.1
K^+	0.12	8.5	0.17	5.8	0.16	11.0	0.14	2.9	0.11	5.3
Ca^{2+}	0.89	61.8	2.12	73.5	0.66	44.9	4.32	87.9	1.00	46.7
Mg^{2+}	0.24	16.6	0.30	10.6	0.22	15.1	0.14	2.8	0.58	26.9
<Anion>										
Cl^-	0.12	8.2	0.17	7.7	0.14	9.3	0.17	22.3	0.22	10.0
HCO_3^-	1.19	80.5	1.36	61.9	1.36	88.0	0.51	66.7	1.41	63.7
SO_4^{2-}	0.17	11.3	0.67	30.4	0.04	2.7	0.08	11.0	0.58	26.4

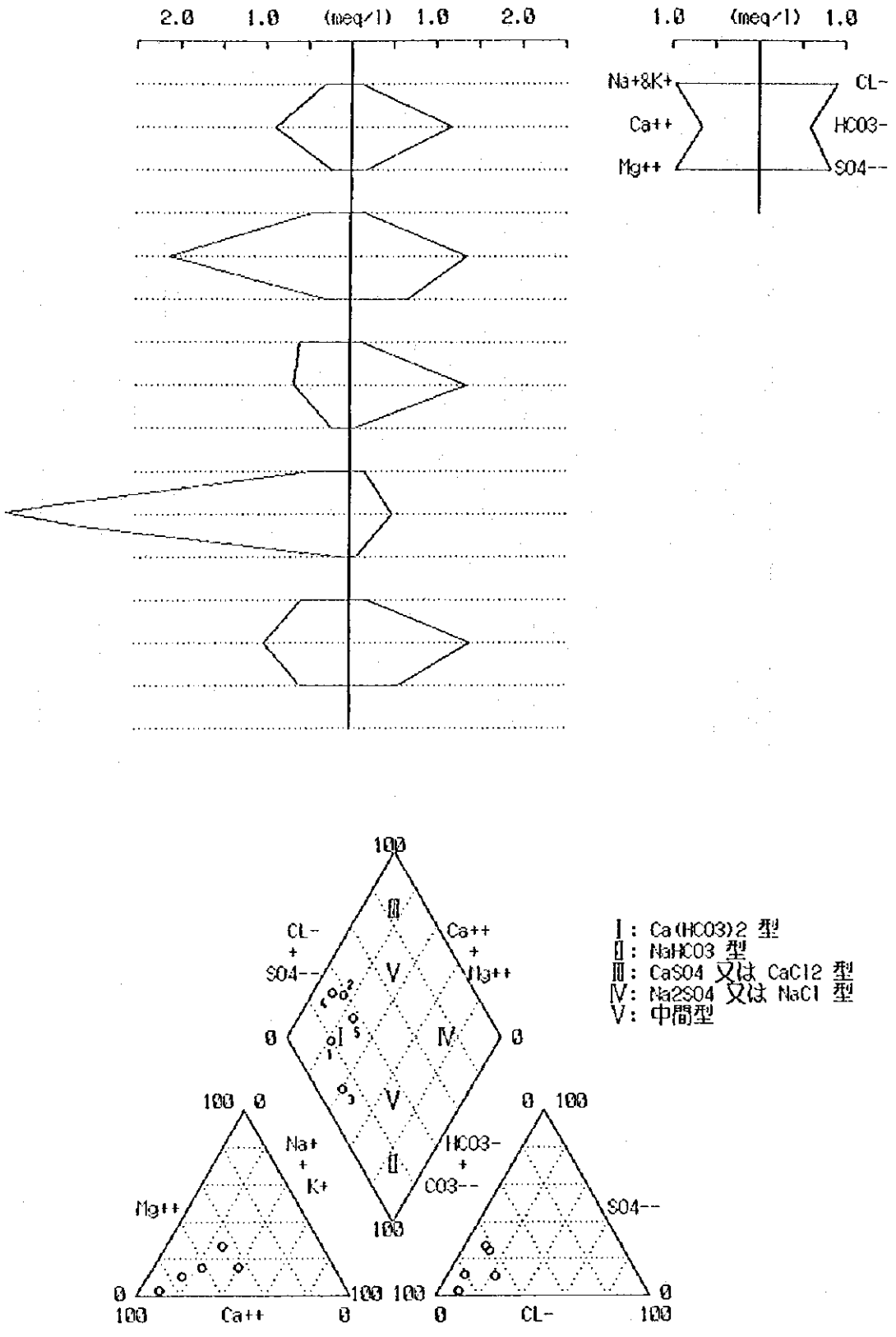


Figure 6-12-2 Water Quality in the Project Area (1)

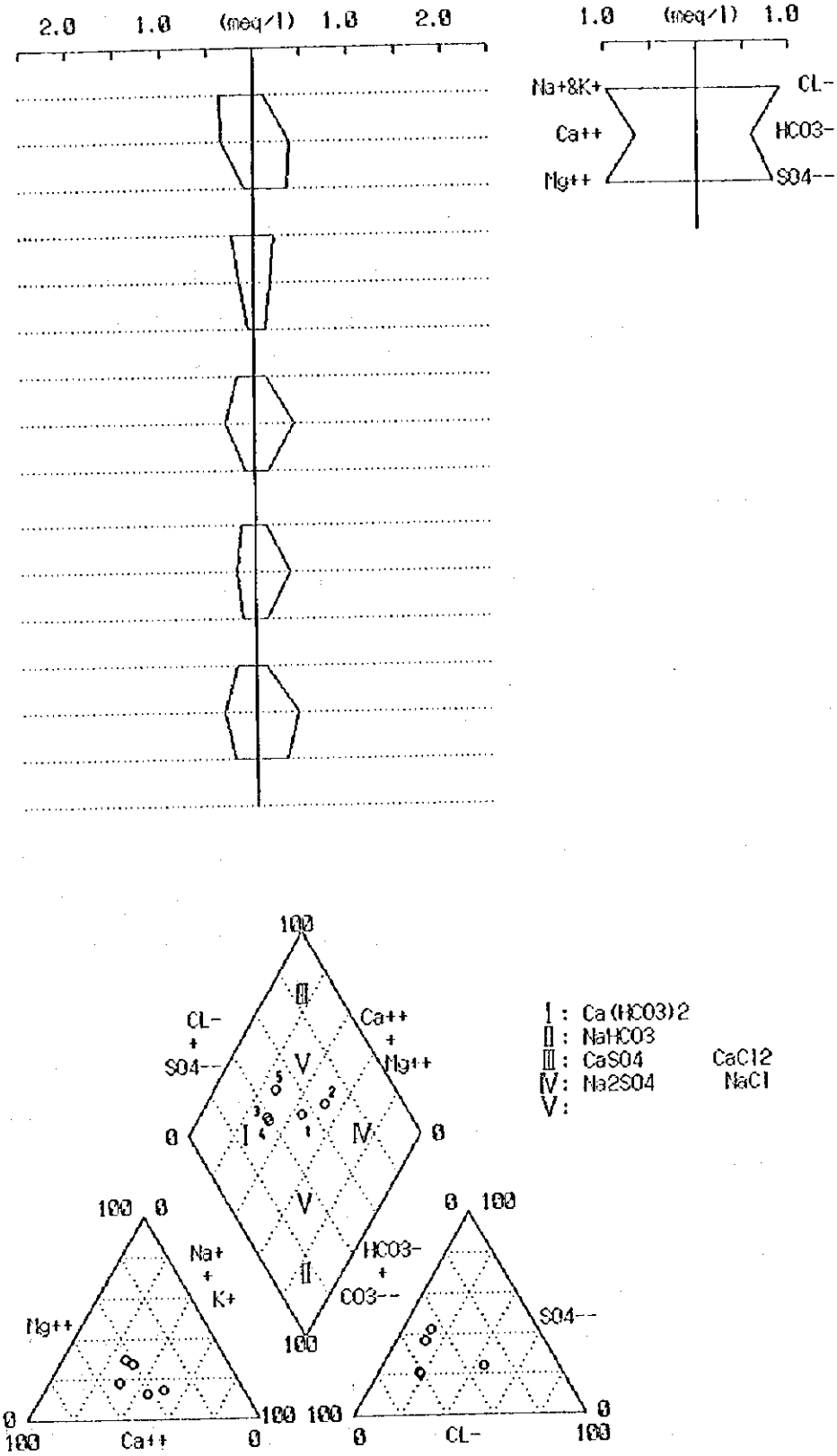


Figure 6-12-2 Water Quality in the Project Area (2)

6.13 Noise

6.13.1 General

(1) Sources of Noise

Noise is generally produced by vehicles, motorcycles, factories, residencies, human activities, natural phenomena including wind, trees, etc., and animal activities. In the project area the main sources of noise are vehicles, motorcycles, human activities and animal activities.

(2) Existing data

No data related to noise in the project area was obtained.

6.13.2 Field Investigation

(1) Measurement Components

The field measurements in the project area consisted of the measurement of the noise level, as well as traffic volume values. At present, there is no vibration pollution, which is why no field survey involving vibration measurements was conducted.

Measurements were taken in the rainy season and in the dry season. Such measurements were taken seven times a day, that is at 5:00, 7:00, 10:00, 15:00, 18:00, 19:00, and 22:00 hours. Noise level (dB[A]) measurements were taken one hundred times at intervals of five seconds.

(2) Location

Noise level measurements were taken at four points inside the project area at San Borja, the Maniqui River, San Ignacio, and Trinidad, as shown in Figure 6-13-1. These points were limited to relatively urban areas. The measuring points were located at the edge of the existing road and at a distance 50 meters from its center. Each measurement point was of 1.2 m from the surface.

(3) Measurement Method

The method used to measure the noise level was the Sound Level Measurement Method, using a sound level meter (NA-20, Rion), which has a revising function of an "A" characteristic frequency. The measurement unit for noise level is the decibel (dB[A].)

6.13.3 Measurement Results

The noise level measurement results are shown in Table 6-13-1. Noise level values ranged between 38.5 and 60.6 dB(A). There was no difference between values obtained in the rainy season and those obtained in the dry season. It was observed that the noise level in Trinidad was slightly higher than at other measuring points or sites. The main sources of noise were insects, birds, frogs, vehicles, etc. These result indicate that noise conditions in the project area are maintained at good levels.

Table 6-13-1 Noise Measurement Results

(1) Rainy Season (February 14~20, 1995*2)

Time	Point*1	Noise Level	Location			
			San Borja	Maniqui river	San Ignacio	Trinidad
5:00	1	dB(A)	58.3	44.5	51.2	51.2
	2	dB(A)	47.6	46.9	54.1	49.8
7:00	1	dB(A)	53.2	44.8	51.2	56.9
	2	dB(A)	40.8	49.1	54.2	50.9
10:00	1	dB(A)	50.7	43.8	44.4	58.9
	2	dB(A)	48.1	45.7	46.6	56.8
15:00	1	dB(A)	49.8	44.3	42.2	53.0
	2	dB(A)	44.7	44.4	45.1	54.0
18:00	1	dB(A)	45.6	42.2	48.8	55.5
	2	dB(A)	46.7	54.0	47.0	63.1
19:00	1	dB(A)	51.1	44.7	50.6	58.2
	2	dB(A)	49.4	45.0	49.6	57.8
22:00	1	dB(A)	59.7	44.3	48.9	60.6
	2	dB(A)	52.6	47.2	44.2	56.2

(2) Dry Season (June 3 ~ 8 , 1955*2)

Time	Point*1	Noise Level	Location			
			San Borja	Maniqui river	San Ignacio	Trinidad
5:00	1	dB(A)	43.7	43.4	42.5	43.4
	2	dB(A)	42.4	43.9	48.8	45.5
7:00	1	dB(A)	52.1	46.9	41.3	49.9
	2	dB(A)	46.9	43.9	46.4	47.8
10:00	1	dB(A)	51.1	43.6	40.8	48.1
	2	dB(A)	44.4	42.9	45.7	48.1
15:00	1	dB(A)	54.9	41.7	42.8	54.2
	2	dB(A)	45.9	41.4	46.2	46.2
18:00	1	dB(A)	53.9	43.4	41.5	55.4
	2	dB(A)	47.1	43.1	38.5	53.3
19:00	1	dB(A)	49.0	47.9	43.6	53.5
	2	dB(A)	50.4	52.3	42.8	54.2
22:00	1	dB(A)	38.7	40.2	43.4	49.7
	2	dB(A)	46.1	42.1	45.5	48.1

Note - *1 Measurement point : 1. At the edge of the existing road
2. At a distance of 50 m from the center of the road

*2 Measurement date

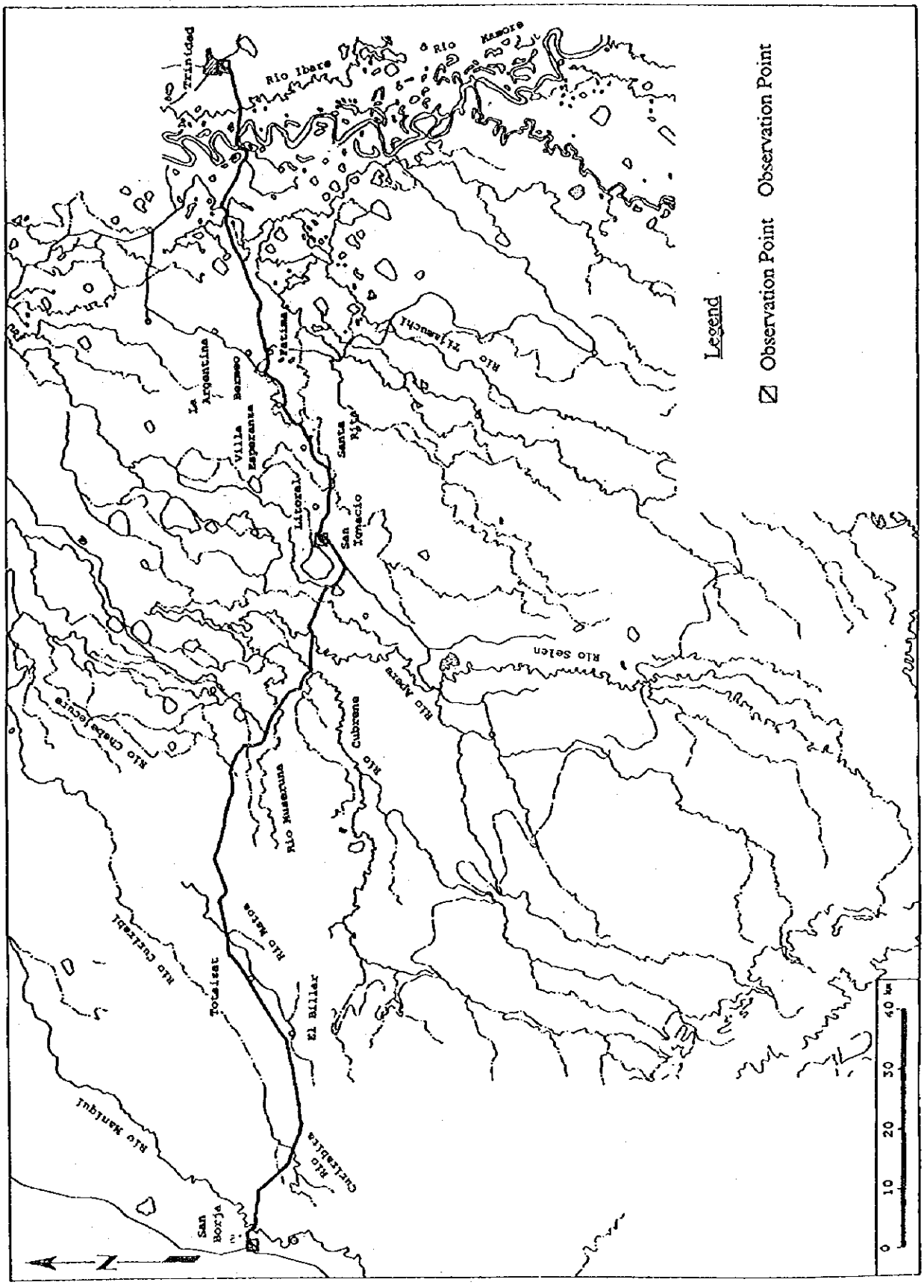


Figure 6-13-1 Location of the Noise Level Measurement Points

CHAPTER 7

PROJECT FORECASTS

CHAPTER 7 PROJECT FORECASTS

7.1 Topography and Geology

7.1.1 Impact Caused by Cleaving of Woods

There are many valuable forest zones along the project road, including the forests of the Biological Station of Beni (EBB), the Yacuma Regional Park forest, the Forest of Chimanes, and various gallery forests. According to the Project's Basic Specification, woods within the right-of-way area (100 m wide) are generally cleaved and stripped in the course of road improvement work, for various purposes, including side-borrow pitting.

If the cleaving area is limited to within the right-of-way area, neither the local topography or geology is changed very much by the cleaving of woods.

7.1.2 Impact Caused by Earth Work

(1) Stability of Embankment

The typical cross section of the road project has already been shown in Figure 4-2-1. The road consists mainly of embankments. The materials used to construct the road embankment and related specifications are as follows:

- Width of road : 9.0 m
- Width of pavement : 7.0 m (with gravel and partially asphalt)
- Height of embankment : 0.3 ~ 8 m
- Slope gradient of embankment : 1:2.0 (26.6°)
- Height of embankment : 2 ~ 4 m (maximum of 8 m)
- Materials:
  - ♦Base : Pit-run gravel & crusher-run, Thickness: 20 cm
  - ♦Roadbed : Sandy silt (CBR > 4%), Thickness: 50 ~ 150 cm
  - ♦Road body : Clay - silty sand (AASHTO A-2 ~ A-7)
  - ♦SPT (N-value) : 4 ~ 16 (by drilling exploration in bridge sites; depth 1 ~ 4 m)

The stability of the embankment slopes was evaluated based on a stability analysis of circular sliding. The formula used for the stability analysis is as follows:

$$Fs = \frac{\sum\{Cx\ell + (W\cos\theta - \mu\ell)\}\tan\phi}{\sum(W\sin\theta)}$$

where,

Fs = Safety factor
W = Weight of unit slice (ton/m)
ℓ = Width of unit slice
θ = Angle between the unit slice and the sliding surface (°)
C = Cohesion (ton/m²)
ϕ = Angle of internal friction (°)
μ = Friction coefficient

The specifications used for the embankment and the constants related to soil mechanics are as follow:

- Height of embankment : 4 m
- Slope gradient : 1:2.0
- Thickness of the roadbed : 1.0 m
- CBR value of the roadbed : 4%
- Soil classification of the roadbed : A-7 (AASHTO)
- SPT (N-value) : 4
- Unit weight : 1.7 ton/m
- Condition of the groundwater : Full
- C : 2.5 ton/m^2
- ϕ : 0°
- Load on the top : 1 ton/m (equivalent to a 24 ton truck)

As a result of the safety analysis for the embankment conducted assuming worst-case conditions, the safety factor was calculated at a minimum of 1.722, as shown in Figure 7-1-1. Therefore, the slope of the embankment is considered stable.

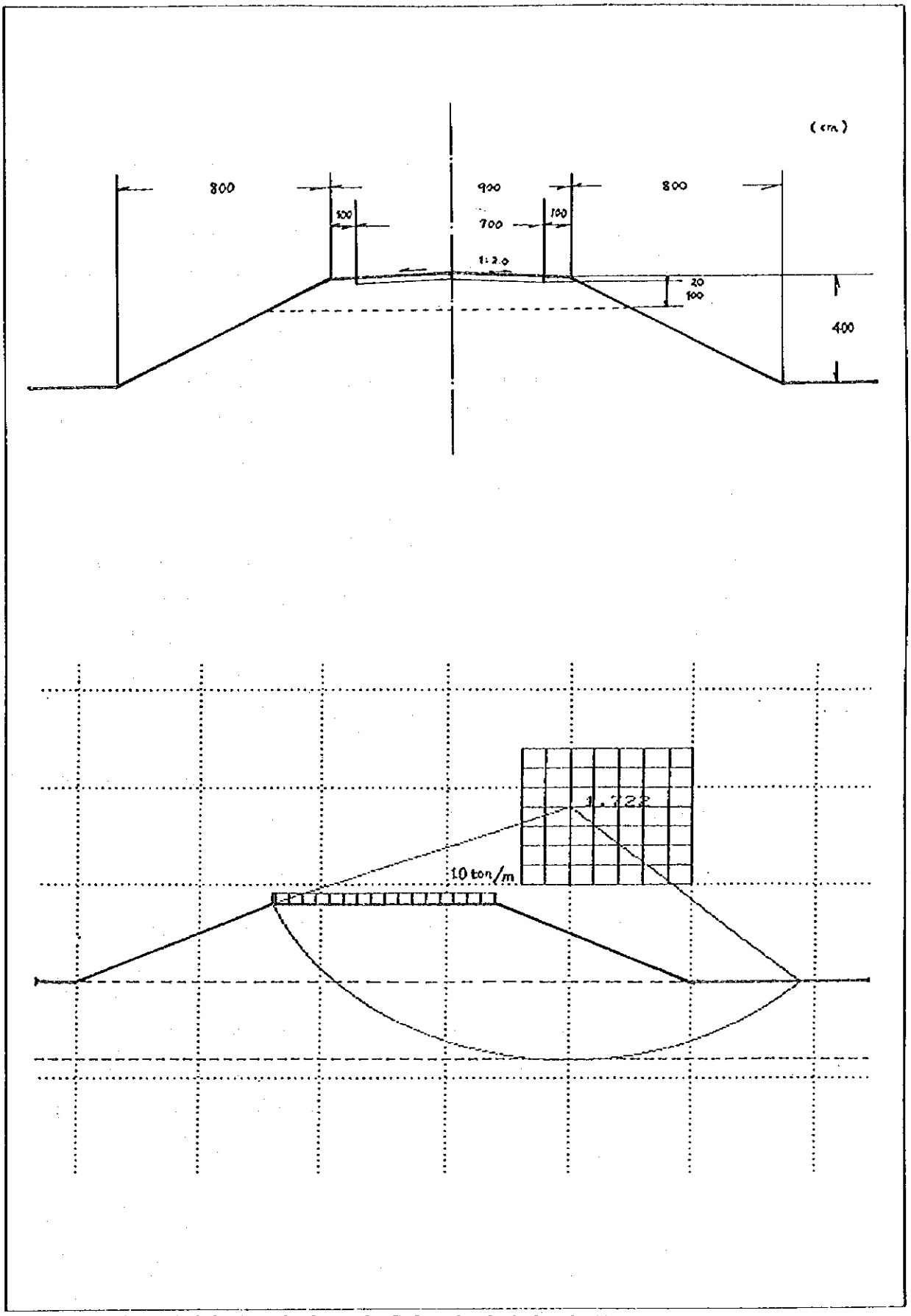


Figure 7-1-1 Results from the Safety Analysis for the Embankment

(2) Erosion of the Embankment

The embankment in the project area is eroded in many places - for instance, at the edges of the road and along bare-ground slopes -, and small gullies have developed in some places due to the runoff produced by rainfalls. In addition, most of the existing drainage facilities consist of steel corrugated pipes and have suffered small-scale erosion at the lower side of the stream, causing the pipes to crop out.

The materials to be utilized for the road body and the roadbed specified in the road project are the same as those used in the construction of the present road embankment. Accordingly, the newly raised embankments can also be expected to erode as a result of rainfall during the construction period.

The construction plan for the embankment is such that all work will be completed before the start of the rainy season. For construction work that takes place before rainy season, the road surface should have a gradient of more than 4% to ensure good drainage conditions. The slope of the embankment should be protected by weeds using surface soil that has been piled up during the surface clearing and cleaning stages.

Since the execution of slope protection work in the construction stage will be completely finished before the rainy season begins, the erosion of the embankment will be kept to a minimum.

The flow angles, both for the inlet and outlet of the steel corrugated pipes, are set between 30° and 45° due to the low speed of the water flow, as shown in Figure 7-1-2. As planned, the materials for the construction of the way in the inlet and outlet of the steel corrugated pipes will consist of mixture of concrete and crushed brick, even though its life span will be about 30 years shorter than if common concrete were used. In addition, the materials for the base slab will consist of bricks joined by mortar, producing a life span of 15 to 30 years.

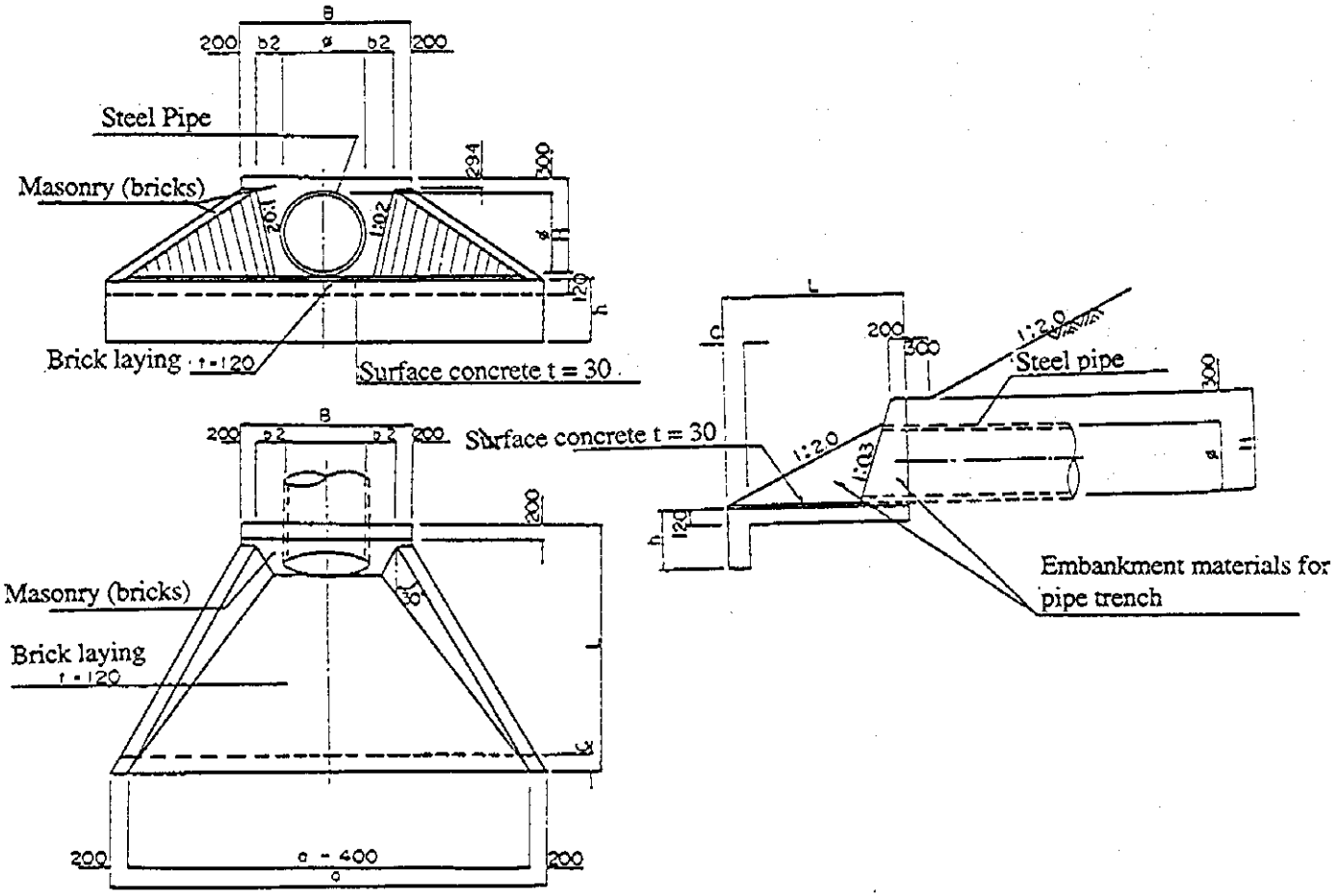


Figure 7-1-2 Typical Cross Section of Steel Corrugated Pipes

(3) Side-Borrow Cutting

According to the plan, the materials for the road embankment body in the project area will consist of the earth obtained from both sides of the road using the side-borrow method. The total volume of earth for the road body is 1,220,000 m^3, and the average volume per meter is 5.5 m^3/m. Therefore, it is possible to obtain soil or earth from both sides of the road within the right-of-way area (200 m wide.)

According to the plan, the earth to be used for the embankment bed will be transported from sites that have CBR values greater than 4%. The total volume of earth for the roadbed is 395,000 m^3. The plan for earth transportation is shown in Figure 7-1-3. The soil or earth located on both sides of the Mamoré River will be transported to sites that are located approximately 2 km to 16 km away. The transportation distance for earth at other sites will be less than 2 km.

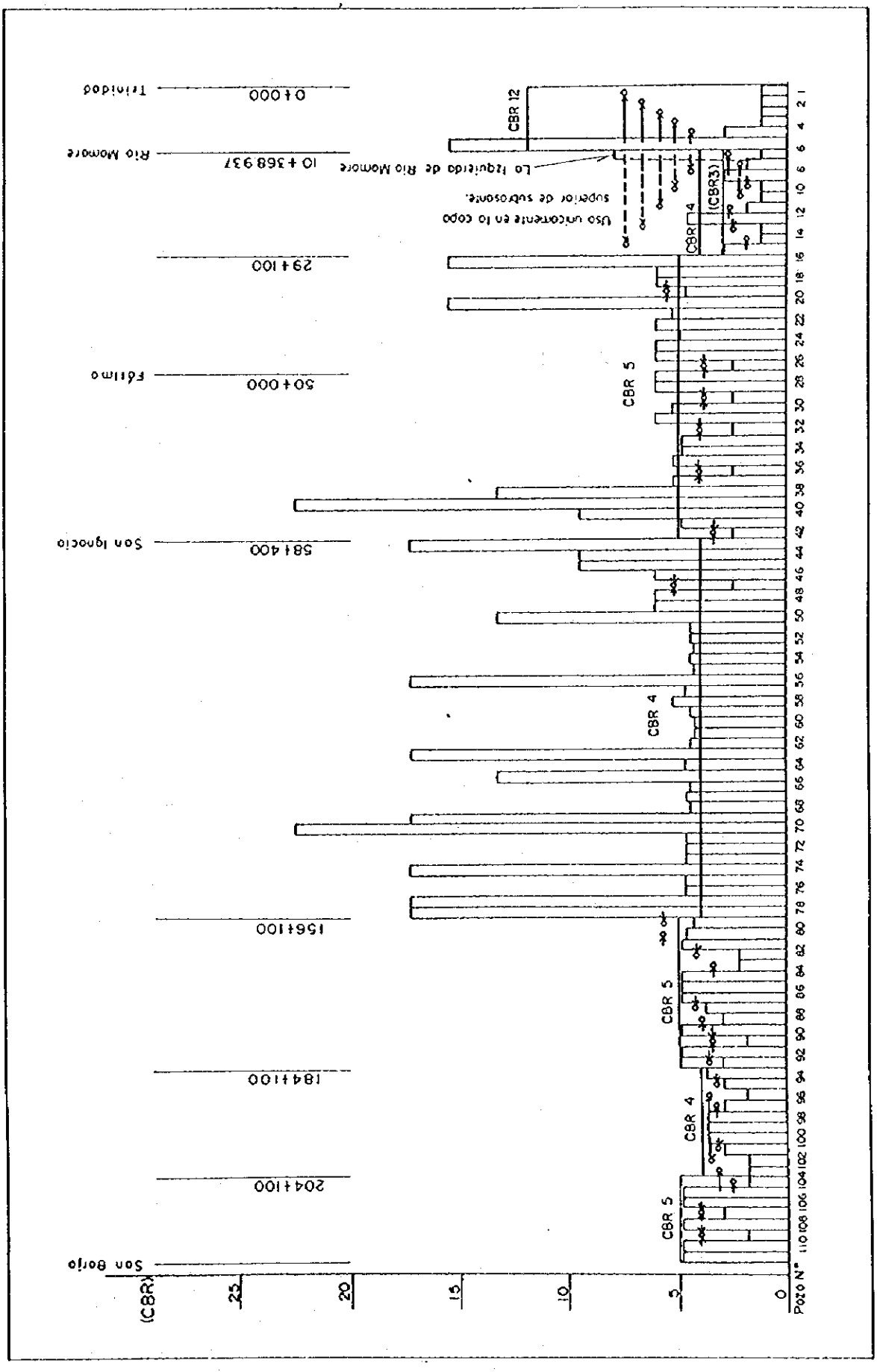


Figure 7-1-3 Plan for Earth Transportation in the Project