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SAN JULIAN COLONIZATION AND CONSOLIDATION

ANNEXES

Prepared for the

United States Agency for

International Development

La Paz, Bolivia

Under Contract Number AID/SOD/PDC-C-0219

by

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1725 K. Street N.W.
Washington, D.C. 20006

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VOLUME II

ENGINEERING ANALYSIS OF THE RIO GRANDE BRIDGE

A. Background:

1. In July 1964, the Architectural/engineering firm of Tippetts-Abbett-McCarthy-Stratton (TAMS) submitted a report on the economic and technical feasibility of constructing a highway from the Rio Grande to Concepción. The project consisted of a proposed all-weather highway about 185 Kms in lenght, extending from the west bank of the Rio Grande northeastward across the Lowlands to the San Julián River, and thence northward through rolling country to San Javier, where the road would turn eastward and proceed to its terminus at Concepción. The project included a bridge of approximately 960 meters in length across the Rio Grande, three smaller bridges varying from 42 to 60 meters lenght, and 644 culvert installations. The proposed Rio Grande bridge crossing connected with the eastern terminus of the improved highway leading to the Okinawa Colony and Guabira.

2. The construction of the road, exclusive of the Rio Grande bridge crossing, to San Julián is now nearing completion with financing of technical assistance and equipment by the Federal Republic of Germany. The design standards

and routing have followed those developed by TAMS in its 1964 submittal. Discussions are currently underway with West German representatives for continuation of the construction to San Javier.

B. Proposed Location:

3. TAMS reported in 1964 that nearly all vehicular traffic entering and leaving the San Julián region crossed the Rio Grande by ferry near Cosoriosito. In its analysis, several possible crossing sites were examined on the ground, and two were studied in more detail-- one at Cosoriosito and the other located about 4.5 Kms upstream from Cosoriosito, at Puerto Banegas. The latter site was selected for the location of the bridge since it offered the best aligment and best hydraulic conditions.

4. The Puerto Banegas site (1964) was situated on a relatively straight segment of river. The main channel, about 350 meters wide, was partially confined between the flood plains that were elevated approximately 2.5 meters above low water level. During flood periods, estimated to occur at least once a year, the river overflowed the banks defining the main channel, and formed a broad water course

about 940 meters wide. The limits of this broad watercourse during flood periods were well defined at the selected bridge site by high banks on both sides.

5. Alternative locations have been suggested along the Rio Grande at sites considered preferable to the bridge crossing at the Puerto Banegas site proposed by TAMS. These locations have varied from as far upstream as Puerto Pailas, east of Santa Cruz, to as far downstream as a site opposite and east of Chané. The general impression conveyed has been that these alternative locations are representive of advantages and benefits to the realized for specific and individual situations and not for global overall area development. For example, the Puerto Pailas crossing is the result of second thoughts on a design, financed by the Brazilian government, for a connecting road from Corumba to Santa Cruz. People from Santa Cruz favor this alternative, mainly because of its proximity, and this type of a general rationale has been offered by many proponents with really little or no specific basis for the alternative locations proposed.

6. During the current study, a field reconnaissance was conducted downstream from the Puerto Pailas site. This reconnaissance did not demonstrate any particularly more advantageous or unusually more practicable bridge location than the proposed Puerto Banegas site. During the overflight, the Puerto Banegas stretch of river was observed to offer relatively straight and stable aligment and to provide a relatively narrow and short river crossing. Some alternative sites were in meandering reaches of the river, indicating potentially unstable channel and bank conditions. Other reaches with apparent narrow channel crossings showed a need to bridge over large and wide flood plains, indicating a requirement for an equally long structure as at Puerto Banegas.

C. Planning and design:

7. In view of the time elapsed since the 1963-1964 study, which was based on limited minimal hydrologic and hydraulic data, due to the shifting nature of the channel and stream bed, and in view of the recent and projected development to the east of the Rio Grande, a new and more current evaluation of the most feasible and prac-

ticable location for a bridge crossing is indicated. To accomplish this, it is proposed that a consulting engineering firm be contracted to undertake the planning and design, complete with construction plans and specifications.

8. A scope of work to define the steps to be taken in accomplishing the planning and design has been prepared. This scope includes the review and examination of all potential bridge crossing sites and a recommendation for the most feasible site selection.

D. Cost estimate:

9. In view of the time elapsed since the 1963-1964 estimate of $ 2.0 million, a preliminary order-of-magnitude cost estimate has been developed based on the most recent available cost data for highway bridge construction in Bolivia. The 616-meter bridge over the Rio Alto Beni at Sapecho is now under construction for a bid price of $ 5,333,500, which is exclusive of engineering costs and which SNC engineers consider to be representative of current costs for construction of this type of structure.

A recent decree raising construction labor salaries $b.-500 (US$ 25) per month, a 25 percent increase, will no doubt have its effect. The proposed crossing at Puerto Banegas is 960 meters. On a strict length ratio basis, this would indicate a construction cost of about 1.56 times that of the Rio Alto Beni bridge. However, the Rio Alto Beni bridge pier foundations are set on solid rock ledge, whereas the Rio Banegas bridge pier foundations are set on cast-in-place concrete piles which penetrate the sand and clay sub-soils. Thus, an order-of-magnitude cost 1.72 has been developed, in order to allow for the increased cost of the pier foundations at the Puerto Banegas site. The ratio of 1.72 resulted in the following cost tabulation:

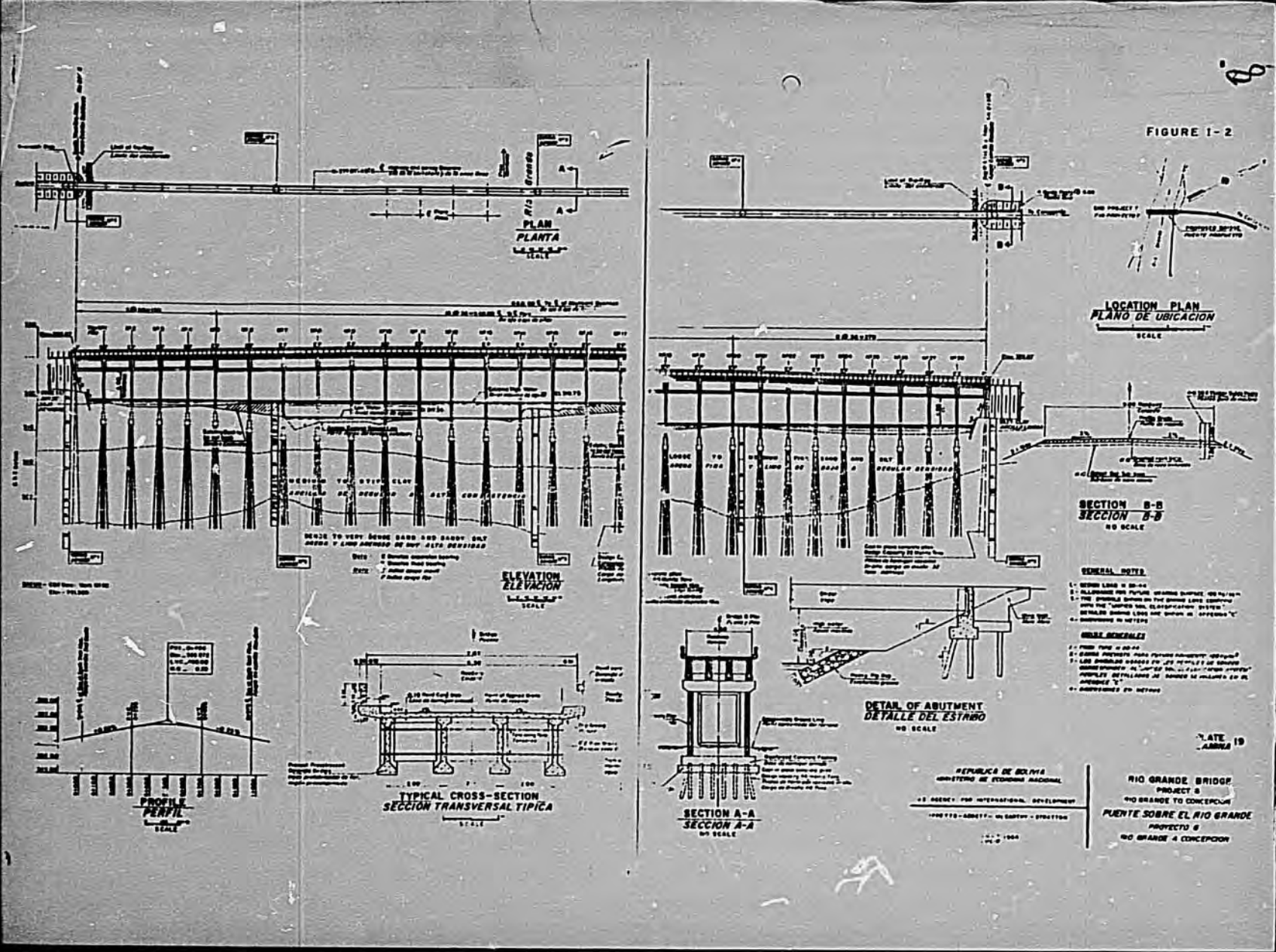
Construction Cost - Rio Alto Beni	$ 5,333,500
Construction Cost - Rio Grande (1.72 x Rio Alto Beni)	9,173,620
Planning and Design - 10% (feasibility - 3%, design 7%)	917,360
Supervision of Construction - 6%	550,420
Contingencies - 15%	1,376,040
Connecting roads - 10 Km at 80,000	800,000
Total Cost	$12,817,440

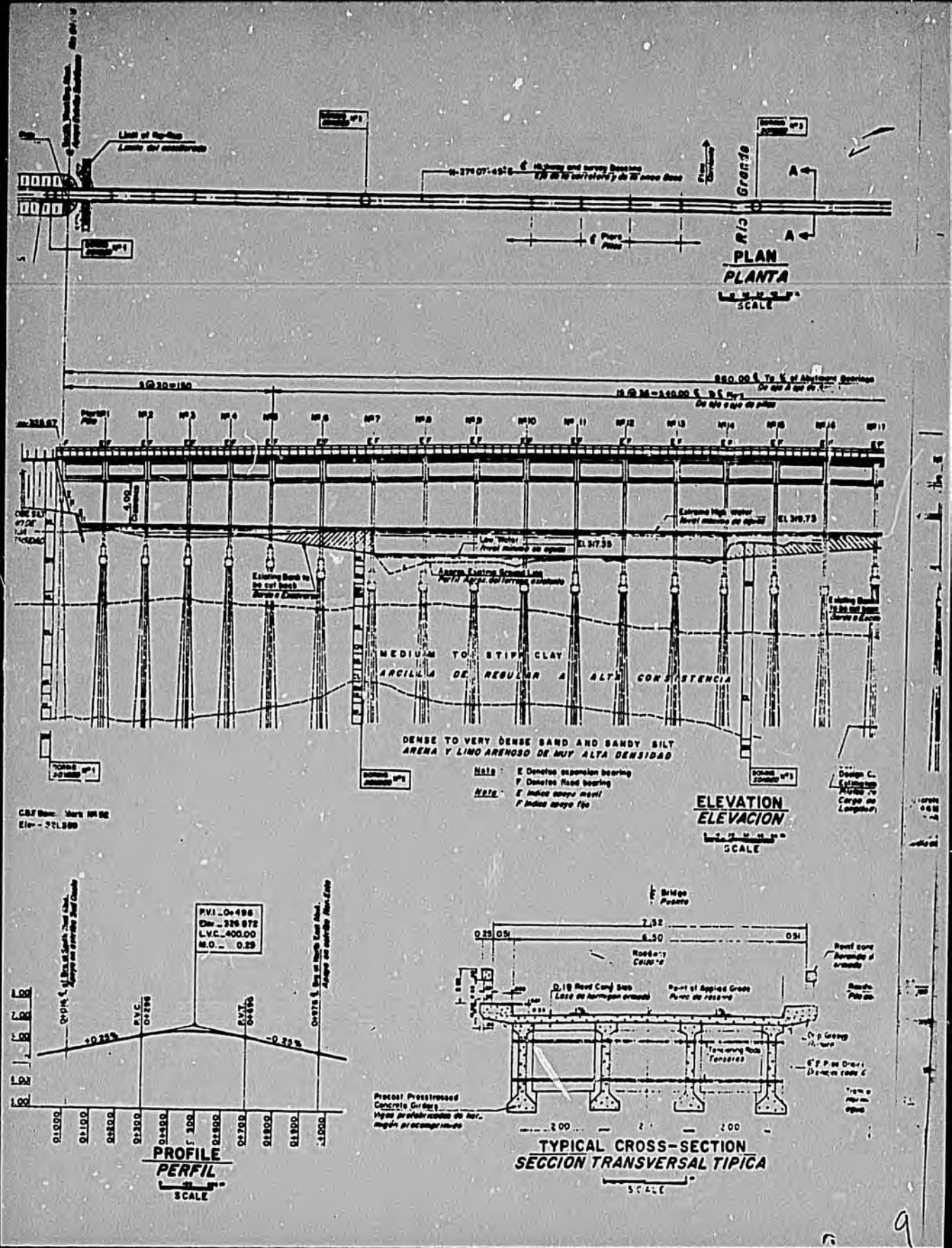
Thus, an order of magnitude preliminary cost estimate of US$ 12,817,440 has been derived. This cost, including allowances for planning, design, construction supervision, connecting roads, and nominal contingencies, is the basis for determining an estimated cost of US$ 917,360 for contracting a consulting engineering firm to perform the initial phases of site reviews examinations and selection to be followed by final design.

E. Contractor Interest:

10. The magnitude of the cost is sufficiently large and the work is of such a concentrated nature that adequate contractor interest should be generated. International bidding is contemplated due to the limited Bolivian capability in this construction specialty. However, based on the broad response for bids on IDB financed bridge construction in the Alto Beni in early 1978, no particular problems are foreseen.

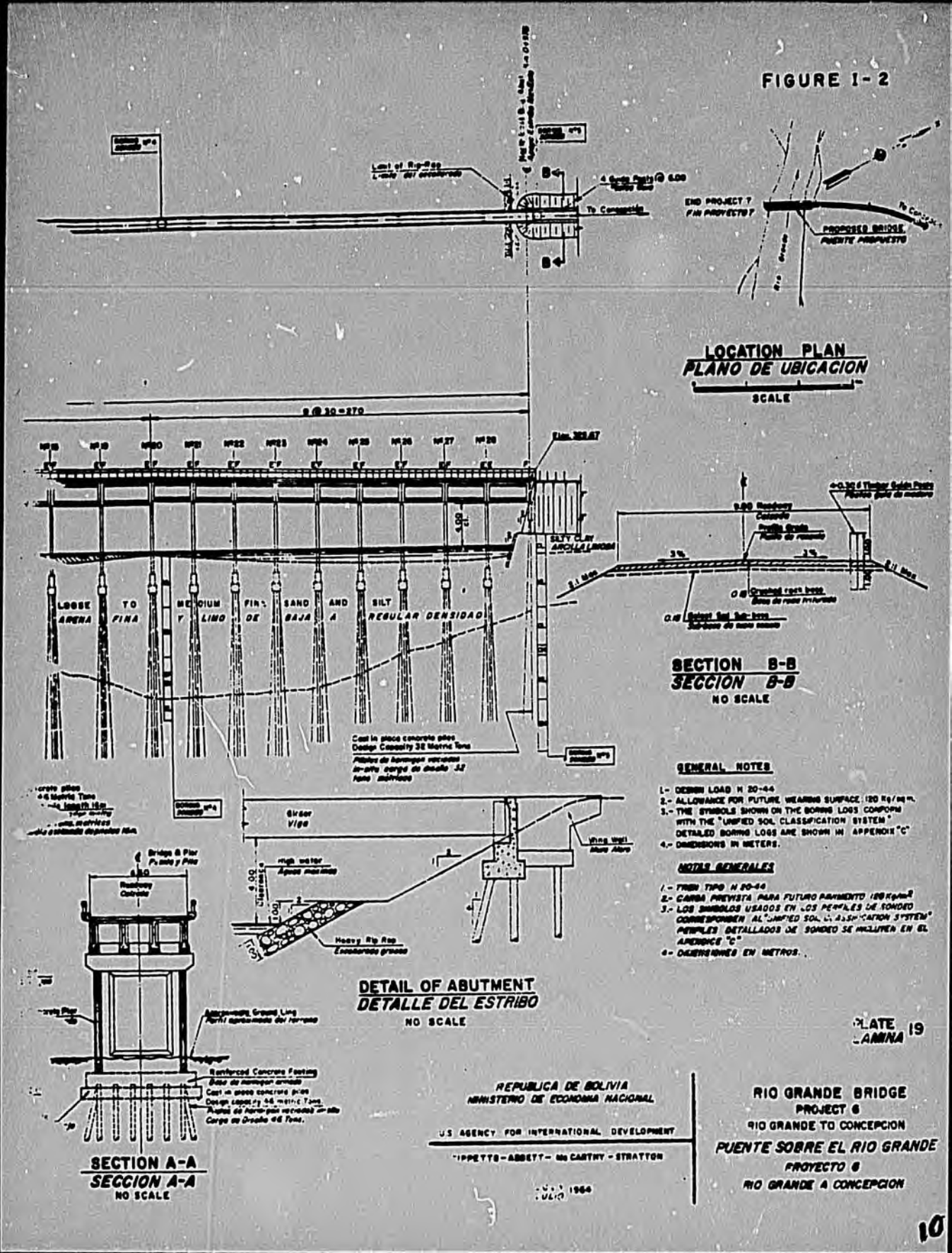
FIGURE 1-2


PLAN
PLANTA
SCALE
ELEVATION
ELEVACION
SCALE
PROFILE
PERFIL
SCALE
TYPICAL CROSS-SECTION
SECCION TRANSVERSAL TIPICA
SCALE
SECTION A-A
SECCION A-A
NO SCALE
DETAIL OF ABUTMENT
DETALLE DEL ESTRIBO
NO SCALE
SECTION B-B
SECCION B-B
NO SCALE
LOCATION PLAN
PLANO DE UBICACION
SCALE
GENERAL NOTES
NOTAS GENERALES
PLATE
LAMINA 19
REPUBLICA DE BOLIVIA
MINISTERIO DE ECONOMIA NACIONAL
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
RIO GRANDE BRIDGE
PROJECT 6
RIO GRANDE TO CONCEPCION
PUENTE SOBRE EL RIO GRANDE
PROYECTO 6
RIO GRANDE A CONCEPCION


PLAN
PLANTA
SCALE
Rio Grande
ELEVATION
ELEVACION
SCALE
MEDIUM TO STIFF CLAY
ARCILLA DE REGULAR A ALTA CONSISTENCIA
DENSE TO VERY DENSE SAND AND SANDY SILT
ARENA Y LIMO ARENOSO DE MUY ALTA DENSIDAD
Extreme High Water
Nivel máximo de agua
EL 319.73
Low Water
Nivel mínimo de agua
EL 317.35
Existing Bank to be cut back
Bridge
Puente
Roadway
Calzada
Deck Slab
Losa de hormigón armado
Point of Applied Grade
Punto de rasante
Precast Prestressed Concrete Girders
Vigas prefabricadas de hormigón preacomprimido
TYPICAL CROSS-SECTION
SECCION TRANSVERSAL TIPICA
SCALE
PROFILE
PERFIL
SCALE
P.V.I. 0+496
Elev. 326.872
L.V.C. 400.00
M.O. 0.29
+0.25%
-0.25%
P.V.C.
P.V.T.

9

FIGURE I-2


LOCATION PLAN
PLANO DE UBICACION
SCALE
END PROJECT 7
FIN PROYECTO 7
PROPOSED BRIDGE
PUENTE PROPUESTO
To Concepcion
9 @ 30 = 270
SECTION B-B
SECCION B-B
NO SCALE
LOOSE TO MEDIUM FINE SAND AND SILT
ARENA FINA Y LIMO DE BAJA A REGULAR DENSIDAD
SILTY CLAY
ARCILLA LIMOSA
Cast in place concrete piles
Design Capacity 32 Metric Tons
GENERAL NOTES
1.- DESIGN LOAD H 20-44
2.- ALLOWANCE FOR FUTURE WEARING SURFACE 120 Kg/m².
3.- THE SYMBOLS SHOWN ON THE BORING LOGS CONFORM WITH THE "UNIFIED SOIL CLASSIFICATION SYSTEM"
DETAILED BORING LOGS ARE SHOWN IN APPENDIX "C"
4.- DIMENSIONS IN METERS.
NOTAS GENERALES
1.- TREN TIPO H 20-44
2.- CARGA PREVISTA PARA FUTURO PAVIMENTO 120 Kg/m²
3.- LOS SIMBOLOS USADOS EN LOS PERFILES DE SONDEO CORRESPONDEN AL "UNIFIED SOIL CLASSIFICATION SYSTEM"
PERFILES DETALLADOS DE SONDEO SE INCLUYEN EN EL APENDICE "C"
4.- DIMENSIONES EN METROS.
Girder
Viga
Wing Wall
Muro Alero
high water
Aguas maximas
Heavy Rip Rap
Enrocadado grueso
DETAIL OF ABUTMENT
DETALLE DEL ESTRIBO
NO SCALE
Bridge & Pier
Puente y Pilar
Roadway
Calzada
Approximate Ground Line
Perfil aproximado del terreno
Reinforced Concrete Footing
Base de hormigon armado
Cast in place concrete piles
Design capacity 46 metric Tons
Pilotes de hormigon vaciados en sitio
Carga de Diseño 46 Tons.
SECTION A-A
SECCION A-A
NO SCALE
PLATE
LAMINA 19
REPUBLICA DE BOLIVIA
MINISTERIO DE ECONOMIA NACIONAL
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
TIPPETTS-ABBETT-McCARTHY-STRATTON
JULIO 1964
RIO GRANDE BRIDGE
PROJECT 6
RIO GRANDE TO CONCEPCION
PUENTE SOBRE EL RIO GRANDE
PROYECTO 6
RIO GRANDE A CONCEPCION

SCOPE OF WORK FOR THE PLANNING AND DESIGN OF THE RIO GRANDE BRIDGE

A. Site location:

1. Prior to undertaking final design, the consultant will conduct an examination and evaluation of potential bridge sites along the Rio Grande between Puerto Pailas and Chané to select the location which will provide the most feasible and practical river crossing to serve the current and projected growth to the east of the Rio Grande. In performing this examination, the consultant will consider and evaluate the implications and effects of the current and projected planning for the expansion of the primary highway network and for the region's growth and the development of its land and water resources. Hydrologic and hydraulic investigations and evaluations will be performed along the reach of river for each site to be examined. The consultant will also consider the physical characteristics of the stream bed and flood

plain, their widths, bank heights, flow capacities, and indicated stabilities. Among the potential bridge sites to be examined will be the Puerto Banegas crossing.

2. Potential development and economic benefits will be evaluated for the recommended bridge crossing site. Justification will be based on an examination of the area of influence and its potential and type of projected development with and without the bridge crossing a review of traffic volume, present and projected, with and without the bridge, by number and types of vehicles, together with projected annual savings to traffic; the projected annual cost, including interest and amortization of investment, and operation and maintenance costs; and finally a comparison of benefits and costs.

3. To obtain reasonably firm estimates of the cost of construction and to evaluate the technical and economic soundness of the location selected, the following items of work will be included in performing the examination of potential and alternative bridge crossing sites:

1. a) Analysis of present and future planning for the expansion of the highway network based on

projections of growth and development in the areas of incluence (the basic information for completion this item will be furnished by the Servicio Nacional de Caminos).

2. b) Hydrologic and hydraulic analysis of the reach of river for each river crossing site examined will be performed; demonstrating and defining limits of usual flood flows, usual ordinary/average flows, usual dry-weather/minimum flows, and the projected peak flood flow with its frequency; the completion of this item will depend upon the judicious use and application of limited hydrologic and hydraulic data and information.

3. c) Aerial photo location and field reconnaissance (field surveys are to be only minimal, limited to essential needs) of the most favorable sites, no fewer than three; findings will be based on economic feasibility, adaptability and applicability to current and future plans for expansion of the primary highway network,

and ability to resist and maintain stability during periods of high flows which cause and c create shifting and changing channel conditions.

4. d) An order-of-magnitude construction cost estimate, to include any new road connections to existing highways, in order to demonstrate the relative costs of the most favorable sites. For purposes of this estimate, results of borings from the earlier the TAMS report will be used as the basis for foundation planning.

5. e) Following step (4), the consultant will submit a preliminary report showing the location , connecting roads and cost estimates for the most favorable sites, together with locations for other sites considered. A narrative will be included outlining the procedures; followed and findings, together with the consultant's recommendation for location of the bridge site. A benefit/cost evaluation will be presented for the recommended

site. The consultant will provide preliminary sketches of pertinent details for the type of structure recommended, together with a projected schedule for accomplishing the design and construction.

6. f) The preliminary report will be reviewed.

B. Final design:

4. If and when the report is approved, the consultant will proceed with the final design.

1. The first step of which will be surveys and borings to establish the alignment and to determine site foundation conditions.

2. During final design (preparation of construction plans and specifications), the consultant will keep the appropriate Bolivian and Bank officials informed of any differences, e.g. revised hydrologic, hydraulic, soils, river bed and channel conditions which will increase estimated costs and/or materially change design concepts from those presented in the preliminary report submission.

3. With submission of the design, the consultant will include a design report which defines the limits and basis of all planning and design and which recommends procedures to be followed in implementing the construction. In addition, the consultant will prepare a maintenance plan, a related staffing structure, together with equipment needs and a projected annual budget to provide appropriate maintenance to the bridge and its oppurtenances. The consultant will also be available to provide assistance in preparing submittals for soliciting financing from the World Bank and/or other international development financing agencies.

SAN JULIAN CONSOLIDATION PROJECT
ENGINEERING ANALYSIS

I. PENETRATION AND LATERAL ROADS; DRAINAGE AND AGRICULTURAL CENTER EXPANSION IN THE SAN JULIAN NORTH AREA

A. Method:

1. A preliminary, reconnaissance-type review and evaluation was conducted to assess the planning, design and construction of the all-weather penetration road and the dry-weather lateral roads now under construction in the San Julian North area of the San Julian Consolidation Project. In addition, based on an overflight and an examination of available maps, new lateral road layouts for expanding the San Julian North development were laid out (Figure I-3). The proposed new San Julian South development was also overflown and the road alignment proposed by INC (Figure I-1) was generally followed and observed from the air between Los Cafes and Canadá Larga. Field visits were made to Puerto Pailas from Santa Cruz to observe road conditions and the existing bridge over the Rio Grande which serves railroad and highway traffic. Discussions with Santa Cruz Regional SNC and CORDECRUZ engineers revealed that several planning studies have been made of the highway network of the area (Figure I-1).

2. The field reconnaissance included site visits in the San Julian area to sections of road completed and to sections under construction.

The entire length of the penetration road was traversed, and random lateral roads were travelled.

B. Existing Penetration Road North:

3. The design contract for the penetration road provided for clearing a 10-meter penetration strip, five meters on each side of the center line. The road was designed for an H10 (AASHO) loading with an 8-meter-wide road and 4-meters width of gravel surfacing to provide all-weather surfacing (Figure I-4). Since the topography is extremely flat, no specific geometric design criteria were followed for horizontal and vertical alignment, and no major drainage structures were contemplated. The following tabulation summarizes the basic design standards:

Right-of-way	40 meters
Roadway width	8 meters
Gravel surface width	4 meters
Gravel surface thickness	15 centimeters
Base thickness	10 centimeters
Load capacity	H 10 (AASHO)
Fill slopes	2:1
Grade	Natural slope
Culverts	RCP or CMP

4. Construction is being implemented under a contract with current progress at about 42 percent complete. Inspection is performed by SNC, who will assume responsibility for the maintenance of the completed road.

5. The original contract, let October 1977, was for 100 kms of road to be constructed at a cost of $US4.2 million. Change Order No. 1 of November 1978 reduced the length to 74 kms., increased the width of gravel surfacing from 4 meters to 8 meters for the first 60 kms, and from 60 to 74 kms., decreased the roadbed platform width from 8 meters to 4 meters with a 4-meter passing lane, 30 meters long, spaced at kilometer intervals. This change, which reduced the cost to $us.1.7 million resulted from funding constraints. However, there is now discussion of extending the decreased, 4-meter section to the original 100-km termination point.

6. The road is scheduled to be completed in the latter part of 1980. This, together with the continuing resettlement as the penetration road advances (lateral roads are now under construction at Km 64), makes it somewhat difficult to fully evaluate the planned and designed road layouts of San Julian North (Figure I-3). Basically, the layout of the penetration road and the lateral roads seems well-planned, extremely practicable and highly adaptable to the nucleo plan for developing of the area. Consideration was given to reshaping land parcels from the current, somewhat unorthodox, pie-shaped plots to more conventional rectangular-shaped plots. In so doing, however, the distances to access roads increased considerably for many outer parcels of the nucleo, resulting in reconsideration in favor of the pie-shaped plots.

7. Therefore, in any expansion and improvement it would be recommended to follow the same basic penetration and lateral road layout which conforms extremely well to the current planning for the nucleo layout and the shape of the farm land distribution. The design standards of the penetration road are minimal. However, with appropriate maintenance they can be considered quite adequate for the type and volume of service contemplated, that of providing all-weather access to the main highway network. The road platform width and the width of gravel surfacing, both of which underwent changes during current construction, basically as a result of financial constraints, will be examined further, however, in any extension of the colonization developement to the south.

C. Existing Lateral Roads:

1. Roadbed:

8. The lateral roads provide secondary access from the nucleo to the penetration road, (Figure I-3). Basically, they consist of a four-meter-wide, earthen, dry-weather road constructed by clearing and grubbing a patway and shaping a slightly raised, unsurfaced roadbed with side drainage ditches. The laterals extend five km from each side of the all-weather penetration road at five kilometer intervals.

9. The lateral roads have no fixed design standards other than the four-meters width and the requirement for side drainage ditches, as tabulated below (Figure I-5).

Roadway width	4 meters
Roadway surfacing	None
Load Capacity	No design limit
Fill slopes	2:1
Grade	Natural slope
Culverts	None
Right of Way	30 meters

2. Drainage:

10. During the random traversing of the lateral roads, drainage problems were noted at low points in the road profile. These are the points where drainage waters will accumulate unless a means is provided for relief and/or escape. On one lateral road, it was noted that at a low point, the road platform had been raised in excess of a meter following the completion of construction. This became necessary following heavy rains which created a serious flooding condition which disrupted access to the nucleo. This was pointed out by the members of the affected nucleo at the time of the site visit.

11. This experience indicates that some care and concern needs to be exercised for cross drainage. Each situation will have its own resolution. However, following clearing and grubbing, a reconnaissance should be conducted to assess potential drainage problems and to identify measures for remedy. Because of the low-cost nature of the roads, such necessary measures will be minimal and of the type that may alleviate the flooding situation but not fully eliminate it. Thus,

depending upon the particular condition, remedial measures, such as raising the roadway platform, provision of cross culverts and/or low-water crossings where a reinforced roadway acts as an overflow spillway, should be considered and evaluated. Cost, simplicity, and effectiveness should be the guiding criteria in determining the type and degree of drainage protection to be provided. A rough estimate of the costs for resolving the drainage problems of the lateral roads is $150,000.

3. Construction:

12. Construction of the lateral road is being performed by INC under force-account procedures, using equipment purchased and financed under the current AID Tropical Lands Development project. Maintenance is to be performed by the colonists they serve.

4. Extensions:

13. Possible ways to extend the San Julian project area with a minimum of added expenditure and time were examined. The narrower, simpler lateral road , particularly at locations nearest to the main highway appears to be the more practical of the two designs. (Figure 1-3.)

14. Since the maximum feasible length of unsurfaced, lateral road is considered to be five kms, the lateral access road leading off the penetration road is improved to a 4-meter, gravel-surfaced, all-weather road with side drainage and culverts. The lateral roads leading off this improved, gravel-surfaced access remain unsurfaced, dry-weather

roads, five km long, as shown in Figure I-3. This design takes advantage of the basic road layout, permitting the development of nine new nucleos with a minimum of added infrastructure expenditure and elapsed time. This extension, of course, presumes land availability within the San Julian North area.

15. Based on the cost data developed for the new San Julian South colonization project, nine new nucleos can be added by expanding as shown in Figure I-3, for a road infrastructure cost of $us57,770 per nucleo, or $us1,440 per family. This is compared to a cost of $us129,970 per nucleo or $us3,250 per family for comparable services in San Julian South.

II. DRAINAGE IN THE COLONIZATION AREA

As land is cleared and put in cultivation the need for drainage will become evident. In certain nucleos this need is already evident. No provisions have been made for drainage in the colonization area. The first step for resolving the drainage problem is a recognizance study of the area as well as the surrounding areas so as to determine the natural drainage courses which could be used. Such a survey is estimated to cost $100,000.

III. EXPANSION OF THE AGRICULTURAL AND COMMUNITY SERVICE CENTER

1. The agricultural service center at Nucleo 38, consisting of 100 hectares with residences, offices, a community center building,

storage, water well, etc., is presently under construction. Originally the plan called for 13 staff houses; however, bachelor quarters have now been substituted for them.

2. These structures have proven to be inadequate to accommodate the permanent staff, and transient personnel essential to the implementation of the project. It now appears that eight family houses having at least 88 meters of living space should be constructed at the agricultural service center to insure successful implementation of the project. One additional house measuring 125 square meters is also required for an expatriate technical advisor to be assigned to the project. Plans for these structures exist. The cost of construction and basic furnishings for the nine houses is estimated to be $234,580.

3. The land area of the center should be cleared and drainage layout provided so as to provide for experimental and demonstration plots, introduction nurseries, etc. This work will cost about $50,000. Thus, the total cost for improvements to the agricultural and community service center will be $us284,580.

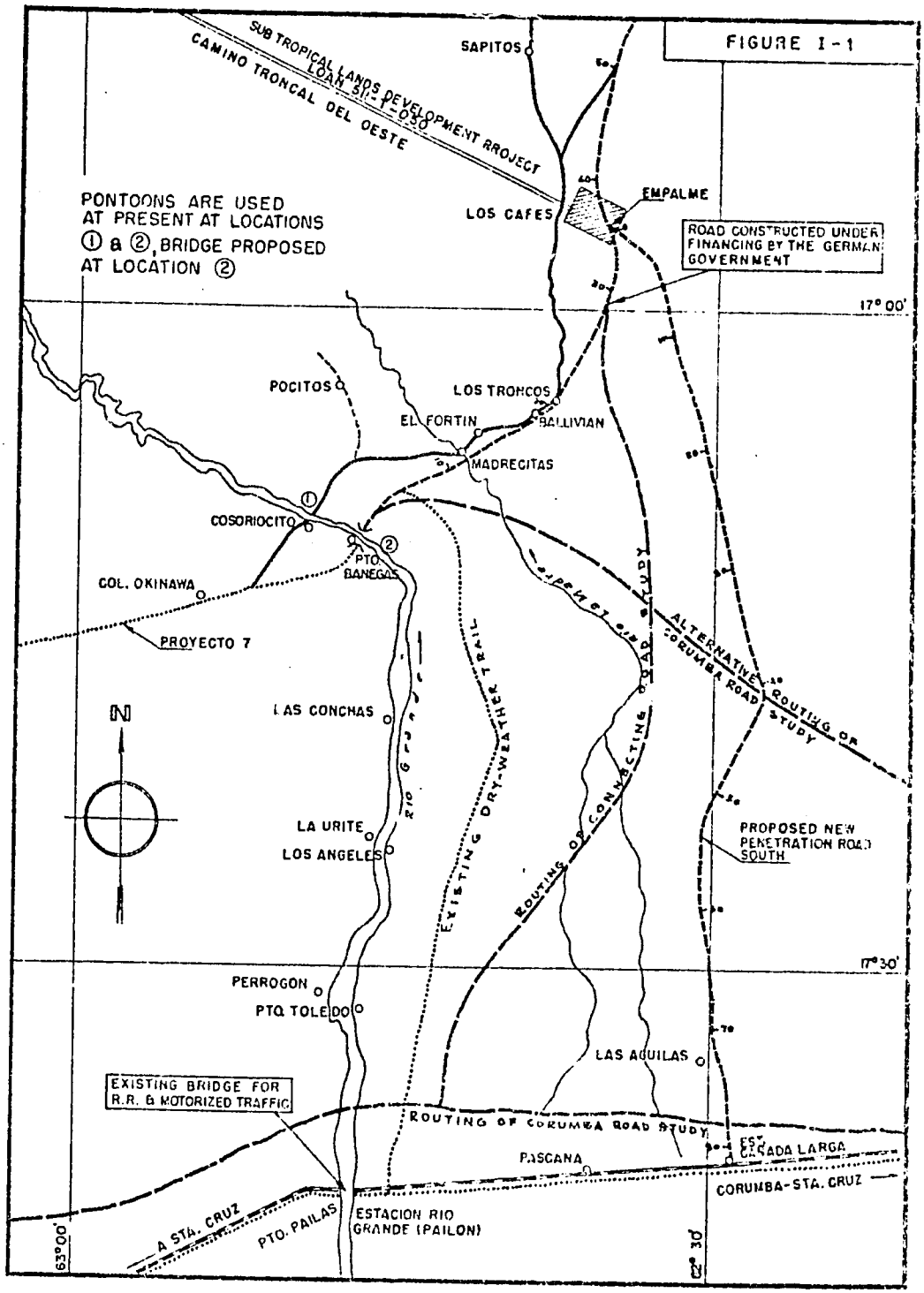


FIGURE I-1
SUB TROPICAL LANDS DEVELOPMENT PROJECT
LOAN 311-0-30
CAMINO TRONCAL DEL OESTE
SAPITOS
EMPALME
LOS CAFES
ROAD CONSTRUCTED UNDER FINANCING BY THE GERMAN GOVERNMENT
PONTOONS ARE USED AT PRESENT AT LOCATIONS ① & ②, BRIDGE PROPOSED AT LOCATION ②
17° 00'
POCITOS
LOS TRONCOS
EL FORTIN
BALLIVIAN
MADREGITAS
COSORIOCITO
PTO. BANEGAS
COL. OKINAWA
PROYECTO 7
LAS CONCHAS
RIO GRANDE
EXISTING DRY-WEATHER TRAIL
ROUTING OF CONNECTING ROAD STUDY
ALTERNATIVE ROUTING OF CORUMBA ROAD STUDY
PROPOSED NEW PENETRATION ROAD SOUTH
LA URITE
LOS ANGELES
17° 30'
PERROGON
PTO. TOLEDO
LAS AGUILAS
EXISTING BRIDGE FOR R.R. & MOTORIZED TRAFFIC
ROUTING OF CORUMBA ROAD STUDY
PASCANA
ESTACADA LARGA
CORUMBA-STA. CRUZ
A STA. CRUZ
PTO. PAILAS
ESTACION RIO GRANDE (PAILON)
63° 00'
62° 30'

25

FIGURE 1-3

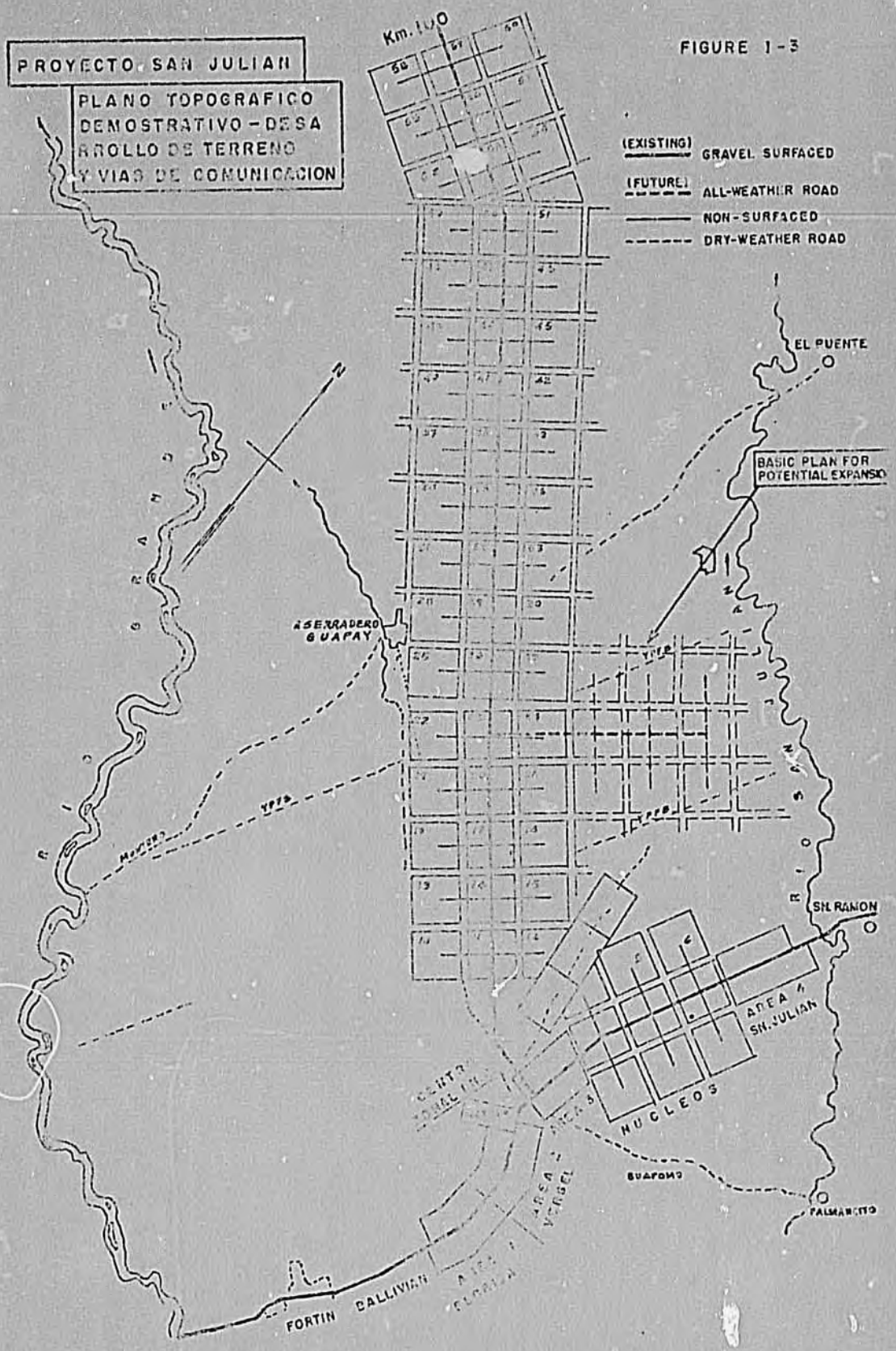
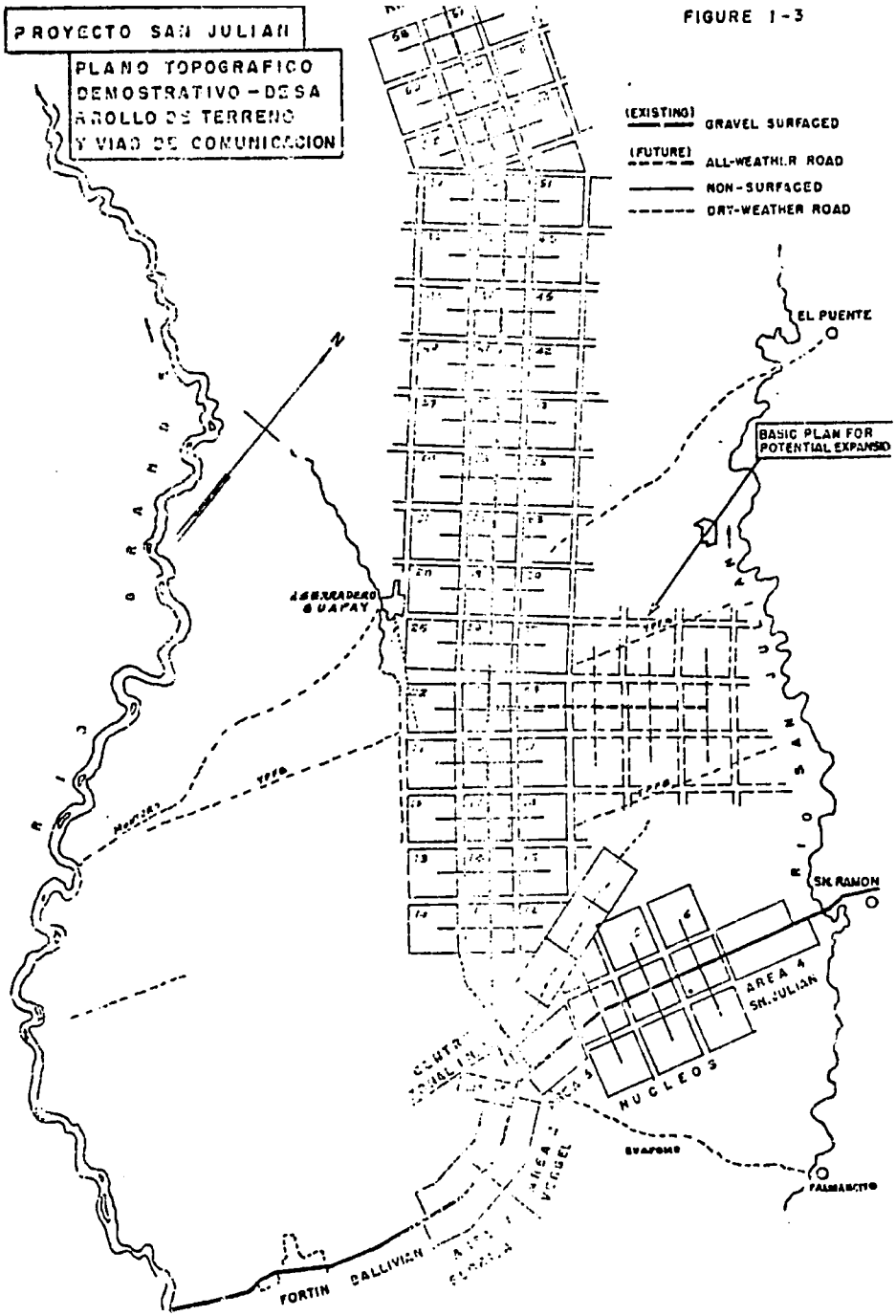
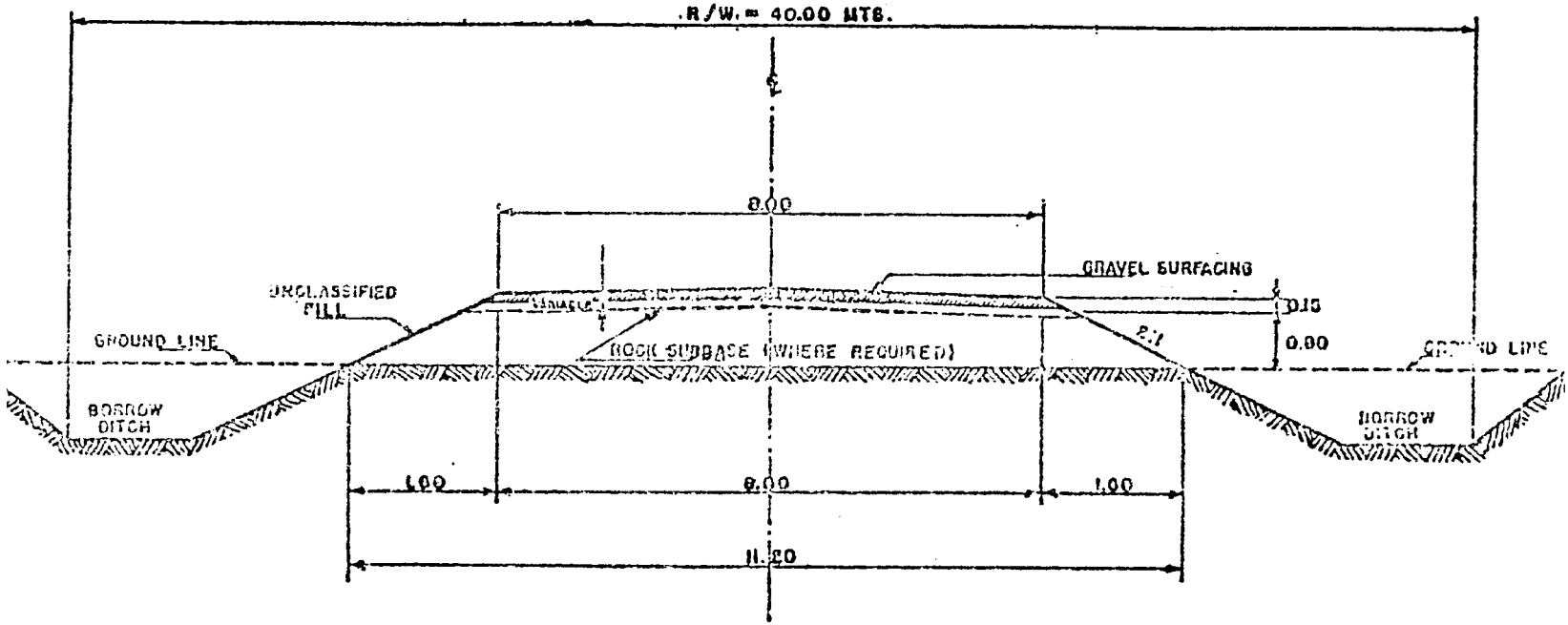

PROYECTO SAN JULIAN
PLANO TOPOGRAFICO DEMOSTRATIVO - DESARROLLO DE TERRENO Y VIAS DE COMUNICACION
Km. 100
(EXISTING) GRAVEL SURFACED
(FUTURE) ALL-WEATHER ROAD
NON-SURFACED
DRY-WEATHER ROAD
EL PUENTE
BASIC PLAN FOR POTENTIAL EXPANSIO
ASERRADERO GUAFAY
RIO GRANDE
RIO SAN
SN. RAMON
AREA A SN. JULIAN
NUCLEOS
FORTIN CALLIVIAN
FALMARITO

FIGURE 1-3

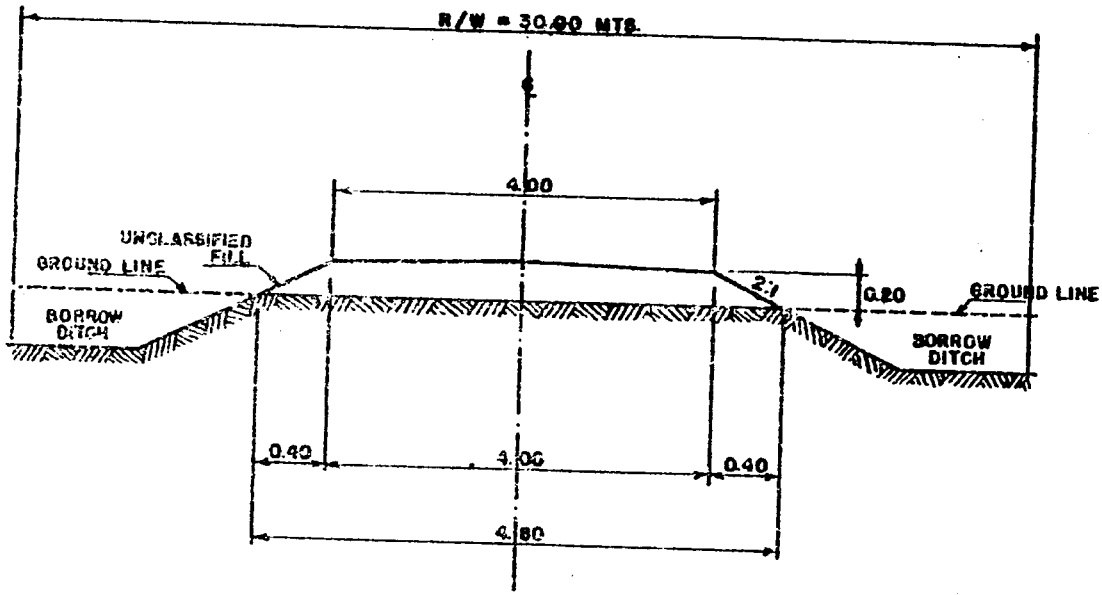

PROYECTO SAN JULIAN
PLANO TOPOGRAFICO
DEMOSTRATIVO - DESA
ROLLO DE TERRENO
Y VIAS DE COMUNICACION
(EXISTING) GRAVEL SURFACED
(FUTURE) ALL-WEATHER ROAD
NON-SURFACED
DRY-WEATHER ROAD
EL PUENTE
BASIC PLAN FOR POTENTIAL EXPANSIO
ASERRADERO GUAPAY
SN. RAMON
AREA 4
SN. JULIAN
NUCLEOS
FORTIN
CALLIVIAN



NOT TO SCALE

TYPICAL CROSS SECTION FOR PENETRATION ROADS

28

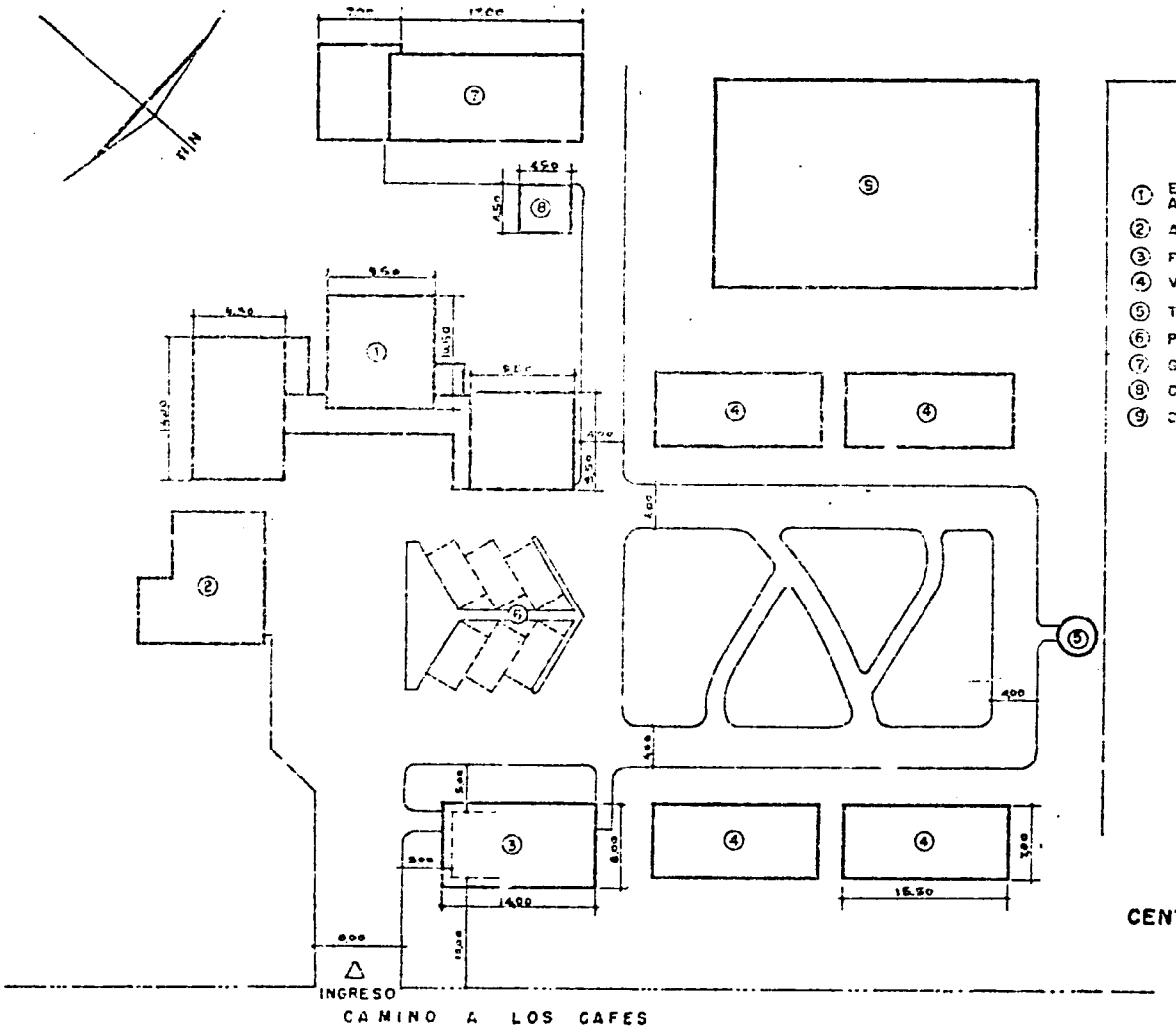


NOT TO SCALE

TYPICAL CROSS SECTION FOR

DRY WEATHER LATERAL ROAD

FIGURE I-5



CENTRO DE SERVICIO AGRICOLA

FIGURE I-6

INFRASTRUCTURE FOR THE SAN JULIAN SOUTH SETTLEMENT AREA ENGINEERING ANALYSIS

I. INTRODUCTION

1. A new colonization support activity, to be known as San Julian South, is contemplated along a penetration road that would be constructed, extending about 80 kms long, in a generally southerly direction from Los Cafés to Estación Canadá Larga along the Corumbá-Santa Cruz railroad (Annex 3, Figure I-1). The plan of development will follow that of San Julian North, now under construction, with a central penetration, all-weather road, lateral, dry-weather roads, an agricultural service center, health center, and nucleo water wells.

2. The preliminary reconnaissance consisted of a review of available map data and an overflight by small plane. The area along the route as seen from the air appears identical to that observed on the ground in San Julian North. The route embraces a sub-tropical zone with a dense forest cover and a relatively flat topography. No large streams appear to cross the area. It is reported, however, that the area is one of less rainfall and somewhat dryer climatic conditions than San Julian North.

II. THE PENETRATION ROAD:

A. Planning:

1. Figure I-1 (Annex 3) shows several routes that have been examined in the location of a new highway between Corumbá and Santa Cruz.

In view of the present uncertainty as to the location of a vehicular bridge crossing of the Rio Grande, alternative rountings have included,one crossing near Puerto Pailas and another crossing at Puerto Banegas. A connecting road between the existing Puerto Banegas-San Julian road and the proposed Corumbá-Santa Cruz road is also shown, as is also an existing dry-weather trail connecting the existing Puerto Banegas-San Julian road and the existing railroad bridge crossing at Puerto Pailas. This trail, which passes through an established, growing Mennonite colony, is used mainly during periods of high flows of the Rio Grande when ferry service at Puerto Banegas cannot operate. This is reported to occur regularly during the rainy season of December, January and February.

2. The exact routing of the new penetration road south will be subject to reviews by the Agrarian Reform and INC, who will identify the government lands which have been reserved and remain available for colonization. The routing of Figure I-1 (Annex 3) approximates the general location as presently known to INC. This is the basic routing which was used in developing the road data and related colonization

information for this report. Obviously, road designs should not commence until the availability and location of the land to be colonized is clearly determined. The location of the settlement lands could result in complete realignment of the penetration road. The data presented herein will be verified and revised to the finally determined field conditions during the final planning and design.

3. The routing of the San Julian South penetration road will depend primarily on the location and identification of the limits and bounds of government lands assigned and/or to be acquired for colonization development. The Agrarian Reform and INC will develop the basic data to permit the location and identification of government-controlled colonization lands. When these have been identified, a road layout will be prepared to show the projected routing of the penetration road south, the locations of the nucleos and the lateral roads connecting to the penetration road. The penetration road will then be staked in the field, making changes and revisions as appropriate to adapt and conform the projected routing to actual field topography and soil conditions. (A scope of work for planning and design is given in ANNEX 5.)

B. Cost Estimate:

4. Data upon which the cost estimates were developed were based on bid prices received in October 1977, for the construction of the San Julian North penetration road and cost estimates prepared in November 1976, in the planning for the connecting road between the Puerto Benegas-San Julian and Corumbá-Santa Cruz roads or (ANNEX 3, Figure I-1).

These roads are basically identical in design standards and generally traverse areas of similar soils, topography and drainage conditions as the penetration road here proposed. A unit price to reflect current costs and allowance for inflation and for the recent decree raising construction labor wages, has been developed as follows:

a.	$us.43,700/Km	-	Oct. 77 construction cost
b.	$us.54,620/Km	-	Sept. 79 construction cost (a X1.25)
c.	$us. 3,820/Km	-	Planning and design - 7%
d.	$us. 1,640/Km	-	Inspection - 3%
e.	$us. 5,460/Km	-	Contingencias - 10%
f.	$us.65,540/Km	-	Total current cost

5. The current, September 79, total cost for the projected 80 kms of penetration road is thus estimated to be $us.5,243.200. This estimated cost will be subject to inflationary influences which in recent years has amounted to an annual rate of six percent in the construction industry. Thus, presuming that construction will be initiated two to three years hence, an increased construction cost of 15 to 20 percent could result.

6. However, planning and design services are expected to be contracted late this year or early next year. Costs for these services, exclusive of the preparation of a base map identifying limits and bounds of the proposed colonization area, would thus very closely approximate those tabulated, plus the 10 percent contingency allowance, resulting in a cost of $us4,200 per km or $us336,000 for the 80 kms of road contemplated.

In addition, an unusual initial cost of about $us.150,000, which is more attributable to colonization planning than penetration road development, will be added to the planning and design services to cover the preparation of the base map identifying the limits and bounds of the colonization area. Thus, the services of planning and design for the penetration road, to include base map preparation, will amount to an estimated $us. 486,000.

The planning and design of the San Julian South penetration road will be contracted and performed by engineering consultants. No particular problems are foreseen in the response of bids for this work. In the construction bidding for the San Julian North, five prequalified contractors were invited to submit bids. Equally responsive contractor bidding can be anticipated for this project.

III. NEW LATERAL ROADS:

A. Plan:

1. New, dry-weather, lateral roads will be constructed at 5-km intervals, extending five kms from each side of the new penetration road as in the San Julian North design (ANNEX 3, Figure I-3). The proposed penetration road will be about 80 kms long (ANNEX 3, Figure I-1), and on this basis, 16 lateral roads totalling 160 kms will be planned to serve 48 nucleos.

B. Design:

2. Under the San Julian North development, the lateral roads had no fixed design standards other than four-meters width and a requirement for side drainage ditches. As noted earlier, the random traversing of lateral roads during a recent site visit showed drainage problems at certain low points in the road profile. (Remedial, cross-drainage relief is now under consideration). Therefore, in designing the San Julian South lateral roads, following the clearing and grubbing operations, a reconnaissance will be performed to assess potential drainage problems and to identify measures for remediation. Remedial measures to be considered will be minimal in view of the low-cost objective for the construction of the roads. As a result of this objective, although they may not always fully resolve drainage problems, they will provide some relief in alleviating them. Thus, depending upon each particular situation, provision will be considered for cross culverts, for raising roadway platforms, and/or for low-water crossings where the reinforced roadway acts as an overflow spillway to provide relief at low points in the profile.

3. The basic design will be governed by the criteria tabulated as follows:

Right of Way	- 30 meters
Road width	- 4 meters
Roadway surfacing	- None
Load capacity	- No limit
Fill slopes	- 2:1

C. Construction Equipment:

4. Inventory and Condition:

4. The pool of heavy equipment required for the construction of the lateral roads has been developed as follows:

1 small tractor w/dozer (60-70 HP)

6 medium tractors w/dozer (100-120 HP)

2 motor graders

1 lube/shop truck

2 water trucks

1 2-1/2 ton stake-body truck

2 dump trucks

1 tilt-top trailer/tractor

2 sheepsfoot rollers

5. The inventory and condition of heavy road construction equipment currently available in the San Julian area was reported as follows:

Item		Condition
1 small tractor	-	working
5 medium tractors	-	working
5 medium tractors	-	need repairs
2 motor graders	-	working
1 lube shop truck	-	working
1 tilt-top trailer/tractor	-	working

Item		Condition
2 water trucks	-	working
2 dump trucks	-	working but needing overhaul

6. It is not proposed to purchase any new road construction equipment for this new project. The equipment INC has in its inventory is adequate for the construction of the 160 Kms of lateral roads contemplated. Under the recent AID/INC project new equipment was procured for the construction of the San Julian North lateral road network. This new equipment, properly maintained, will have a life expectancy of six to eight years, sufficient to complete both the San Julian North and the San Julian South colonization projects.

2. Repair and Maintenance:

7. The inventory of working equipment, as can be seen, is approaching the minimum of that needed to effectively perform the road construction work. Any further breakdowns would probably delay construction.

8. At the time of the field review, the heavy road construction equipment, maintenance and repair shop being set at Los Cafes consisted of only corrugated metal roofing over earth floor and with no side walls. It appeared that INC lacked the funds to finish the shop and to connect and install a new electric generator and air compressors lying nearby. No repair work was going on at the time of the visit, although many pieces of heavy equipment were on site in need of repairs. The chief mechanic

advised that the uncompleted shop and lack of activity was due to funding constraints which prevented the purchase of needed spare parts and contract for services, materials and tools to complete the shop. Some tractors were repaired by the Caterpillar dealer in Santa Cruz.

9. Under the current San Julian North colonization development, AID proposes to contract for the services of a heavy construction equipment specialist in September 1979 to assist the INC in organizing and establishing a maintenance and repair capability for heavy equipment and trucks at Los Cafes and for light equipment and vehicles at the agricultural service center. The maintenance shop construction at Los Cafes to date has been the result of planning recommended by an AID-contracted equipment consultant retained under the rural roads program. The consultant, after completing his rural roads assignment, volunteered his services to review the INC situation. No written report , other than some sketches for proposed shop facilities at Los Cafés, is available of his work. These are what INC is using as a basis for its current shop construction.

10. The planning and design consultant for the penetration road will be asked to review the INC lateral road construction capability, both regarding the number and condition of available pieces of road construction equipment and regarding its status of operation condition and maintenance.

D. Construction Agency:

11. For purposes of this study, it is presummed that INC will continue to construct the lateral roads using its present equipment pool and force account procedures. However, INC is a colonization planning and development agency and not a road construction entity. Logically, road construction responsibility rests with SNC. The consultant who is to perform the penetration road study will be asked to review this situation to determine whether INC should continue to construct the lateral roads by unsupervised force account, whether this responsibility should be transferred to SNC, whether the design, including supervision and construction, should be done by contract, and/or some combination of the aforementioned.

E. Cost Estimates:

12. The cost estimates for the construction of 160/km of lateral roads is based on the operation costs of the equipment to be utilized. These costs were developed from Caterpillar Performance Handbook data. They include allowances for projected fuel consumption, lubricants and filters, nominal repairs, operators' salaries and benefits. No allowance has been made for depreciation or other capital costs for equipment since it was procured under the current San Julian North program and projected for retirement under this project.

13. The construction cost has been developed as follows:

$US 4,610/Km	- Operation cost - September 1979
460/Km	- Planning and design - 10% (including consultant review).
1,150/Km	- Contingency - 25% - includes allowance for drainage provisions).
$US. 6,220/Km	Total cost.

14. Thus, the construction of 160 km of lateral roads by force account, including allowances for planning and providing minimal cross-drainage relief, is estimated to amount to $US995,200.

E. Maintenance:

15. The maintenance of the lateral roads will be the responsibility of the colonists living along the roads. It is proposed to purchase 200 sets of picks, shovels and wheelbarrows, four sets per nucleo to be distributed for this purpose. Brigades will be organized within the nucleos and trained by community development promoters to be responsible for and to perform this function.

The maintenance will be simple, consisting of a weekly pass (or as frequently as needed over an assigned 2-km stretch of lateral road to fill potholes, smooth the road surface and clean drainage channels and ditches. Periodically, as needed, possibly about once every two years, arrangements may be made to bring in a grader to rework and reshape the road. This will be done at colonists' expense which will amount to about $us.600 per kilometer, as based on current costs.

IV. SUMMARY OF ESTIMATED ROAD COSTS:

1. The following tabulation summarizes the estimated costs of the road program for a proposed San Julian South colonization development.

Base map	$US 150,000
Penetration road (180/Km)	5,243.200
Lateral roads (160/Km)	995,200
Hand tools for maintenance	25,000
Rehabilitation of shops and equipment	150,000
Total cost	$US6,563,400

2. These estimated costs are representative of current (September 1979) costs and are subject to inflationary influences, which in most recent years has amounted to an annual rate of six percent for the construction industry. A 25 percent increase of $b. 500 per month granted to construction laborers this year is reflected in the cost estimates. Implementation of this program two to three years hence will likely result in increased costs of 15 to 20 percent over those herein presented.

V. OTHER INFRASTRUCTURE:

1. Other basic infrastructure which will be incorporated in the initial development of the new colonization area is the provision of a water well at each nucleo and an agricultural service center with a health post to be centrally located within the new area. Schools will

be promoted and constructed by the nucleos as they feel schools are needed, most likely when the school population warrants, a practice now followed in San Julian North. Nucleo residents have constructed one-room schools and have provided living quarters for the teacher, who is furnished by the Ministry of Education when the school and living quarters are in place.

A. Agricultural Service Center:

2. The agricultural service center in the San Julian North area is now under construction, about 45 percent complete. It is noted that the staff housing as originally planned has now been changed to dormitory style housing. Since the center is still under construction and not yet in operation, it is too soon to evaluate the influence of the change in housing (private to dormitory) on potential staffing interest for assignment under such isolated working conditions. This will be examined prior to initiating the proposed San Julian South Center.

1. Design:

3. For purposes of the presentation the agricultural service center proposed for the new colonization project will follow the same layout as that of San Julian North. It will be centrally located at about KM 40 (ANNEX 3, Figure I-6).

2. Cost Estimate:

4. The bidding documents (design plans, specifications) will

be prepared by consultants retained by INC who will be requested to assign inspection supervision to oversee construction progress. Based on the bidding of August 1977, the following cost is projected for this complex:

$US 225,800	Bid price without dormitories.
80,000	Dormitories.
11,290	Design - 5% (no inspection)
5,000	Water well and pump
$US.322,090	Construction cost - August 1977
$US.402,610	Construction cost-September 1979 (plus 25%) (includes 10% allowance for 1979 salary for construction labor).

5. This cost also is subject to inflationary influences, presently estimated at six percent per annum for the construction industry, and the estimated cost for implementation two to three years hence could increase as much as 12 to 15 percent.

B. Water Supply:

1. Design:

6. A four-inch cased well with a 1-1/2 inch pipe hand pump discharge will be drilled and installed at each nucleo. The general area is reported to be underlain with an excellent ground-water acquifer encountered at depths of 40 to 50 meters. Pump settings are generally at 15 to 20 meters.

2. Equipment and Materials:

7. A rotary, truck-mounted drilling rig was procured under the earlier AID/INC project for the San Julian North colonization development. INC is operating the rig and has drilled and equipped all wells to date. It is proposed to continue this procedure. The equipment and materials for 50 hand-pump wells to be procured will include 2500 meters of four-inch casing, 1200 meters 1-1/2 inch discharge pipe, 50 pump cylinders, 1200 meters 1/4" rods, plus a 10 percent allowance for spares, together with miscellaneous accessories and fittings for both drill-rig operations and pump installations. In addition, materials will be procured for two six-inch wells to be equipped with motor-driven pumps for the ground-water supply at an elevated tank.

8. It has been reported that under the San Julian North AID/INC project, materials were procured for 200 wells. Under present planning only about 60 wells are contemplated in this north area. Therefore, prior to any new materials procurement for wells, an accounting of the current inventory is indicated in the agricultural cervice center.

3. Technical Assistance:

9. It was reported during the site visits, that the present drilling crew is strong in perforrating and drilling wells but may lack in capability to fully exploit and develope the drilled well to take full advantage of the potential yield of the ground-water acquifer. Granted that the wells with hand pumps have relatively low pumping and

and low yield requirements, the water bearing sands around a well, whatever its yield, can and do become plugged when not carefully developed. To confront this possible problem, technical assistance in well drilling will be provided.

4. Cost Estimate:

10. The estimated cost of procuring the materials and performing the force account well drilling operations has been projected as follows:

$US	1,520	current cost of 4" cased well, 45 m deep, equipped with 1-1/2" hand pump, 20 m setting.
$US	5,000	current cost of 6" cased well, 45 m deep, equipped with 4" motor driven pump, 20 m setting

50 - 4" wells -	$US 76,000
2 - 6" wells -	10,000
Technical assistance	25,000
Total Cost	$US111,000

11. This is a current September 79 cost estimate subject to inflationary influences of about six percent per annum.

BOLIVIA

TERMS OF REFERENCE FOR ROAD DESIGN IN THE NEW SETTLEMENT AREA

San Julian South

A. General

1. Prior to performing any design work on the penetration road, the consultant will, in collaboration with Department of The National Institute for Colonization (INC) and the Agrarian Reform, draft a map of the zone projected for development as the resettlement and colonization area identifying and locating the limits and bounds of the government lands reserved and/or to be acquired. When this has been prepared, the consultant will proceed, with INC collaboration, to develop a layout plan showing the route of the penetration road, the location of the nucleos, lateral roads, and the agricultural/community service center. When this has been approved by INC, the consultant will, as the initial step of design, proceed to stake the center line of the penetration road in the field.

2. In view of the experience in San Julian North, where a 4-meter width of gravel surfacing was increased to 8 meters by change

order during construction, a full 8-meter width of gravel surfacing will be placed (Figure I-4). In addition to develop the colonization area this road will be a connecting road between the existing Puerto Banegas/San Julian road and the existing Santa Cruz/Robore road with its Rio Grande crossing at the railroad bridge. Its opening will generate some through traffic in both directions, further reinforcing a need for eight meters width of gravel surfacing. Colonists who settle in the southern end of the area will also be influenced to go southward to potential markets rather than northward to Los Cafés.

3. Since the topography is flat, no specific geometric design criteria will be followed for horizontal and vertical alignment, and no major drainage structures are contemplated. The proposed basic design standards will be as tabulated as follows:

Roadway width:	8 meters
Gravel surface width:	8 meters
Gravel surface thickness:	15 centimeters
Base thickness:	10 centimeters
Loac capacity:	H 10 (AASHO)
Fill slopes:	2:1

Grade:	Natural slope
Culverts:	RCP or CMP
Right of way:	40 meters

4. With appropriate maintenance, this standard of road is considered adequate for the type and volume of service projected, that of providing secondary, all-weather access to the main highway network. During the performance of field work and planning and design, however, the consultant will advise of any changes that field surveys and site conditions indicate are appropriate to maintain and preserve the life, utility and maintenance of the road.

B. Detailed Terms of Reference

5. In making the planning and design, the consultant will perform and report on the following items of work:

6. a) With INC, develop a map of the proposed colonization area, showing limits and bounds of government lands reserved for colonization development (INC and Agrarian Reform will provide basic data and information in developing this map).

7. b) When a property map has been prepared that is acceptable to INC, and the external financing agency, the Agrarian Reform, the consultant, working with INC, will prepare a plan of the proposed colonization development site, showing the penetration road, lateral roads, and the layouts of nucleos. A preliminary cost estimate for the construction of the penetration road, to be constructed by contract in accordance with the design standards, will be prepared.

8. c) With this map as a base, the consultant will stake out the penetration road in the field. To conform to actual field conditions, changes in alignment may be necessary. Such changes will be made at the discretion of the consultant. However, INC will be immediately advised and will be presented with appropriate justification for the charges.

9. d) In staking out the penetration road, the consultant will clear a trail 10 meters wide, 5 meters on each side of the centerline.

10. e) A plan and profile of the centerline will be surveyed, and permanent monuments will be located and placed, such that elevations and centerline can be readily reestablished. Cross-sections shall be taken every 200 meters, at abrupt changes in topography, and at locations of cross-drains.

11. f) Based on available data, hydrologic and hydraulic reviews, an analyses will be made of all proposed culverts and related cross drainage systems. Side drainage will also be reviewed and analyzed. In these reviews, consideration will be given to the effects of potential drainage from the side ditches of the lateral roads.

12. g) Soil samples will be taken every 1,000 meters and analyses made to determine classification, sieve analysis, Atterberg limits, compaction, and CBR in conformance with AASHO standards.

13. h) Potential borrow areas will be investigated, and soils will be examined along the route of the road and in adjacent areas, if necessary.

14. i) On the basis of the proposed alignment and related soils information, construction plans and specifications will be prepared, showing the alignment in plan and profile, typical road sections, drainage details and related details needed for a contractor to competitively bid and construct the road. During the design, the consultant will keep the INC advised of any condition which will materially alter the estimated construction cost.

15. j) With submission of the design (construction plans, specifications and estimated cost) the consultant will include a design report which will define the limits and basis of all planning and design and which will present time schedules and procedures to be followed in implementing the construction. In addition, the consultant will prepare a maintenance plan, a related staffing structure, together with equipment needs and a projected annual budget to provide appropriate care and maintenance to the road. The consultant will also be available to provide assistance in preparing submittals for soliciting financing from the World Bank and/or other international development financing agencies.

ECONOMIC ANALYSIS OF RIO GRANDE BRIDGE COMPONENT

A. Introduction:

1. A bridge across the Rio Grande is considered to be an essential element for the economic development of the area to the east including the San Julián colonization project area. With the construction of the new road to the Beni, an enormous area of natural resources will be opened to exploitation. The amount of development that has already begun is testimony to this potential, coming as it has in the face of such serious transporation constraints.

2. In calculating the potential benefits of this element of the project, one realizes that they probably are in an order of magnitude several times the actual cost of construction. The approach has been, therefore, to be as conservative as possible. Thus, a positive economic analysis of any magnitude would reliably indicate that the true benefit would be sufficiently large to fully justify the project. Therefore, this analysis is limited to the narrowest direct benefits, i.e., the savings to vehicles crossing the river. Increases in prices to farmers, lowered transport

costs, decreases in prices for goods going to the zone, decreased cost of passenger traffic, etc., are assumed to be reflected in the savings in tolls, time and damage to vehicles using the river crossing.

B. Estimates of Present Traffic Crossing the Rio Grande at the Puerto Banegas Crossing:

3. The estimates of vehicles crossing the Rio Grande at Puerto Banegas crossing are based on a reconcilliation of the best estimates of knowledgables (Note 1). The current level of crossings is estimated to be:

Heavy vehicles:	35,000 per year
Light vehicles:	12,500 per year

C. Present Cost to Traffic without the Project:

4. At an average cost of $US. 20.00 per heavy vehicle crossing, and $US. 7.50 per light vehicle, the current tolls for crossing are approximately $US. 800,000 per year.

5. The average waiting time per crossing for heavy trucks is four hours. Given the daily rental of a heavy truck in Santa Cruz at approximately $b. 1,500 ($US. 75), and assuming a twelve-hour day, the average cost per truck is $US. 25.00 for time lost. No lost income from waiting

is assumed per light vehicles since they tend to cross with minimum waiting time.

6. A final element included in this analysis is the cost of lost and damaged vehicles. Although no precise data exists, all sources queried agree that several heavy vehicles and some light ones are lost to the river each year. In addition, many vehicles get deeply mired and/or damaged traversing the sandy approaches to the river crossings. As a conservative estimate, we value this loss at $US. 100,000 annually. (Table 1)

TABLE 1. Estimated Current Annual Cost of Rio Grande Puerto Banegas Crossings

Heavy vehicles:			
Toll	$US 20.00		
Crossing	(x) 35,000	$US.	700,000
Value of time lost:	$US 25.00		
Crossing:	35,000		875,000
			1,575,000
Light vehicles:			
Toll :	$US 7.50		
Crossing :	(x) 12,500		93,750
Estimated losses and damage:			100,000
Estimated total annual costs		$US.	1,768,750

D. Future Costs:

7. Growth in traffic crossings is estimated at seven percent natural increase and at 20 percent per year after the bridge is completed. (See Note a. and b.)
At a seven percent annual rate of increase the annual cost with the present system would be at approximately $US-- 2,025,000 when the project begins in 1981, and $US.-- 2,481,000 when the bridge opens for traffic at a predicted date of January 1, 1984. Savings would begin in that year, when the estimated annual rate of increase would rise to 20 percent and continue at that rate for the seven remaining years of the analysis.
Depreciation of the bridge (estimated cost $US12,818,900) is assumed at to be five percent a year, starting in the year of completion. The salvage value is therefore $8,950,900.

E. Results of Economic Analysis of Bridge:

8. Using a 15 percent discount factor and the assumptions presented above, the internal rate of return on the bridge is 22 percent.

TABLE 2. Internal Rate of Return on the Rio Grande Bridge Project

Net present worth:	$ 4,840,700
Discounted benefits:	$14,904,500
Discounted costs:	$10,063,800
Benefit/cost ratio:	1.48
Internal rate of return:	22%

TABLE 3 BENEFIT/COST ANALYSIS OF THE RIO GRANDE BRIDGE ELEMENT OF THE SAN JULIAN CONSOLIDATION PROJECT

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	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Project Costs 1/ ($US1000)	5743.2 2/	4137.4	2947.3	-	-	-	-	-	-	
Salvage Value (5% Deprec.)										8950.9
Project Savings ($US1000)	(2025.0)	(2166.8)	(2318.5)	2782.2	3338.6	4006.3	4807.6	5769.1	6922.0	8307.5
Net Cashflow	-5743.2	-4137.4	-2947.3	2782.2	3338.6	4006.3	4807.6	5769.1	6923.0	17258.4
(Discount) Factor(15%)	0.870	0.756	0.658	0.572	0.497	0.432	0.376	0.327	0.284	0.247
Present worth NPW 4840.7	-4996.6	-3127.9	-1939.3	1591.4	1659.3	1730.7	1807.7	1886.5	1966.1	4262.8
Discounted Benefits	14904.5									
Discounted Costs	10063.8									

BIC ratio 1.48

IRR = 22%

1/ Contingency Factor of 12.02% applied to yearly estimates of costs.

2/ Pre-investment costs figured in first year.

NOTE: Sources of estimates of Rio Grande price crossings at the project.

a. Tippettd-Abbett-McCarthy-Stratton (TAMS), Preliminary Economic Study and Route Selection for Río Grande Crossing.

La Paz: USAID, 1963.

b. Engineering Services Inc. (ESI), Camino Los Aceites - Los Troncos: Diseño Final.

Santa Cruz: Comité Departamental de Obras Públicas, 1978.

c. Servicio Nacional de Caminos "Datos Estimados Referentes al Puente Río Grande"

La Paz: Communication to Project Engineer Charles Stevens, 9/1979.

d. Personal communication based on interviews with pontoneras (raftmen) at the Puerto Banegas crossing, Harry Peacock: Montero: 9/1979.

e. George Hoover, La Paz: USAID Engineer, personal conversation.

ANNEX 7
Table 1

DETAILS OF PROJECT INPUTS AND COSTS

SAN JULIAN CONSOLIDATION - TECHNICAL SERVICES COMPONENT

ITEM	NUMBER	UNIT OF ANNUAL RATE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL
Extension/Cooperative/Research							
PERSONNEL							
Chief Extension Service (Ing. Agronomo)	1	6,300	6,300	6,300	6,300	6,300	25,200
Lifestock Production (Ing. Agronomo)	1	5,600	5,600	5,600	5,600	5,600	22,400
Rural Youth Development (Ing. Agronomo)	1	5,600	5,600	5,600	5,600	5,600	22,400
Information/Radio Specialist	1	5,600	5,600	5,600	5,600	5,600	22,400
NADEPA Extension Spec. (Tec. Agronomo)	6	4,200	25,200	25,200	25,200	25,200	100,800
NADEPA Home Improvement Agent	6	4,200	25,200	25,200	25,200	25,200	100,800
Production System Research (Ing. Agronomo)		5,600	5,600	5,600	5,600	5,600	22,400
Production System Research (Tec. Agronomo)		4,200	4,200	4,200	4,200	4,200	16,800
Cooperative Development Promoter	3	4,900	14,700	14,700	14,700	14,700	58,800
Secretary/Clerk	2	3,000	6,000	6,000	6,000	6,000	24,000
Chofer	1	2,800	2,800	2,800	2,800	2,800	11,200
Mechanic	1	2,800	2,800	2,800	2,800	2,800	11,200
Nucleo Auxiliary Assistant	80	250	20,000	20,000	25,000	25,000	90,000
Laborers	15	625	12,500	12,500	12,500	12,500	50,000
Sub-Total	-	-	142,100	142,100	142,100	142,100	578,400
25% Premium Pay except for Laborers and Auxillary Assistants							109,600
TOTAL PERSONNEL							688,000

(Cont.)

ANNEX 7
Table 1

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//2. SAN JULIAN CONSOLIDATION - TECHNICAL SERVICES COMPONENT

EQUIPMENT AND SUPPLIES							
Vehicles 4 x 4 Pick Up	2	10,000	20,000	-	-	-	20,000
4 x 4 - 6 Passenger Pick Up	1	15,000	15,000	-	-	-	15,000
Motobike	18	1,500	27,000	-	-	-	27,000
Animal Traction Unit	2	1,650	3,300	-	-	-	3,300
Light Farm Tractor with Equipment	1	30,000	30,000	-	-	-	30,000
Office Equipment	-	-	3,000	-	-	-	3,000
Audio Visual Equipment	-	-	5,000	-	1,000	-	6,000
Micellaneous Supplies	-	-	10,000	13,000	13,000	13,000	49,000
TOTAL EQUIPMENT AND SUPPLIES	-	-	113,300	13,000	14,000	13,000	153,300
OPERATIONS							
20% Equipment Cost per year	-	-	30,660	30,660	30,660	30,660	122,640
Per Diem for Travel	-	-	4,800	4,800	4,800	4,800	19,200
TOTAL OPERATION	-	-	35,460	35,460	35,460	35,460	141,840
TOTAL EXTENSION/COOPERATIVE/RESEARCH							983,140
Credit Delivery System							
PERSONNEL							
Credit Agent	1	6,300	6,300	6,300	12,600	12,600	37,800
Cashier/Clerk	1	3,200	3,200	3,200	3,200	3,200	12,800
TOTAL	-	-	9,500	9,500	15,800	15,800	50,600
25% Premium pay	-	-	-	-	-	-	12,650
TOTAL PERSONNEL	-	-	-	-	-	-	63,250

(Cont.)

//3. SAN JULIAN CONSOLIDATION - TECHNICAL SERVICES COMPONENT

EQUIPMENT AND SUPPLIES							
Vehicle 4 x 4 Pick Up	1	10,000	10,000	-	-	-	-
Motobike	1	1,500	1,500	-	-	-	10,000
	-	-	-	-	-	-	1,500
Office Equipment	-	-	2,700	-	-	-	2,700
Supplies	-	-	500	500	500	500	2,000
TOTAL EQUIPMENT	-	-	14,700	500	500	500	16,200
OPERATIONS							
25% Equipment Cost	-	-	6,550	6,550	6,550	6,550	26,200
Per Diem for Travel	-	-	600	600	1,000	1,000	3,200
TOTAL OPERATIONS	-	-	-	-	-	-	29,400
TOTAL CREDIT							108,650
GRAND TOTAL TECHNICAL SERVICES							1,091.8
TECHNICAL ASSISTANCE (1) (Foreign)							
Agro-Livestock Production System	1	-	90,000	90,000	18,050	18,050	216,100
Credit Delivery System	1	-	90,000	90,000	12,700	12,700	205,400
CONSULTANTS (2)							
Tropical Horticulture	1	-	12,700	12,700	6,350	6,350	38,100
Market Information and Promotion	1	-	-	6,350	6,350	6,350	19,050
Animal Production	1	-	-	6,350	6,350	6,350	19,050
Forestry Management and Development	1	-	12,700	6,350	-	6,350	25,400
Rural Youth Development	1	-	12,700	6,350	-	-	19,050
Small Agro Industries	11	-	-	-	6,350	6,350	12,700
						62,500	554,850

(1) Figures include salaries, allowances, official and vacation travel etc.
(2) Consultants will be used intermittently.

(Cont.)

//4.

DETAILS OF PROJECT INPUTS AND COSTS

SAN JULIAN CONSOLIDATION - RURAL INFRASTRUCTURE COMPONENT
1,000 $US.

ITEM	YEARS 1	2	3	4	TOTAL
Lateral Roads Extension	200.0	300.0	340.0	200.0	1,040.0
Lateral Roads Improvement	25.0	50.0	40.0	35.0	150.0
Area Drainage Study	-	50.0	50.0	-	100.0
Addition to the Agricultural Center	200.0	85.0	-	-	285.0
TOTAL INFRASTRUCTURE	425.0	485.0	430.0	235.0	1,575.0

RIO GRANDE BRIDGE
1,000 $US.

ITEM	PREINVESTMENT	YEARS 1	2	3	4	TOTAL
Engineering Design	917.4					
Supervision of Construction		220.2	192.6	137.6	-	550.4
Construction		3,669.4	3,210.8	2,293.4	-	9,173.6
Connecting Roads			320.0	280.0	200.0	800.0
TOTAL BRIDGE		3,889.6	3,723.4	2,711.0	200.0	10,524.0

ANNEX 7
Table 1 (Contd.)

ANNEX 7
Table 2

SAN JULIAN SOUTH - NEW SETTLEMENT AREA

TECHNICAL AND MATERIAL SUPPORT

$US.

	NUMBER	RATE/YEAR OR UNIT	YEAR 1	2	3	4	TOTAL
ORIENTATION UNIT							
Personnel							
Director	1	6,100	4,575	6,100	6,100	6,100	22,875
Technico Agronomo	2	4,000	2,000	8,000	8,000	8,000	26,000
Nurse	1	4,000	1,000	4,000	4,000	8,000	17,000
Cooperative Promoter	1	4,000	1,000	4,000	4,000	8,000	17,000
Social Promoter	2	4,000	2,000	8,000	8,000	8,000	26,000
Home Economist	2	4,000	2,000	8,000	8,000	8,000	26,000
Clerk/Warehouseman	1	2,700	1,350	2,700	2,700	2,700	9,450
Chofer	1	2,700	1,350	2,700	2,700	2,700	9,450
Chain Saw Instructor	4	1,200	1,200	4,800	4,800	4,800	15,600
Orienters (1)	7	1,000	300	7,000	7,000	7,000	21,300
SUB-TOTAL PERSONNEL	-	-	17,775	55,300	55,300	63,300	190,675
25% Premium pay (except for Orienters and Chain Saw Instructure) for insulation	-	-	3,819	10,875	10,875	12,875	38,443
TOTAL PERSONNEL	-	-	20,594	66,175	66,175	76,175	229,118
Equipment and Supplies							
Vehicles: 4 x 4 Pick Up	5	10,000	50,000	-	-	-	50
5 Ton Truck	1	18,000	18,000	-	-	-	18
Motobike	10	1,500	15,000	-	-	-	15
Light Farm Tractor with Equipment	1	27,000	27,000	-	-	-	27

(1) These are drawn from units which had been settled earlier.

(Cont.)

ANNEX 7
Table 2

//2. SAN JULIAN - NEW SETTLEMENT AREA

Building Material for temporary shelters	-	-	50,000	-	-	-	50
Micellaneous Materials and Supplies	-	-	30,000	25,000	20,000	20,000	95
TOTAL EQUIPMENT AND SUPPLIES	-	-	190,000	25,000	20,000	20,000	255,000
Operations							
25% of Equipment and material per year	-	-	45,000	70,000	70,000	70,000	255,000
Rations for Colonos	-	-	-	90,000	90,000	90,000	270,000
Extension, Cooperative and Credit Services	-	-	-	-	210.2	210.2	420.4
TOTAL TECHNICAL AND MATERIAL SUPPORT	-	-	255,594	251,175	456,375	466,375	1,429,518

SAN JULIAN SOUTH - NEW SETTLEMENT AREA

RURAL INFRASTRUCTURE COMPONENT

$US. 1,000

	PREINVESTMENT	YEAR 1	2	3	4	TOTAL
Survey and Mapping of Area	150.0					
Penetration Road .						
Aliment and Design	336.0					
Construction Costs		1,329.1	1,326.0	1,448.7	265.8	4,369.6
Supervision	-	39.4	39.4	46.2	6.3	131.2
SUB-TOTAL	-	1,368.5	1,365.4	1,494.9	272.1	4,500.8

(Cont.)

ANNEX 7
Table 2 (Contd.)

//3. SAN JULIAN SOUTH - NEW SETTLEMENT AREA

Lateral Roads						
Planning and Design	-	73.6	-	-	-	73.6
Rehabilitation of Equipment	-	100.0	50.0	-	-	150.0
Construction	-	147.5	221.3	295.0	73.8	737.6
Hand Tools for Maintenance	-	25.0	-	-	-	25.0
SUB-TOTAL	-	346.1	271.3	295.0	73.8	986.2
Agriculture Services						
Center Construction	-	100.0	202.0	100.6	-	402.6
Nucleo Water Supply (wells)	-	30.0	40.0	41.0	-	111.0
T O T A L S	-	1,844.6	1,878.7	1,931.5	345.9	6,000.6
GRAND TOTAL - $US. 1,000	486.0	2,100.2	2,629.9	2,387.9	811.8	7,429.9

ANNEX 7
Table 2 (Contd.)

ANNEX 8
Table 1

ECONOMIC ANALYSYS OF THE SAN JULIAN NORTH PROJECT COMPONENT

$b. 1,000

	YEARS										
	0	1	2	3	4	5	6	7	8	9	10
1. INCOME WITH PROJECT		43,569	56,332	75,355	89,799	100,933	111,548	122,952	135,749	143,983	156,089
2. RESIDUAL VALUE		-	-	-	-	-	-	-	-	-	183,135
SUB-TOTAL		43,569	56,332	75,355	89,799	100,933	111,548	122,952	135,749	143,983	339,224
1. INCOME WITHOUT PROJECT		36,955	41,869	47,719	52,162	55,162	57,173	60,205	62,979	65,935	69,075
2, RESIDUAL VALUE		-	-	-	-	-	-	-	-	-	84,263
SUB-TOTAL		36,955	41,869	47,719	52,162	55,162	57,173	60,205	62,979	65,935	153,338
DIFFERENCE :		6,614	14,463	27,636	37,637	45,771	54,375	62,747	72,770	78,048	185,886
COSTS WITH PROJECT											
1. Investment	16,290	-	20,381	24,600	27,455	19,894	26,505	17,173	17,095	8,713	8,035
2. Production Costs	-	36,126	38,345	54,495	61,972	68,951	74,440	80,470	86,960	91,903	97,840
3. Technical Support :											
Local Personnel		6,366	4,360	4,480	4,460	-	-	-	-	-	-
External Assistance		4,362	4,362	1,124	1,250	-	-	-	-	-	-
4. Administration of Credit		674	392	554	556	-	-	-	-	-	-
5. Infrastructure	8,500	-	9,700	8,600	4,700	-	-	-	-	-	-
SUB-TOTAL	24,790	47,528	77,540	93,853	100,393	88,845	100,945	97,643	104,055	100,616	105,875
COSTS WITHOUT PROJECT											
1. Investment	3,138	-	3,537	3,937	4,331	5,119	5,119	5,119	5,119	5,119	5,119
2. Production Costs	-	30,273	34,218	39,032	42,402	44,399	46,176	48,169	50,435	52,772	55,121
SUB-TOTAL	3,138	30,273	37,755	42,969	46,733	49,518	51,295	53,288	55,554	57,891	60,240
DIFFERENCE :	21,652	17,255	39,785	50,884	53,660	39,327	49,650	44,355	48,501	42,725	45,635
NET DIFFERENCE :	(21,652)	(10,641)	(25,322)	(23,248)	(16,023)	6,444	4,725	18,392	24,269	35,323	140,251
IRR :	12%										

ANNEX 8
Table 1

ANNEX 8
Table 2

ECONOMIC ANALYSIS OF PROJECT FARM MODEL

(In Bolivian Pesos)

	YEARS 0	1	2	3	4	5	6	7	8	9	10
I. INCOME WITH PROJECT		12,690	28,350	34,810	45,350	57,700	81,820	91,290	109,410	111,400	268,460
Sales											
Annual Crops		11,340	25,650	31,960	32,500	32,500	41,500	56,650	65,720	67,000	74,800
Perennial and garden crops		150	300	450	2,450	3,600	5,080	5,080	6,930	11,780	18,660
Animals and Products		1,200	2,400	2,400	10,400	21,600	36,180	29,560	36,760	32,620	32,620
Residual Value		-	-	-	-	-	-	-	-	-	142,380
II. INCOME WITHOUT PROJECT		5,200	9,975	13,750	14,150	14,650	15,250	16,000	16,750	17,550	45,100
Sales											
Annual Crops		4,950	9,375	12,750	12,750	12,750	12,750	12,750	12,750	12,750	12,750
Perennial and garden crops		150	300	450	600	800	1,000	1,250	1,500	1,800	2,100
Animals and Products		100	300	550	800	1,100	1,500	2,000	2,500	3,000	3,500
Residual Value											26,750
III. DIFERENCE (I-II)		7,490	18,375	21,060	31,200	43,050	66,570	75,290	92,660	93,850	223,360
IV. COST WITH PROJECT	21,130	10,531	24,834	66,762	37,967	45,486	51,992	59,589	69,632	69,021	79,200
Investment											
Land Clearing	1,250	-	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
Animals and Animal Infrastructure	8,300	-	2,900	9,900	2,400	4,400	500	500	500	500	500
Storage and drying structures	8,590	-	-	-	-	-	-	-	-	-	-
Animal Transport and Traction	2,750	-	2,750	33,500	-	375	-	-	6,250	-	9,500
Perennial Plantings	240	-	480	720	720	720	720	720	720	720	720
De-Stumping	-	-	-	-	-	-	2,400	1,800	7,200	9,600	12,000
Production Costs											
Labor		5,275	8,310	10,915	12,980	14,514	18,725	21,635	24,445	26,814	29,173
Inputs		5,256	8,544	18,477	20,617	24,227	30,797	35,484	36,467	39,737	38,057

ANNEX 8
Table 2

(Cont.)

//2. ECONOMIC ANALYSIS OF PROJECT FARM MODEL

VV.	COSTS WITHOUT PROJECT	1,250	3,928	9,131	12,707	12,982	13,483	13,925	14,603	15,155	15,616	16,202
	Investment											
	Land Clearing	1,250	-	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
	Production Costs											
	Inputs		1,563	3,091	4,522	4,627	4,807	5,145	5,568	5,990	6,431	6,872
	Labor		2,365	4,790	6,935	6,980	7,051	7,155	7,410	7,540	7,560	7,705
VI.	DIFFERENCE (IV-V)	19,880	6,603	2,672	(32,995)	6,215	11,047	28,503	30,304	38,183	40,445	160,362
VII.	NET DIFFERENCE	(19,880)	887	15,703	(11,935)	24,985	32,003	38,067	44,986	54,447	53,405	62,998
	IRR :	55.3%										

complimentary to the other farm activities and self-capitalizing.

Although the model is built around one such unit per farmer, it is expected that the profitability of livestock and the predisposi-

ANNEX 8
Table 2 (Contd.)

THE FARM PRODUCTION MODEL

A. Introduction

1. The primary objective of the consolidation phase of the San Julian settlement project is the establishment of the basis for a stable and continuing agricultural production system for the small farmer. Several considerations underlie the consolidation concept: (1) the observable limitations of the existing production technology from the standpoint of providing adequate levels of income to the colonists, with the result that they are essentially condemned to a low living standard with little potential for improvement; (2) the adverse impact of the system of production which is employed on the natural resource base of the area; and (3) the avoidance of relegating a substantial area of some of the best soils of the country to an extensive livestock enterprise.

Existing Models

2. The development of agriculture in the Department of Santa Cruz has generally followed two widely divergent paths: (1) the commercial farm model in which the land is cleared mechanically and a mechanized single-crop farming system is established; and (2) the colono path in which hand labor is used in a slash-and-burn production system, which limits the area cultivated at any one time by a family unit to approximately three hectares. There exist few examples of an intermediate approach to agricultural development in the area. These are usually to be found in immigrant colonies

wherein the settlers srrived with capital and a substantial baggage of technical know-how. These groups have generally developed a production system based on mechanical land clearing and mechanical cultivation based on animal traction as well as motorized power, however, on a small farm scale rather than the extensive commercial scale of the large farm agriculture. They have moreover developed a more intensive system of land use, a more diversified production base and a substantial integration of livestock with crop production.

3. Among these three systems, only the hand labor, slash-and-burn option appears to be available to the new Bolivian colonists who arrive in the area with neither capital nor technical knowledge in tropical and subtropical agriculture beyond that which some may have learned as day laborers on the commercial farms. The latter experience usually provides little basis for decision-making on the colonist's own farm. This option has been called the barbecho crisis due to the fact that once entrapped in the slash-and-burn barbecho system, there are only limited avenues of escape.

B. The Proposed Farming System Model

4. This proposal offers a fourth option. It begins with a new settler or colono without capital and with only a very limited technological baggage, beginning his production enterprise with the slash-and-burn technology. Several innovations are introduced which lead

to a permanent cropping system, integration of livestock in the production enterprise and the elimination of barbecho. The essential features of the system are the use of multiple cropping and crop sequences which keep the land occupied and in production throughout the year, and the replacement of the barbecho cycle with leguminous plants that serve as a cover for the soil as well as pasture and forage for livestock. A wide range of crops can fit into such a system, providing diversity as well as choice in keeping with the individual colono's circumstances and the market outlook. The system is also designed to gradually move the settler, as he gains experience in management of the system, from a wholly hand labor operation towards the use of external power, either animal or mechanical, thus expanding the scale of the enterprise.

5. The concept of graduality is key to the proposed system. It would be relatively simple to provide each settler with several hectares of cleared land at the outset and avoid the arduous task of hand clearing the tropical forest. To do this, however, would help little unless the settlers were also to be provided with the means to control the weeds, which would rapidly develop, making hand cultivation beyond the third or fourth year impossible, with the result that the land, expensively cleared, would revert to barbecho. Even if the settler were provided with mechanical equipment to cultivate his land, his level of knowledge and his management

and technical skills in these early years would preclude the level of efficiency of production to pay the very substantial debt which would have to be engaged. The gradual approach in the model proposed provides time for learning and a gradual capitalization of the farm unit without incurring an overwhelming debt load.

6. Another important reason for graduality is the fragility of markets for the principal crops (rice and corn) currently produced by the colonist, and likely to be the principal crops produced until more diversified farming systems can be demonstrated. If each settler in the colonized areas were to at once plant 10 hectares of these crops in a mechanized operation instead of one to two hectares cultivated by hand, the total production of these crops would be approximately doubled. Such an increase in production would be unmanageable, market wise, hence the concept of moving the farmer gradually into a more diversified agro-livestock production system which would provide a wider range of marketable commodities and the opportunity to regulate production in keeping with markets.

Tables 1 to 8 provide farm production models which have been developed for continuous occupancy of cleared land with crops or legume forage/pasture. Implicit in the application of the production models are farmunit development models, which show a gradual diversification, expansion and capitalization of the farm unit over time. The models ultimately lead to a production unit which is

mechanized, producing sufficient surpluses to permit self-capitalization, as well as an increase in disposable income for improvement of living conditions. For Example, under the traditional slash-and-burn agriculture after 10 years a colono with 50 hectares of land would be cultivating 3 hectares in annual crops, 0.3 hectares in tree crops, 2.5 hectares of grass pasture, and 6.2 hectares in barbecho. He would have 38.1 hectares left of forest land. He would have an annual net income of $b.2,148 and the residual value of the farm unit would be placed at about $b.26,750.

8. In comparison, assuming an average cross section of the several production models, in 10 years a colono with 50 hectares of land would be cultivating 6 hectares double and trippled cropped with annual crops, one hectare of perennial crops, 3 hectares in legume pasture. He would have no barbecho, leaving 40 hectares in original forest. His annual net income would be $b.44,400, and the farm unit would have a net worth of $b.140,380. The significant differences between the two approaches from the standpoint of resource use and conservstion becomes more apparent if the traditional system is projected further, say to year 20. By year 20 if the trend of earlier colonization continues over 30 hectares of forest will have been cleared; approximately 20 hectares will be in barbecho; and pasture will have increased to 8.7 hectares, reflecting the increasing importance of livestock in the farm unit. The area cultivated will

have changed little. The net income will be on the order of $b.4,525 and the net worth of the farm unit approximately $b.90,550, still below the project model farm in its tenth year.

The project model would have no barbecho and would have between 30 and 40 hectares of the 50 hectares remaining in forest.

Details of the Project Farming System Model

9. The proposed agricultural production system begins with a new colono clearing one hectare of woodland by hand for the first crop year, which is the same start-up as in the traditional system. Several innovations are introduced, some beginning in the first year, others are introduced in succeeding years.

10. In the first year, the concept of intercropping and multiple cropping is introduced. The traditional crops are planted in overlapping sequences such that three crops are usually planted on the same land during one annual cropping cycle. The density of the crop plants are also increased, the usual practice is to plant crops widely spaced, providing only about half the plant population that the soil and water conditions of the area could support. A higher plant density should provide a higher yield and better ground cover. One of the principal objectives of constant cropping is weed control. Maintaining a constant cover over the soil is an effective way of reducing weed growth through shading. This system also provides for spreading the labor requirements over the annual cycle, and higher

income can be expected from two to three crops during the year compared to one, or one and one half crops a year in the traditional model.

11. In the second year, a similar sequence of crops is planted without allowing the usual between-seasons weed growth.

12. At the third year, usually the last year crop production, before abandoning the land to barbecho, primarily because weed growth has become unmanageable under the traditional system, a first crop of maize is planted with an interplanted forage legume. The legume will provide complete ground cover by the time the maize is mature. The legume cover is maintained for two years, during which time there will be little weed growth and small stumps and roots will rot to a large extent. Three other purposes are served by the legume cover: (1) soil protection; (2) improvement in soil fertility by nitrogen fixation; and (3) forage produced for livestock. Several legume species could be used, including Peuria spp. kudzu, Dolichus spp. lablab, Glycine spp. forage type soyabean, Stizolobium spp. velvet bean, and Centrosema spp. In experiments by CIAT, a number of these species have shown much promise for use as cover as well as for pasture and/or forage.

13. Fruit trees and family gardens will be planted, beginning on a small scale for subsistence and increasing over time to provide marketable quantities. Livestock enterprises will also begin. The

livestock enterprise will be integrated into the system in balance with the availability of leguminous pasture and feed grains.

14. Additions to farm infrastructure and equipment begins in the first year and is gradually built up over time. Grain drying patios and barns; threshers for grain and seed legumes; and animal-drawn carts for transportation are the first elements of infrastructure and equipment to be provided. These elements are designed to decrease demand for labor at harvest time, the most critical period in terms of demand for labor, and thus more readily accomodate the labor requirement of multiple cropping and diversification into intensive livestock production. The grain storage and drying facilities will permit more advantageous marketing and reduce post harvest losses estimated to amount to about 25%.

15. Generally, in the traditional system there are no farm improvements except for land clearing and planting of fruit and gardens during the first one to three years.

16. Investment in animals also begings the first year with the purchase of poultry and swine. The cattle enterprise enters the model when the legume pastures have been established, which is the fourth year. With the addition of the livestock enterprises, additional farm investments are required in fencing, water supply, etc.

17. After the first cleared land has been in crops for 3 years and 2 years of legume pasture, it is cleared and destumped. At this

stage, a light to medium size tractor with root take should clear the land at a relatively low cost with a minimal damage to the soil. Once cleared, plowing and cultivation with animal-drawn equipment can begin. It is assumed that the first stage in mechanization will be by animal-drawn implements; however motorized mechanization could rapidly replace animal traction. With the introduction of animal traction, the area planted to annual crops increases to 6 hectares by the tenth year.

18. The production model is neither stereotype nor static. There is ample opportunity for variation from farm to farm as conditions warrant. Moreover, it is an evolving model, which moves the farmer from the traditional slash-and-burn system through several stages of increasing complexity to a highly integrated, diversified farming system. The rate of evolution is also flexible.

19. Table 9 summarizes the evolution of land use, gross income, costs, amortization and interest on capital, interest on production loans, net income and net worth of the typical farm model over a ten-year period. This is a composite of five models including several crops, livestock, vegetable crops and tree crops. It assumes a cross section of investment in infrastructure, equipment, animals, land destumping, perennial crops plantings as well as a cross section of use of production credit.

The Crop Models

20. The details on the five crop models are given in tables 1 through 8. Tables 1 and 3 illustrate five crop sequences with hand cultivation and two sequences with animal traction. These show the costs distributed between labor and inputs and the expected gross income from each crop. Tables 4 through 8 provide the details from which the labor and input costs were developed.

The Mixed Livestock Models

21. The mixed livestock models involve poultry, swine, and cattle. These are integrated into the crops models in accordance with the following pattern:

22. The poultry element consits of 10 laying hens and a rooster. The estimated value of annual production is $b.2,400 and costs are $b.1,200, consisting entirely of maize produced on farm.

23. The swine production model consists of one breeding sow producing two litters of six pigs a year, fattened to one hundred kilograms each and sold for a gross value of $b.24,000 per year. The colono starts off with the purchase of a 20 kilogram weanling gilt of improved breeding stock, a part ownership in a weanling boar, plus four 20 kilograms feeder pigs to fatten in the first year. After the first year feeder pigs would be produced on the farm. A simplified list of assumptions follows:

Swine Production Assumptions

Investments

(First year only) 1 20 kilogram gilt for breeding	$b.	800.00
1/8 part 20 kilogram boar for breeding		100.00
	$b.	900.00

Inputs

(First year only) Feeder pigs (20 kg) each	$b.	6[illegible].00
Variable costs per pig fattened+		
Veterinary costs	$b.	60.00
Marketing costs		30.00
Feed costs		690.00

(+Maintenance of sow and boar included)

Labor Costs	3/4 hr/day/sow unit + $b.1,650/year
Sale Value	100 kilograms market hog at $b.20/kg. = $b.2,000 per head

Assume 6 pigs fattened per litter, 2 litters per year.

1/3 hectare legume pasture per sow unit.

Fencing and equipment included in overall livestock enterprise budget. Table 11.

24. The operating budget for the swine operation, based upon these assumptions is found in Table 10. From the third year on the production is stable at 12 pigs per year; $b.24,000 sales, $b.9,360 inputs and $b.1,650 labor.

25. The cattle operation starts in the first year with the purchase of a Brown Swiss/Criollo crossbred heiffer calf and a stocker calf for fattening. Another stocker is purchased in the second year.

The first steer is sold at the end of the second year, the second in the third year. The heiffer matures, drops a calf and begins milking in the middle of the third year. By the tenth year the herd consists of 4 milking cows, 3 calves and 3 steers. Aside from the stocker calves purchased for the first two years, four steers are sold from the herd's production in the first 10 years. The assumptio ns of the cattle operation are:

- 1 Hectare legume pasture for each cow unit (cow, yearling and calf)
- Inputs (once established) per cow unit per year:

Breeding	$b. 100
Veterinary supplies	300
Feed supplements	200
	$b. 600/year

- Labor: 1/2 hour per day per cow unit
- Investments: Heiffer calf $b.2,700
- Infrastructure

Year 1:	Fencing: $b.3,200,	Equipment: $b.1,500	
Year 2:	" 2,400	" $b.500 stockwell 7,000	
Year 3:	" 2,400	" 500	
Year 4:	" 2,400	"	
Year 5:	" 2,400	Corral and Milk Sheds: $b.2,000	
Year 6, 7, 8	" 500		
Year 9:	" 1,400	Equipment: $b.1,000	
Year 10:	" 1,000		

- Calving rate: 80%
- Calving mortality: Assume 3 die during 10 year model

Income: 5 liters milk/day 270 days. 300 liters for calf. At $b.3/liter, sales of $b.3,150 per cow unit per year. (Or home consumption).

Steers sold at 2 years, 400 kilograms at $b.18/kg. = $b.7,200.

Value of animals

1/2 blood cow	$b. 6,500
Yearling	5,400
Calf (3 months)	2,700

The following budget is based upon these assumptions and is the basis for the budget in Table 11:

Cattle Budget
($b.)

Year	Animals Cows	Calves	Steers	Input Costs	Labor Costs	Value of Animals	Sales
1	-	2+	-	200	550	5,400	
2	-	1+	1	300	550	6,500	7,200++
3	1	1	-	600	1,100	9,200	8,780++
4	1	1	1	800	1,100	14,600	3,160
5	1	-	1	800	1,100	11,900	10,360++
6	2	2	-	1,200	1,650	18,400	6,320
7	2	1	2	1,200	1,650	26,500	6,320
8	3	2	1	1,200	2,200	30,300	16,690++
9	3	3	2	1,800	2,200	38,400	16,680++
10	4	3	3	1,800	2,750	50,300	19,840++

+ Includes two purchased for fattening.
++ Steer sold in that year.

The poultry, swine, and cattle enterprises just described were combined to produce the mixed livestock enterprise presented in Tables 10 and 11.

26. It should be noted that no production credit for procurement of animals is assumed after the first year, when a farmer would need it for purchasing feeder pigs and a beef calf. Beyond that year, 90% of input costs are grains and legume pasture produced on farm. The labor is largely family labor.

27. The livestock enterprise model follows the overall project objectives in that it is gradual, diversified, land-intensive,

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complimentary to the other farm activities and self-capitalizing. Although the model is built around one such unit per farmer, it is expected that the profitability of livestock and the predisposition of some farmers toward this kind of enterprise will lead many to specialize in animal production. Under an intensive system of management such as described here, it is an appropriate use of the available resources.

C. General Farm Infrastructure

28. Facilities for grain drying and storage are among the first elements of infrastructure to be added. On-farm storage consisting of simple construction from local materials, plus wire mesh and nails, is provided for each farm unit, rather than larger commercial structures, which would require sophisticated management. The structures are accompanied by concrete patios for drying. It is assumed that 25% of the farmers will adopt the storage and drying package during the first year and 25% each succeeding year until all units will have these facilities.

29. Animal-drawn transporation (oxen or horses and cart) are introduced during the first year. It is assumed that initially, given the compactness of the núcleo settlements, each animal transportation unit will serve eight farm units. Later, this will increase to one unit for four farm units. Finally, with the introduction of animal traction for cultivation, the transporattion units will merge with the work units.

30. Mechanical threshers are introduced at an early stage as a means of reducing labor demand at harvest. It is assumed that threshing units, which will be able to thresh the production from 30 hectares of grain and/or legume seed crops, will be acquired by individuals, groups of individuals or copperatives for custom threshing. The cost of threshing is calculated as an input cost rather than as a capital cost since the individual farm unit is expected to pay for threshing on a unit cost basis.

31. Animal traction for cultivation is introduced only after the land has been destumped. For the newly settled colono, this will be in the sixth year, following 3 years of cropping and 2 years of legume/forage cover. For established colonos, the use of animal traction for cultivation could begin in the third year. The model does not assume mechanical clearing of forest as the first step for reasons given earlier.

32. The model assumes the availability of credit. A description of the credit delivery system and modalities for extending credit are given in ANNEX 10.

33. Tables 12, 13 and 14 provide the assumptions as to costs and expected amortization schedules for investments in infrastructure.

34. Table 15 provides the capital budget for the typical project farm model.

35. Table 16 provides the assumed rate of adoption of the several project elements.

D. The Traditional Farm Model

36. To provide a basis for comparison and calculation of benefits of the project a traditional farm model has been developed, Table 17. This model represents an archetypal San Julian parcel as it develops from the first year of settlement through the twenty-second year.[1]

The model summarizes the evolution of the colony's agriculture over time in an average parcel, including all the activities which exist or will exist in the proportions predicted. It is the basis for the benefit: cost analyses in Chapter VIII.

37. The model assumes continuation of the marketing constraint imposed by the difficulties and high cost of transportation due to the unsatisfactory state of the Rio Grande crossing, that there will be little or no increase in technical advisory services to the farmer or in credit availabilities, that the slash-and-burn cultivation

1. Based on Harry Wing's recent survey in the zone, conversations with knowledgeable persons, the 1978 USAID Evaluation Reports, descriptions of the changes over time experienced in the older colonies of Yapacaní and Chané-Pirai, and the work done by Simon Maxwell and Melvin Pozo at CIAT in Santa Cruz.

barbecho cycle will prevail, and that the family labor will provide most of the labor input.

38. Beginning with one hectare of land cleared and utilized the first year, the area increases gradually over time. A maximum of 3 hectares of annual crops plus an increasing area in perennial and garden crops to about 0.3 hectares and an increasing area in pasture up to 8.7 hectares in the tenth year is assumed.

39. The model assumes that rice (usually planted the first year after clearing) and maize (planted for two successive years after rice) will continue to be the principal annual crops produced. The remaining cultivated land is devoted to perennial fruit crops and annual garden crops. It is assumed that after three years of cropping, the land will return to barbecho and remain as such for 4 to five years before being cleared again for cropping. The amount of land devoted to pasture increases as cattle become increasingly important part of the farm business. Table 16 provides the essential elements of the model. Income and cost calculations are based on the following assumptions:

Income

Maize	Yield of 45 qq/ha. valued at $b.75/pp.
Rice	Yield of 18 fanegas/ha. valued at $b.600/fanega
Other crops	Estimated value of sale of miscellaneous fruit and vegetables from the family garden
Livestock	During the first four years only poultry and swine products are considered. The value of these are assumed to increase gradually to attain $b.1,000 by year 5. Income from cattle is assumed to begin in the fifth year.

Production costs

	Inputs	Labor
Maize	$b.1,325/ha.	$b.2,200/ha.
Rice	1,595/ha.	2,400/ha.
Land clearing		1,250/ha.
Livestock		
Dooryard - 20% of gross sales		
Commercials - 60% of gross sales		11% of gross sales
Labor is calculated at $b.50 per day.		

The income column in Table 17 reflects net cash income. The proportion of family labor provided--this would be almost 100% during the first 5 years--would increase the family income accordingly.

The final column of Table 17 gives net worth values by years. In arriving at these values, no debt was assumed and no value was ascribed to land. Improvements were valued as follows: newly cleared land (chaqueo) $b.1,250/ha.; second year $b.1,000/ha.; third year $b.500/ha.; land in the "other" category $b.10,000/ha.; pasture (fenced) $b.4,000/ha.; and livestock at 4 times gross commercial sales.

TABLE : SUMMARY PROJECT CROP BUDGETS

RICE-MAIZE-SOYA (1st. YEAR CHAQUEO
(1 Hectare)

MODEL	COMMODITY	COSTS $b.		INCOME $b.		
		INPUT COSTS	LABOR COSTS	YIELDS	PRICE	GROSS
A	Rice	2,050	2,650	12 Fanegas	650/Fanegas	7,800
First Year	Maize	550	350	20 qq	90/qq	1,800
Slash and	Soy	1,000	1,650	15 qq	200/qq	3,000
Burn	TOTAL	3,600	4,650	-	-	12,600

MAIZE-BEANS-WHEAT (2nd. YEAR CHAQUEO)

(1 Hectare)

MODEL	COMMODITY	COSTS $b.		INCOME $b.		
		INPUT COSTS	LABOR COSTS	YIELDS	PRICE	GROSS
B	Maize	1,650	1,700	60 qq	90/qq	5,400
Second Year	Beans	975	1,200	25 qq	250/qq	6,250
Slash and	Wheat	1,300	1,400	15 qq	190/qq	2,850
Burn	TOTAL	3,925	4,300	-	-	14,500

TABLE : SUMMARY PROJECT CROP BUDGETS

MAIZE-PEANUTS-WHEAT
ANIMAL TRACTION
(1 Hectare)

MODEL	COMMODITY	COSTS $b.		INCOME $b.		
		INPUT COSTS	LABOR COSTS	YIELDS	PRICE	GROSS
D	Maize	1,325	825	65 qq	90/qq	5,850
Animal	Peanuts	1,980	1,200	1,500 Kg.	5.7 Kg.	8,550
Traction	Wheat	1,200	800	15 qq	190/qq	2,850
	TOTAL	4,505	2,825	-	-	17,250

MAIZE-BEANS-SOYA
ANIMAL TRACTION
(1 Hectare)

MODEL	COMMODITY	COSTS $b.		INCOME $b.		
		INPUT COSTS	LABOR COSTS	YIELDS	PRICE	GROSS
E	Maize	1,325	825	65 qq	90/qq	5,850
Animal	Beans	975	1,000	25 qq	250/qq	6,250
Traction	Soya	900	750	15 qq	200/qq	3,000
	TOTAL	3,200	2,575	-	-	15,100

TABLE : SUMMARY PROJECT CROP BUDGETS

CORN-LEGUME
(3rd. YEAR TO FALLOW)
(1 Hectare)

MODEL	COMMODITY	COSTS $b.		INCOME $b.		INCOME $b.
		INPUT COSTS	LABOR COSTS	YIELDS	PRICE	GROSS
C	Maize	1,650	1,700	60 qq	90/qq	5,400
Third Year	Legume	500	150	-	-	-
Slash and						
Burn	TOTAL	2,150	1,850			

LABOR AND INPUT COSTS PER HECTARE-CROP MODEL A

RICE/MAIZE/SOYA FIRST YEAR SLASH AND BURN

I T E M	LABOR COSTS			(1) TOTAL LABOR COST	INPUT COSTS			TOTAL INPUT COSTS
	RICE	MAIZE	SOYA		RICE	MAIZE	SOYA	
Slash and Burn	25			1,250				1,250
Cleaning	4		12	800				800
Seed	1			50	300	25	300	675
Sowing	2	1	2	250				250
Herbicides					200			200
Herbicides	2			100				100
Weeding	5		8	650				650
Insecticides					250			250
Insecticide	2			100				100
Harvest	5	4	5	700				700
Threshing	5	1	4	500	400	100	200	1,200
Selling	2	1	2	250	100	50	100	500
Transportation					700	300	300	1,300
Fixed Costs					100	75	100	275
Variable Costs								
Other								
T O T A L S	53	7	33	4,650	2,050	550	1,000	8,250

(1) Labor Cost at $b. 50 per day

LABOR AND INPUT COSTS PER HECTARE-CROP MODEL B

MAIZE/BEANS/WHEAT SECOND YEAR SLASH AND BURN

I T E M	LABOR COSTS			(1) TOTAL LABOR COST	INPUT COSTS			TOTAL INPUT COSTS
	RICE	MAIZE	SOYA		RICE	MAIZE	SOYA	
Slash and Burn	12		8	1,000				1,000
Cleaning					50	300	300	650
Seed	1	1	2	200				200
Sowing					200			200
Herbicides	2			100				100
Herbicides	5	6	5	800				800
Weeding							300	300
Insecticides			4	200				200
Insecticide	10	5	5	1,000				1,000
Harvest	2	10	2	700	300	100	200	1,300
Threshing	2	2	2	300	100	100	100	600
Selling					900	375	300	1.575
Transportation					100	100	100	300
Fixed Costs								
Variable Costs								
T O T A L S	34	24	28	4,300	1,650	975	1,300	8,225

(1) Labor Cost at $b. 50 per day

LABOR AND INPUT COSTS PER HECTARE-CROP MODEL C

MAIZE/LEGUME FORAGE THIRD YEAR SLASH AND BURN

ITEM	LABOR COSTS		(1) TOTAL LABOR COSTS	INPUT COSTS		TOTAL INPUT COSTS
	MAIZE	LEGUME		MAIZE	LEGUME	
Slash and Burn	12		600			600
Cleaning				50	500	550
Seed	1	3	200			200
Sowing				200		200
Herbicides	2		100			100
Herbicides	5		250			250
Weeding						
Insecticides						
Harvest	10		500			500
Threshing	2		100	300		400
Selling	2		100	100		200
Transportation				900		900
Fixed Costs				100		100
Variable Costs						
TOTALS	34	3	1,850	1,650	500	4,000

(1) Labor Cost at $b. 50 per day

ANNEX 9
Table 7

LABOR AND INPUT COSTS PER HECTARE-CROP MODEL D

MAIZE/PEANUTS/WHEAT WITH ANIMAL TRACTION

ITEM	LABOR COSTS			(1) TOTAL LABOR COST	INPUT COSTS			TOTAL INPUT COSTS
	MAIZE	PEANUTS	WHEAT		MAIZE	PEANUTS	WHEAT	
Plowing	1 1/2			75				75
Disking	2		2	200				200
Seed					25	930	300	1,255
Sowing	1	3	1	250				250
Weeding	2	8		500				500
Insecticides						200	300	500
Insecticide		2	4	300				300
Harvest	6	5	5	800				800
Threshing	2	4	2	400	300	400	200	1,300
Selling	2	2	2	300	100	100	100	600
Transportation					900	350	300	1,550
Fixed Costs					800	320	480	1,600
Variable Costs					200	200	200	600
TOTALS	16 1/2	24	16	2,825	2,325	2,500	1,880	9,530

(1) Labor Cost at $b. 50 per day

LABOR AND INPUT COSTS PER HECTARE-CROP MODEL E

MAIZE/BEANS/SOYA WITH ANIMAL TRACTION

I T E M	LABOR COSTS			(1) TOTAL LABOR COST	INPUT COSTS			TOTAL INPUT COSTS
	MAIZE	BEANS	SOYA		MAIZE	BEANS	SOYA	
Plowing	1 1/2			75				75
Disking	2		2	200				200
Seed					25	300	300	625
Sowing	1	3	1	250				250
Weeding	2	6	1	450				450
Insecticides								
Insecticide								
Harvest	6	5	5	800				800
Threshing	2	4	4	500	300	200	200	1,200
Selling	2	2	2	300	100	100	100	600
Transportation					900	375	300	1,575
Fixed Costs					800	160	640	1,600
Variable Costs					200	200	200	600
T O T A L S	16 1/2	20	15	2,575	2,325	1,335	1,740	7,975

(1) Labor Cost at $b. 50 per day

ANNEX 9
Table 9

SUMMARY ACCOUNT FOR PROJECT FARM MODEL (1)

YEAR	LAND USE (IN HECTARES)									GROSS INCOME $b.				COSTS $b.					
	ANNUALS																		
	RICE/MAIZE AND SOYA (A)	MAIZE/BEANS WHEAT (B)	MAIZE LEGUME (C)	ANIMAL TRACTION (D&E)	TOTAL	PERMANENT	LEGUME PASTURE	TOTAL CLEARED	TOTAL STUMPED	GRAINS AND BEANS	OTHER PRODUCTS	LIVESTOCK AND PRODUCTS	TOTAL SALES	INPUT COSTS	LABOR COSTS	INTEREST AND AMORTIZATION OF INVESTMENT	PRODUCTION CREDIT INTEREST	NET INCOME	NET WORTH
1	0.9	-	-	-	0.9	0.1	-	1.0	-	11,340	150	1,200	12,695	5,256	5,275	3,970	816	- 2,622	2,304
2	1.0	0.9	-	-	1.9	0.1	-	2.0	-	25,650	300	2,400	28,350	8,544	8,910	4,509	1,176	5,211	6,093
3	1.0	1.0	0.9	-	2.9	0.1	-	3.0	-	31,960	450	2,400	34,810	10,477	10,915	4,086	1,521	7,811	10,549
4	1.0	1.0	1.0	-	3.0	0.1	0.9	4.0	-	32,500	2,450	10,400	45,350	20,617	12,980	7,049	2,542	2,162	20,444
5	1.0	1.0	1.0	-	3.0	0.2	1.8	5.0	-	32,500	3,600	21,600	57,700	24,227	14,514	10,091	1,840	7,028	29,590
6	1.0	1.0	1.0	0.6	3.6	0.4	2.0	6.0	1.0	41,560	5,080	35,180	81,820	30,797	18,725	18,972	2,845	10,481	42,508
7	1.0	1.0	1.0	1.4	3.4	0.6	2.0	7.0	2.0	56,650	5,080	29,560	91,290	35,484	21,635	16,902	3,605	13,664	65,915
8	1.0	1.0	1.0	2.2	5.2	0.8	2.0	8.0	3.0	65,720	6,930	36,760	109,410	36,467	24,445	16,840	3,629	28,029	86,504
9	1.0	1.0	1.0	2.0	5.0	1.0	3.0	9.0	4.0	67,000	11,780	32,720	111,500	39,737	26,814	14,341	4,140	26,468	113,672
10	1.0	1.0	1.0	3.0	6.0	1.0	3.0	10.0	5.0	74,800	18,660	32,720	126,180	38,057	29,173	10,928	3,614	44,408	142,380

(1) Assumes a new settler established in year 1, adopting all elements of the model

ANNEX 9
Table 9

ANNEX 9
Table 10

MIXED LIVESTOCK ENTERPRISE : SUMMARY ACCOUNT

YEAR (1)	VARIABLE INPUT COSTS				AMORTIZATION AND INTEREST	LABOR COSTS			TOTAL COSTS	GROSS INCOME (SALES)			NET INCOME	LAND REQUIREMENTS
	POULTRY	SWINE	CATTLE	TOTAL		CATTLE	SWINE	TOTAL		PRODUCTS	ANIMALS	TOTAL		
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
[illegible]	1,200	5,520	3,100	9,820	3,385	550	700	1,250	14,455	2,400	8,000	10,400		1.0
[illegible]	1,200	[illegible]	3,400	9,280	6,850	550	1,100	1,650	17,780	2,400	19,200	21,600	3,820	2.0
3	1,200	9,360	700	11,260	7,247	1,100	1,650	2,750	21,257	3,980	31,200	35,180	13,923	2.0
4	1,200	9,360	800	11,360	6,182	1,100	1,650	2,750	20,292	5,560	24,000	29,560	9,268	2.0
5	1,200	9,360	800	11,360	7,125	1,100	1,650	2,750	21,235	5,560	31,200	36,760	15,525	2.0
6	1,200	9,360	1,200	11,760	5,631	1,650	1,650	3,300	20,691	8,720	24,000	32,720	12,029	3.0
7	1,200	9,360	1,200	11,760	3,223	1,650	1,650	3,300	18,283	8,720	24,000	32,720	14,437	3.0
8	1,200	9,360	1,500	12,060	2,497	2,200	1,650	3,850	18,407	11,880	31,200	43,080	24,673	4.0
9	1,200	9,360	1,500	12,060	2,608	2,200	1,650	3,850	18,518	11,880	31,200	43,080	24,562	4.0
10	1,200	9,360	1,500	12,060	1,829	2,750	1,650	4,400	18,289	15,040	31,200	46,240	27,951	5.0

(1) Cattle enterprise begins in the 4th. year

ANNEX 9
Table 10

ANNEX 9
Table 11

MIXED LIVESTOCK ENTERPRISE . - INVESTMENT AND CAPITAL ACCOUNT

YEAR (1)	INVESTMENTS			CAPITAL COSTS			CAPITALIZATION				
	ANIMALS						VALUE OF CAPITAL STOCK				
	CATTLE	SWINE (2)	LIVESTOCK INFRASTRUCTURE (3)	AMORTIZATION PAYMENTS (4)	OUTSTANDING DEBT (5)	INTEREST PAYMENTS (6)	CATTLE (7)	SWINE (8)	INFRASTRUCTURE (9)	TOTAL (10)	NET WORTH (11)
1	2,700	900	4,700	2,140	8,300	1,245	5,400	2,640	4,700	12,740	4,440
2			9,900	4,120	18,200	2,730	6,500	3,120	14,600	24,220	6,020
3			2,900	4,700	16,980	2,547	9,200	3,120	17,500	29,820	12,840
4			2,400	3,980	14,680	2,202	14,600	3,120	19,900	37,620	22,940
5			4,400	4,860	15,100	2,265	11,900	3,120	24,300	39,320	24,220
6			500	4,020	10,740	1,611	18,400	3,120	24,800	46,320	35,580
7			500	2.140	7,220	1,083	26,500	3,120	25,300	54,920	47,700
8			500	1,660	5,580	837	30,300	3,120	25,800	59,220	53,640
9			2,400	1,660	6,320	948	38,400	3,120	28,200	69,720	63,400
10			1,000	980	5,660	849	50,300	3,120	29,200	82,620	76,960
TOTAL	2,700	900	32,800	30,260	2,540	16,317					

(1) Cattle enterprice begins in the 4th. year.

ANNEX 9
Table 11

10-YEAR CAPITAL BUDGET FOR ANIMAL TRACTION TEAM (2 HORSES) AND EQUIPMENT

YEAR	PRINCIPAL OUTSTANDING (1)	AMORTIZATION PAYMENTS (2)	INTEREST PAYMENTS (3)	TOTAL PAYMENTS (4)	SALVAGE VALUE (5)
1	33,500	6,700	5,025	11,725	30,108
2	26,800	6,700	4,020	10,720	26,715
3	20,100	6,700	3,015	9,715	23,324
4	13,400	6,700	2,010	8,710	19,932
5	6,700	6,700	1,005	7,705	16,540
6	4,500	900	675	1,575	17,648
7	3,600	900	540	1,440	14,256
8	14,000	3,200	2,100	5,300	22,364
9	10,800	3,200	1,620	4,820	18,972
10	7,600	3,200	1,140	4,340	15,580

(1) See GRABER " Creditos de Capitalización: Una Alternativa al Sistema Tradicional" Santa Cruz, 1.978. Cuadro 5. (Harness depr. 5 years)

(2) 5-Year payback period.

(3) 15% interest

(4) Cols. (2) + (3)

(5) See Graber for depreciation rates.

Table 13

10-YEAR CAPITAL BUDGET

ANIMAL TRANSPORT ; 2 HORSES AND WAGON

YEAR	PRINCIPAL OUTSTANDING (1)	AMORTIZATION PAYMENTS (2)	INTEREST PAYMENTS (3)	TOTAL PAYMENTS (4)	CAPITAL VALUE (5)
1	22,000	4,400	3,300	7,700	19,550
2	17,600	4,400	2,640	7,040	17,100
3	13,200	4,400	1,980	6,380	14,650
4	8,800	4,400	1,320	5,720	12,200
5	4,400	4,400	660	5,060	12,750
6	3,000	600	450	1,050	10,300
7	2,400	600	360	960	7,850
8	8,800	2,000	1,320	3,320	12,400
9	6,800	2,000	1,020	3,020	9,950
10	4,800	2,000	720	2,720	7,500

(1) See Graber "Creditos de Capitalizacion : Una Alternativa al Sistema Tradicional" Santa Cruz, 1970, Cuadro 5 for Cost and Depreciation Estimates. Harness Depreciation Charged to 5 Years.

(2) 5-year amortization

(3) 15% interest

(4) Cols. (2) + (3)

(5) Salvage value in given year.

GRAIN STORAGE STRUCTURE AND DRYING PATIO

Table 14

YEAR	PRINCIPAL OUTSTANDING (1)	AMORTIZATION PAYMENTS (2)	INTEREST PAYMENTS (3)	TOTAL PAYMENTS (4)	CAPITAL VALUE (5)
1	8,590	1,718	1,289	3,007	8,590
2	6,872	1,718	1,031	2,749	8,590
3	5,154	1,718	773	2,491	8,590
4	3,436	1,718	516	2,234	8,590
5	1,718	1,718	258	1,976	8,590

(1) Granery Budget (8' x 10' x 8' Structure)

a) Construction Lumber

735 bd. ft. at $b. 3.50/bd. ft. $b. 2,570

b) Corrugated Roofing

12 sheets at $b.150 each $b. 1,800

c) Nails; 15 kilos at $b.10/kilo $b. 150

d) Hardware Cloth 44 m2. at $b. 30/m2. $b. 1,320

e) Labor; 7 days at $b. 50/day $b. 350

$b. 6,190

Drying Patio

a) 12 m2. of concret brick flooring at $b.200/m2. $b. 2,400

(2) 5 year loan amortization

(3) 15% interest rate

(4) Col (2) + Col (3)

(5) With minimum repair and maintenance structure will retain full utility for 20-25 years. For simplicity we have assumed full salvage value.

ANNEX 9
Table 15

CAPITAL BUDGET FOR PROJECT FARM MODEL (1)

Current $b.

YEAR	OUTSTANDING PRINCIPAL				INTEREST AND AMORTIZATION			VALUE OF CAPITAL STOCK						
	GRAIN DRYING AND STORAGE	ANIMAL TRANSPORT AND TRACTION	LIVESTOCK AND INFRASTRUCTURE	TOTAL DEBT	AMORTIZATION PAYMENTS	INTEREST PAYMENTS	TOTAL PAYMENTS	LIVESTOCK	FRUIT TREES	ANIMAL TRANSPORT AND TRACTION	INFRASTRUCTURE	LAND IMPROVEMENTS	TOTAL CAPITAL STOCK	NET WORTH
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	8,590	2,750	-	11,340	2,268	1,702	3,970	-	1,360	2,444	8,590	1,250	13,644	2,304
2	6,872	4,400	-	11,272	2,818	1,691	4,509	-	2,000	4,275	8,590	2,500	17,365	6,093
3	5,154	3,300	-	8,454	2,818	1,268	4,086	-	3,000	3,663	8,590	3,750	19,003	10,549
4	3,436	2,200	8,300	13,936	4,958	2,091	7,049	8,040	4,000	3,050	13,290	6,000	34,380	20,444
5	1,718	1,100	18,200	21,018	6,938	3,153	10,091	9,620	6,360	3,188	23,190	8,250	50,608	29,590
6	-	33,500	16,980	50,480	11,400	7,572	18,972	12,320	10,720	30,108	26,090	13,750	92,988	42,508
7	-	26,800	14,680	41,480	10,680	6,222	16,902	17,720	15,720	26,715	28,490	18,750	107,395	65,915
8	-	20,100	15,100	35,200	11,560	5,280	16,840	15,020	22,720	23,324	32,890	27,750	121,704	86,504
9	-	13,400	10,740	24,140	10,720	3,621	14,341	21,520	31,720	19,932	33,390	31,250	137,812	113,672
10	-	6,700	7,220	13,920	8,840	2,088	10,928	29,620	40,000	16,540	33,890	36,250	156,300	142,380

(1) Assume a new settler established in year 1 and adopting all elements of the model.

ANNEX 9
Table 15

ANNEX 9
Table 16

TRADITIONAL FARM MODEL

YEAR	LAND USE (IN HECTARES)								GROSS INCOME					PRODUCTION COSTS			
	ANNUAL CROPS																
	MAIZE	RICE	TOTAL	OTHERS	PASTURE	BARBECHO	TOTAL CLEARED	NEW CLEARED	MAIZE	RICE	OTHERS	LIVESTOCK	TOTAL SALES	INPUTS	LABOR	NET INCOME	NET WORTH
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	a (18)
1	0.4	0.6	1.0	-	-	-	1.0	1.0	1,350	3,600	150	100	5,200	1,563	3,615	22	1,250
2	1.0	1.0	2.0	-	-	-	2.0	1.0	3,375	6,000	300	300	9,975	3,091	6,040	844	2,250
3	2.0	1.0	3.0	-	-	-	3.0	1.0	6,750	6,000	450	550	13,750	4,522	8,185	1,043	2,750
4	2.0	1.0	3.0	0.1	0.3	0.7	4.1	1.1	6,750	6,000	600	800	14,150	4,627	8,355	1,168	4,910
5	2.0	1.0	3.0	0.1	0.7	1.6	5.4	1.3	6,750	6,000	800	1,100	14,650	4,807	8,676	1,167	7,950
6	2.0	1.0	3.0	0.2	1.0	2.5	6.7	1.3	6,750	6,000	1,000	1,500	15,250	5,145	8,780	1,325	11,750
7	2.0	1.0	3.0	0.2	1.4	3.6	8.0	1.3	6,750	6,000	1,250	2,000	16,000	5,568	9,035	1,397	15,350
8	2.0	1.0	3.0	0.2	1.8	4.5	9.3	1.3	6,750	6,000	1,500	2,500	16,750	5,990	9,165	1,595	18,950
9	2.0	1.0	3.0	0.3	2.1	5.9	10.6	1.3	6,750	6,000	1,800	3,000	17,550	6,431	9,185	1,934	23,150
10	2.0	1.0	3.0	0.3	2.5	6.2	11.9	1.3	6,750	6,000	2,100	3,500	18,350	6,872	9,330	2,148	26,750
11	2.0	1.0	3.0	0.3	2.9	7.2	13.3	1.4	6,750	6,000	2,400	4,000	19,150	7,313	9,600	2,237	30,350
12	2.0	1.0	3.0	0.3	3.2	8.3	14.7	1.4	6,750	6,000	2,700	4,500	19,950	7,754	9,745	2,451	33,550
13	2.0	1.0	3.0	0.3	3.4	9.4	16.1	1.4	6,750	6,000	3,000	5,000	20,750	8,195	9,890	2,665	36,350
14	2.0	1.0	3.0	0.4	3.7	10.5	17.6	1.5	6,750	6,000	3,300	5,500	21,550	8,636	10,160	2,754	40,550
15	2.0	1.0	3.0	0.4	4.1	11.6	19.1	1.5	6,750	6,000	3,600	6,000	22,350	9,077	10.305	2,968	44,150
16	2.0	1.0	3.0	0.4	4.5	12.7	20.6	1.5	6,750	6,000	3,900	6,500	23,150	9,518	10,450	3,182	47,750
17	2.0	1.0	3.0	0.4	4.9	13.9	22.2	1.6	6,750	6,000	4,200	7,250	24,200	10,124	10,748	3,328	52,350
18	2.0	1.0	3.0	0.4	5.5	15.0	23.9	1.7	6,750	6,000	4,500	8,000	25,250	10,730	11,045	3,475	57,750
19	2.0	1.0	3.0	0.4	6.2	16.1	25.7	1.8	6,750	6,000	4,800	9,000	26,550	11,611	11,370	3,569	64,550
20	2.0	1.0	3.0	0.4	6.8	17.4	27.6	1.9	6,750	6,000	5,100	10,250	28,100	12,437	11,723	3,940	71,950
21	2.0	1.0	3.0	0.4	7.8	18.4	29.6	2.0	6,750	6,000	5,400	11,500	29,650	13,373	12,075	4,202	80,950
22	2.0	1.0	3.0	0.4	8.7	19.6	31.7	2.1	6,750	6,000	5,700	13,000	31,450	14,474	12,455	4,521	90,550

All economic data in constant Bolivian Pesos.
a [illegible] for [illegible] discu[illegible]ion an[illegible] [illegible]tions

ANNEX 9
Table 16

ANNEX 9
Table 17

RATES OF ADOPTION OF LIVESTOCK AND CROP ACTIVITIES UNDER THE PROJECT

PROJECT YEAR	GRAIN STORAGE UNITS/YEAR	ANIMAL TRANSPORT UNITS/YEAR	ANIMAL TRACTION UNITS/YEAR	THRESHING MACHINES UNITS/YEAR	LIVESTOCK ENTERPRICES UNITS/YEAR	LIVESTOCK ENTERPRICES CUMULATIVE	STUMPING HAS/YEAR	CROP PLAN A HAS/YEAR	CROP PLAN B HAS/YEAR	CROP PLAN C HAS/YEAR	CROP PLAN D HAS/YEAR	CROP PLAN E HAS/YEAR	FRUIT TREES HAS/YEAR
1	780	55	-	20	120	120	-	300	300	185	-	-	240
2	790	85	-	24	185	305	-	660	660	425	-	-	480
3	790	85	30	42	240	545	140	1,145	1,145	1,030	140	-	720
4	790	55	25	40	425	970	130	1,445	1,445	1,695	135	135	720
5	-	-	85	35	360	1,330	275	1,690	1,690	2,180	275	270	720
6	-	-	280	30	360	1,690	560	1,870	1,870	2,360	365	504	720
7	-	-	252	25	60	1,750	660	2,050	2,050	2,445	696	509	720
8	-	-	240	20	60	1,810	855	2,170	2,170	2,485	701	1,032	720
9	-	-	-	15	60	1,870	785	2,295	2,295	2,520	1,041	853	720
10	-	-	-	10	60	1,930	750	2,350	2,350	2,545	845	1,608	720

ANNEX 9
Table 17

BOLIVIA

SAN JULIAN COLONIZATION PROJECT FINANCIAL SERVICES

A. Objective

1. The objective of the rural financial services element of the project proposed porject is to provide the capital and other financial services to the project community which is required for achievement of the rate of socio-economic development anticipated in the project design. Due to the order of the requirements of the various financial services, the appropriate lending services are described here. The other services essential to a rural developing community, including savings, investment, financial transfers and insurance, are deferred for development in the course of project implementation.

B. Clients and Uses of Credit

2. The following types of loans are proposed:

a) short-term credit, generally required for the support of farm production inputs.

b) medium to long term loans for farm capital investment, such as the purchase of livestock, machinery and land improvement.

c) capital and operating loans to finance local agri-businesses which provide essential services to the project area settlers

C. Service Delivery System

3. The financial service delivery system requires the establishment of a savings and credit sub-agency in San Julian with enough descentralization for credit decisions, in order to provide a useful and timely service to the farmers and to minimize credit delinquency.

4. A roving credit system is recommended for maximizing effectiveness in reaching the farmers, reducing their non-financial costs of credit and improving compliance with the repayment schedule. All credit operations from filling out loan applications to repayments should be done at the community level.

5. The protfolio should be controlled with as few accounts as possible. Short-term credit for agriculture should be channeled through a line-of-credit and managed as one outstanding balance per

client to reduce cost and to develop confidence on the part of the farmers regarding the availability of funds, provided that they comply with the credit terms.

6. Every new, long-term credit should be blended with the outstanding balance of the previous one to simplify procedures and minimize costs. The repayment schedule would be reviewed with every additional credit.

7. In the case of credit for rural small business, loans for capital equipment and working capital should be carried as a single account.

8. A credit manual should be drafted and adopted by the lending agency, establishing lending policy, elegibility for credit, credit terms, debt service requirements and account management procedures.

9. Loan application forms should be designed to first reveal the elegibility of the applicant. Then they should include questions, the answers to which weighted values can be assigned, the sum of which would be the basic reference point for deciding on the worthiness of the application. Such a scheme would reduce the time

required to process an application and would contribute to consistency in decision-making.

10. The disbursements provided for each crop and for seasonal activities of permanent crops should be for 12 months, and those for long-term uses should have repayment periods of 5-8 years. Loans for working capital for small businesses would have a maximum repayment period of 30 months, and for fixed assets up to seven years.

D. Charges

11. Minimum agricultural and small business loans should be established. Loans below certain amounts are uneconomical because the produce very little income from interest charges. Group lending would be the way to overcome this constraint in loans for agriculture. A higher interest rate should be charged for small loan amounts so as to improve the contribution to fixed cost.

12. Interest rates of 19% for short-term loans and 15% for long-term loans were used in the economic feasibility analysis of agricultural credit. Under the assumptions made, these interest rates were adequate.

13. In addition to the interest rate, there should be a commission charge of between 1/2% and 1% on each disbursement, so that the lender would be reimbursed immediately for the variable cost of processing each application and disbursing the fund.

14. It should be reasonable to start the small business program with an interest rate of 19% for loans below $30,000 and 15% for loans above that amount. Considering that the small-scale entrepreneurs are yet to emerge, it would be reasonable to start a small credit program for them, setting a low minimum loan amount of about $3,000. Such a policy at the beginning would likely allow more small businesses to get started.

15. The minimum amount for short-term loans for agriculture should be about $3,000. This is due to the fact that with an average outstanding balance of about $2,000 at 19% interest, the contribution to fixed costs would be approximately zero.

16. For long-term loans the minimum amount should be calculated according to the repayment period.

E. Credit Requirement

17. Based on the rate of adoption of the farm development models which were estimated in the economic analysis, the credit requirements would be $693,000,000 in the first four years of the project. The fund requirements, net of repayments, would be $566,353,000. The contribution to fixed costs, net of incremental costs, delinquency and interest, would be about 8.6% of the outstanding portfolio at the end of the fourth year.

18. The credit demand for small and medium size business was estimated to be $56,675,000 during the first four years. Credit for agricultural machinery and for two sawmills accounted for 51.9% and 45.6% of the total requirements. The inclusion of sawmills as probable investments assumes that a clarification and some modifications in the forestry policies will be made.

F. Broadening the Scope of Financial Services

19. Considering the almost complete absence of financial management capabilities among the settlers at the present, it is obviously necessary to restrict financial service to the provision of credit by outside institutions. However, strong emphasis should be placed

on developing financial management capabilities among the settlers. It is recommended that they be assisted in developing their own multi-purpose cooperative as rapidly as they can. It should include savings and credit which could in time manage all of the credit required by its members.

BOLIVIA

SAN JULIAN CONSOLIDATION

FINANCIAL AND TECHNICAL ASSISTANCE TO THE
INSTITUTO DE COLONIZACION PLANNING OFFICE

A. Objectives

1. The INC is charged with all aspects of the colonization program--determination of policies, planning and supervision of colonization activities, allocation of areas for spontaneous colonization, orientation of new settlers, granting of titles to land to settlers, restructuring of spontaneous settlements and coordination of activities of other institutions with respect to colonization areas.

2. The effective discharge of many of their responsibilities has been limited by the lack of definition of basic responsibilities of the organization and especially that of defining the limits of its area of competence. Limited resources have also limited its capacity for executing its several functions. Planning has been done usually on a year-to-year basis. One of the consequences of this short-term approach to planning has been a proliferation of spontaneous small farmer settlements as well as acquisition of land in larger blocks by cooperatives and syndicates. The result is a jigsaw pattern of land ownership or supposed ownership which creates

serious problems in the design of basic communications and services infrastructure as well as in the orderly settlement of new colonies. Moreover, the haphazard pattern makes it difficult to do effective land use and forest conservation planning.

3. The principal objective of this aspect of the project is to assist the INC in medium- to long-term planning. This will involve: (a) support for the organization of existing basic information, e.g., ecological (vegetation, soils, topographic, natural drainage systems), transportation and communication systems, cadastral systems, etc.; and (b) support for an in-depth study of existing land policies and strategy and their application, including institutional mechanisms for their application as a basis for recommendations as to policies, needed legislation and modifications in institutional structures for effective implementation of the policies.

B. Ordering of Basic Information

4. The INC will be provided financial support for contracting locally for researching and ordering of basic information. This will involve the collection of aerial photography and soils, vegetation, topographical and transportation maps, and through the process of superposition, define the basic characteristics of the potential colonization areas. This will permit the definition and characterization of regions in terms of their basic natural characteristics as well as their relationship to the existing and proposed

communication systems. With this information it will be possible to establish orders of priority for colonization and the type of colonization to be pursued. Moreover, this information could be used as a basis for (a) granting, withholding and for revoking concession for forestry exploitation and (b) granting or withholding rights of colonization to spontaneous groups, cooperatives and syndicates until plans have been developed for the colonization of the areas in a rational and orderly basis.

5. This ordering of priorities should permit proceeding with prefeasibility study of selected projects at the rate of one per year after the first year so as to maintain some momentum in the colonization process.

C. Land Policy and Institutional Capacity Study

6. Resources will be provided to INC for contracting for an indepth study of existing land policies, statutes governing the application of policies and institutional arrangements for implementing policies.

7. The scope of the study will include:

(1) Review of land statutes.

(2) Review of the land registry system.

(3) Review of current processes for issuing titles to land.

(4) Review of criteria for adjudicating land in title.

(5) By sample survey determine conformity to land use criteria of lands adjudicated in the past 10-15 years, especially in areas newly opened by roads.

(6) Inventory of current forestry concessions.

(7) Review of the status of titling of land in colonization areas.

(8) Review of current roles exercised by different institutions in the implementation of land policies and statutes.

8. With the foregoing as a basis, make recommendations with respect to:

(1) Clarification and/or modifications in existing land statutes for facilitating an orderly process of colonization and adjudication of land titles. These should reflect particular concern for rational and effective use of the natural resources.

(2) Clarifications and modifications of the procedure for adjudicating land titles, including processes for assuring conformity with land use criteria as a condition of ownership.

(3) Means of consolidating the land registry system, for updating and for maintaining the system to date, especially in the colonization and related areas.

(4) Disposition of current forestry concessions where they conflict with colonization projects. Medium- to long-term procedures for regulating and managing the exploitation of forest resources

consistent with the national interest and with the best interest of colonists.

(5) Consideration of the possibility of freezing the issuance of new forest concessions and new permits for colonization and the adjudication of land titles to spontaneous settlement by colonist and cooperatives and syndicates for a limited period to permit establishment of a planning framework for guiding these processes.

(6) Institutional arrangement, including precise definition of responsibilities for and limitations on the role and scope of each institution affecting the distribution of land and timber, with special reference to land settlement. In this respect the role of the several institutions should be defined in terms of the different stages in the settlement process, i.e., pioneer, consolidation and self-development stages.

(7) Assess the desirability of imposing land taxes as a means for encouraging effective use of land, especially in the lowland areas and in areas with developed infrastructure.

BOLIVIA
SAN JULIAN CONSOLIDATION PROJECT

Terms of Reference for Technical Assistance Personnel

A. Long Term Project Advisors

a. Duties

1. Agricultural Production Systems Advisor

The Agricultural Production Systems Advisor will be the principal expatriate agricultural advisor to the project. He will assist the project director in organizing and implementing research/extension/cooperative activities at the project level. His duties shall include: a) serving as the principal technical advisor to the project management entity; b) establishing and maintaining close working relations with the project's agronomic backstopping agency, i.e., Centro de Investigación Agrícola Tropical (CIAT); c) assisting with the organization and management of the project agriculture center as a test farm engaged in adaptive research, variety observational testing, and regional trial managed by CIAT, plant introduction, multiplication of germ plasm and distribution of plant and animal material to farmers; d) guiding and directing the in-country and expatriate technical staff in the organization, planning, implementation and evaluation of the integrated farm production systems through a multidisciplinary approach, (agronomy, animal husbandry, extension, credit and cooperatives); e) preparing operational plans with terms of reference and scheduling of expatriate consultants; f) preparation of annual work programs, their implementation and evaluation; g) preparation of annual budgets.

b. Qualifications

The Agricultural Production Systems Advisor should have a strong, practical background in agricultural development in tropical regions and a B.S. or Master's degree in Agriculture. The expert should be thoroughly familiar with multiple cropping, inter-cropping and minimum tillage technologies as well as having the necessary practical experience in organizing and administering entities engaged in a multidisciplinary approach to integrated crop and livestock production. World-wide experience in assisting small farmers in adopting improved technologies is desirable, although not absolutely essential. Preference should be given to a person who has worked on agricultural production systems in Latin American for at least two years. The expert should be able to read and speak the Spanish language at a level equivalent to the FSI-S3-R3 level and be willing to live at an isolated post.

2. Agricultural Credit and Cooperative Expert

a. Duties

The Agricultural Credit and Cooperative specialist will work under the guidance of the Agricultural Production Systems expert and in the absence of the Production Systems Expert will act as the principal expatriate agricultural advisor to the project and assist the overall project manager. His duties shall include: a) establishing and maintaining close working relationships with the project level technical group, his counterparts and other key officials of the BAB and for

other lending institutions, b) developing detailed lending criteria with project technical staff and lending institution officials; c) organizing and training credit committees; d) establishing simplified norms and lending criteria and carrying out training courses for farmers on use of credit; e) developing simplified delivery systems and training counterparts, as well as project technical staff in a unified approach to lending and collecting from clients; f) organizing a procurement and delivery system of in-kind inputs; g) assisting the agricultural production systems expert in management aspects of the program and act in his absence as principal advisor to the project manager; h) training and assisting the project organization and cooperatives staff in promoting cooperative activities among the project population; i) promote the development of private agriculture related services enterprises and develop credit programs to assist these.

b. Qualifications

The Agricultural Credit Expert should have a solid academic background and the necessary practical experience in organizing and administering credit programs designed for small farmer crop and livestock development. The expert's training and experience should demonstrate broad knowledge of crop and livestock production as applicable to integrated agricultural production. He should have at least four years of relevant experience and should be able to show that he has had important roles in organizing credit programs and cooperative recruiting staff, preparing operational manuals, and organizing as well as implementing both technician and farmer training programs.

Preference----------

should be given to recruiting a specialist who has worked with rural credit programs in Latin America for at least three years. He should be able to read and speak the Spanish language at the FSI-S3-R3 level and be willing to live at an isolated post.

B. Short-Term Consultants

1. Tropical Horticulturist

a. Duties

The principal duties of the Tropical Horticulturist are to assist the project director and technical staff in,a) reviewing the project guidelines concerning tropical horticultural potentials and plans for the area, reconfirming species and varieties of plants to be proven by studying the project area, reviewing pertinent literature, visiting horticultural enterprises in the Santa Cruz area and interviewing CIAT or other concerned technical people; b) specifying plants, seed or other propagation materials and supplies to be procured, assisting in the location and introduction of these materials on a timely basis; c) assisting in the establishment of permanent budwood gardens at Saavedra or other locations to be chosen; d) training project technicians and personnel in the methodology of organization, management and operations of systems for rapid multiplication and distribution of improved plant material.

The consultant should be committed to repeated periods of consultation during the life of the project, leaving detailed plans and work assignment with project technician for work to be done in the iterim period before his next trip to the project area.

b. Qualifications

The specialist in tropical horticulture should have sound academic training and broad experience in tropical countries with a wide range of tropical plants. At least one year of this experience should have been in Latin America. He must be able to demonstrate that he has successfully executed roles in organizing and directing programs involving plant introduction, plant propagation and distribution. The expert should be able to read and speak the Spanish language at the FSI-S3-R3 level.

2. Animal Husbandman

a. Duties

The principal duties of the Animal Husbandman will be to assist the project director and the project technical staff in, a) designing, executing and evaluating the optimum mix and swine, cattle, sheep and poultry in the integrated farming models being implemented in the San Julian project area; b) training project technicians in planning and implementing the livestock production of the program at the farm level, simplified delivery systems for improved animal health, animal nutrition utilizing home-grown feed, and marketing of animals or animal products; c) designing and promoting schemes to assist the settlers to grow from a no-cattle herd to a small family, general purpose animal enterprise with a minimum capital outlay; d) assisting in designing and implementing profitable systems for the farmers to utilize waste,

root crops and legume pasture in "hogging-off" type swine production; e) working with CIAT experts in determining priorities for long-and-short-term research programs; f) assisting with practical marketing arrangements by helping to promote integrated agro-industrial interprizes. The consultant should be committed to repeated periods of consultation.

b. Qualifications

The Animal Husbandman should have at least a B.S. degree in animal science, as well as a practical background in animal production. He should have at least three years experience in applied research or practical field experience in animal reproduction, animal deseases and parasites, and animal feeding. Extensive experience in swine production is essential. The expert's experience should have been partially with small farmers in developing countries, at least one year of which should have been in Latin America. He should read and speak Spanish at the FSI-S3-R3 level.

3. Marketing Expert

a. Duties

The principal duties of the Marketing Expert will be to assist the project director and the project technical staff in: a) investigating and promoting the market potential for present and prospective products of the colony; b) advising technicians and cooperative managers in drafting policies governing cooperatives or other organiza-

tions buying, selling or processing products produced in the colony; c) analyzing management problems of such organization in communication with the technical staffs and the boards of directors; d) assisting in planning and executing short courses and other training for project technicians, cooperative managers and business managers. The consultant should be committed to repeated periods of consultation during the life of the project.

b. Qualifications

The Marketing Expert should have the equivalent of a B.S. degree in Agricultural Economics (Marketing). He should have had overseas experience in the marketing of agricultural products as well as training and demonstrated experience in management and accounting. A background in organizing and managing cooperatives, especially, marketing cooperatives would be desirable. The expert should be able to read and speak the Spanish language at the FSI-S3-R3 level.

4. Forestry Expert

a. Duties

The principal duties of the forestry expert will be to make field level studies, review relevant material and, in consultation with knowledable individuals in the private and public sector, a) develop a concise plan for policy level decision for the allocation of forest resources to the colony with resources on individual plots going to the colono and resources of the green belts going to the NADEPA for public

works. The plan should include provision for technical guidance by the Bolivian forestry department in forest management to the colonists and NADEPA; b) determine the value of the timber resources remaining on the individual farms and in the green belts and develop rational plans for its exploitation to the benefit of the colonists; c) review the existing concession system for exploitation of forest resources, evaluate its application to land in actual and prospective colonization areas and make recommendations for modification as may be appropriate; and d) determine the advisability of reforestation with valuable species or with pulp species and make recommendations, accordingly.

b. Qualifications

The forestry expert must have a solid academic base and a broad practical background in tropical forestry. He should have at least five years' experience in forestry management, reforestation, harvesting and marketing. At least one year should have been spent in Latin America. The specialist should be able to read and speak the Spanish language at the FSI-S3-R3 level.

5. Rural Youth Advisor

a. Duties

The Rural Youth Advisor will assist the project rural youth leader in , a) organizing and training a network of adult sponsors of youth programs; b) developing annual programs of work, including

meaningful activities for the youth of the project; c) coordinating the program with Departamental and National youth programs; d) acquiring and adopting subject matter appropriate to the needs of project youth; e) supervising youth projects f) developing reward systems and g) evaluating the rural youth program

b. Qualifications

The Rural Youth Advisor should have himself or herself been an active member in a 4-H Club program or similar system, hold the B.S. degree in agriculture or human resources development (home economics) with special training in extension methods. He or she should have had at least two years of successful experience in professional rural youth development work. He or she should be able to read and speak Spansih at the FSI-B-S3 level.

BOLIVIA
CENTRO DE INVESTIGACION AGRICOLA TROPICAL
(C I A T)

1. CIAT was created in March 1975 to serve as the principal institution for agricultural research (including livestock) and extension services in the department of Santa Cruz. Although an arm of the Departmental Directorate of MACA, CIAT enjoys a considerable amount of Administrative and financial autonomy. CIAT is governed by a board of directors with representation of MACA through its Santa Cruz departmental directorate, CODECRUZ, the Bolivian University Gabriel René Moreno, the Chamber of Agriculture of the Oriente and the Santa Cruz Departmental Chamber of Industry and Commerce.

2. The organization of CIAT was motivated by the recognition of the need to diversify agriculture and increase productivity in a manner consistent w the technical, economic and social conditions of the Department and of the different population groups. Moreover, the existing structure for research and extension was in an advanced state of deterioration while duplication of services among institutions was commonplace. Financial and material (equipment) resources were grossly inadequate. Financial resources resulted in irregularities in payment of salaries. This plus the low-level of salaries was causing serious interruptions in work programs. The lack of general direction in the programs was also manifest.

3. It was to resolve these problems that CIAT was created, providing an opportunity for public as well as private institutions and/or

individuals to participate in defining objectives, planning and the supporting efforts to develop, improve and transfer agricultural technology.

4. The institution became operational in August 1976. The organization of CIAT is given in charts one and two. The first shows the existing organization while the second gives a proposal for a new organizational structure.

5. Financial support is derived from several sources: The National Budget through the MACA, the Departmental Development Corporation, the Departmental Agricultural and Industrial and Commercial Chambers, the University (UBGRM), producers associations and other private sources. The annual expenditures in 1976 was approximately $b5,000.000. This increased to about $b10,000.000 in 1977 and $b. 14,000,000 in 1978. The largest contribution of funds has been from the CODECRUZ with a contribution of from 50 percent to 60 percent of the total each year. Contributions from the national budget through the MACA began in 1976 at about 50 percent of the total. However, in 1977 and 1978, this contribution dropped to about one-third of the total. Further reduction in MACA contributions was projected for 1979. Contributions from all other entities have ranged from five percent to 8 percent of the total budget. The available funds generally fell short of the budget. Moreover, due to failures of the central government and other supporting institutions to contribute funds in line with those programmed, expendi-

tures exceeded available resources, especially in 1971. This gap was filled by advances provided by the CODECRUZ, thus creating a debt of $b2,000,00 against CIAT, which has subsequently been increased to $b.3,700,000, which remains outstanding.

6. A recent proposal for institutional reform has been advanced as part of a five-year plan for CIAT. The proposal addresses financial as well as the institutional problems. These reforms are designed to provide greater security in financial resources, defining more precisely the responsibilities of cooperating institutions, it would create two advisory boards - one on technical matters and one on administration, it would define more precisely the role of the technical personnel and technical departmental heads and provide for stronger technical direction in research and extension programs.

7. CIAT posts 8 professional personnel at Saavedra. Several external entities are providing assistance to CIAT and are working within its institutional framework. A.U.K. Mission is providing nine scientists who are carrying out programs of research in cotton, livestock and pastures, economics, weed control and soil fertility. Short-term technical advisory services are also provided. USAID provides an agronomist and an entomologist as well as general assistance in planning, design and execution of research. Training and short-term consultoring services are also important parts of the USAID. A Republic of China mission consisting of two specialists, one in oil plants and one in

pineapple production are working at a San Ingnacio sub-station. Cooperative relations are maintained with a Swiss Mission (COTESU).

8. CIAT operates an experiment station at Saavedra, 15 km northeast of Montero, which is in an ecological setting, similar to the southern portion of the project area. The research program which is operated by a professional staff of eight, deals mostly with the major crops of the area - rice, maize, soybeans, cotton, pastures and forage for cattle. Limited attention is given to tree corps. In addition to the specific, crop-oriented research, investigations of pest and weed control as well as soil fertility are carried out. The infrastructure of land, buildings and equipment is adequate for the scope of research that is undertaken.

9. A sub-station at Portachuelo and one at San Ignacio, plus off-station work at several points in the area provide a sampling of the different soils and climatic zones in the area.

10. CIAT participates in the regional variety and germ plasm testing of several international research institutes CIMMYT, IRRI, and CIAT (Columbia).

11. The research program of CIAT is heavily weighed toward variety testing and variety improvement. Sixty-seven percent of the 126 field tests carried out during the two-year period, 1976-1977 and 1977-1978, dealt with variety testing and improvement; 11 percent dealt with insect

control and 14 percent dealt with various cultural practices, chiefly spacing and planting dates, and with soil management. Cropping systems, including intercropping and multiple cropping received very little attention. The potential for utilizing year-round cropping with different crop sequences, including intercropping and legume forage crops as a tool in weed control, has apparently been largely overlooked. Weed control work has concentrated on the use of herbicides and tillage practices.

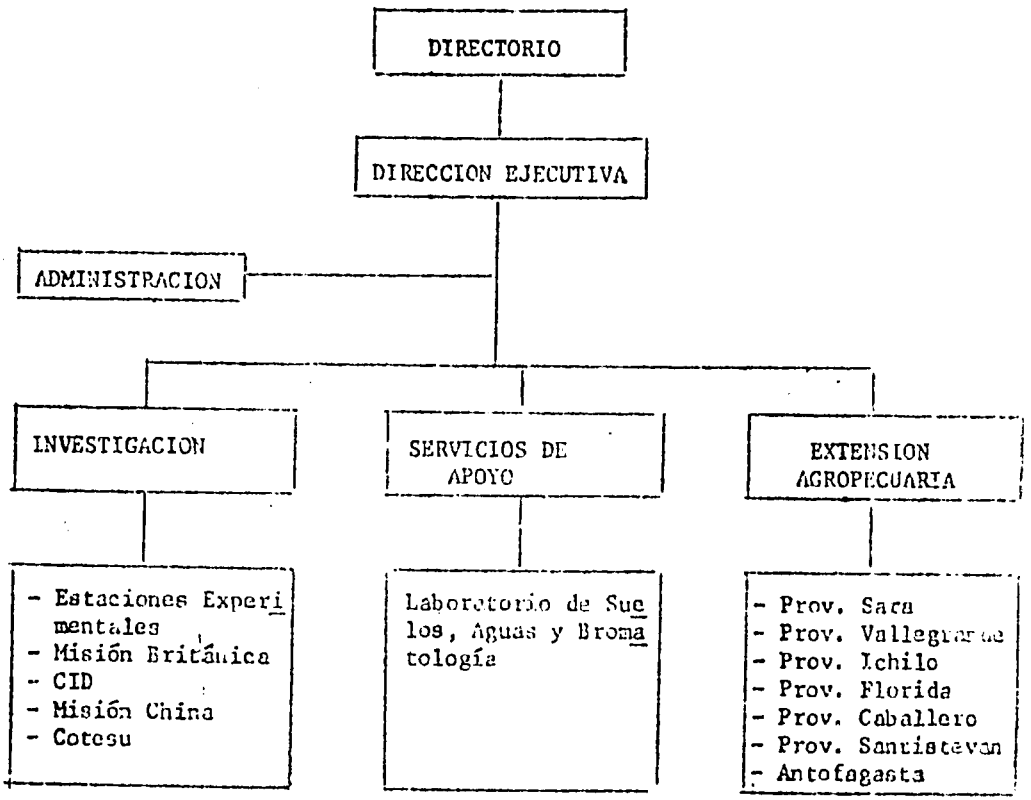
12. The inclusion of cropping systems research would likely pay high dividends in developing a farming technology intermediate between the traditional slach-and-burn system of the small farmer and the highly mechanized system of the large farmer.

13. An appraisal of the effectiveness of the CIAT research program in terms of quantity and quality of the information developed as well as in terms of the balance of emphasis on various aspects of crop production was made for the years 1976-1977 and 1977-1978 by a CID research specialist. This appraisal concluded that of the 126 field trials, only 27 percent yielded results of good quality, 28 percent of moderate to good quality and 45 percent of poor to moderately good quality. The evaluation also noted the almost total lack of studies in soils, soil fertility and soil moinsture relations. Among other recommendations from the evaluation were: a reduction of the emphasis on varieties and

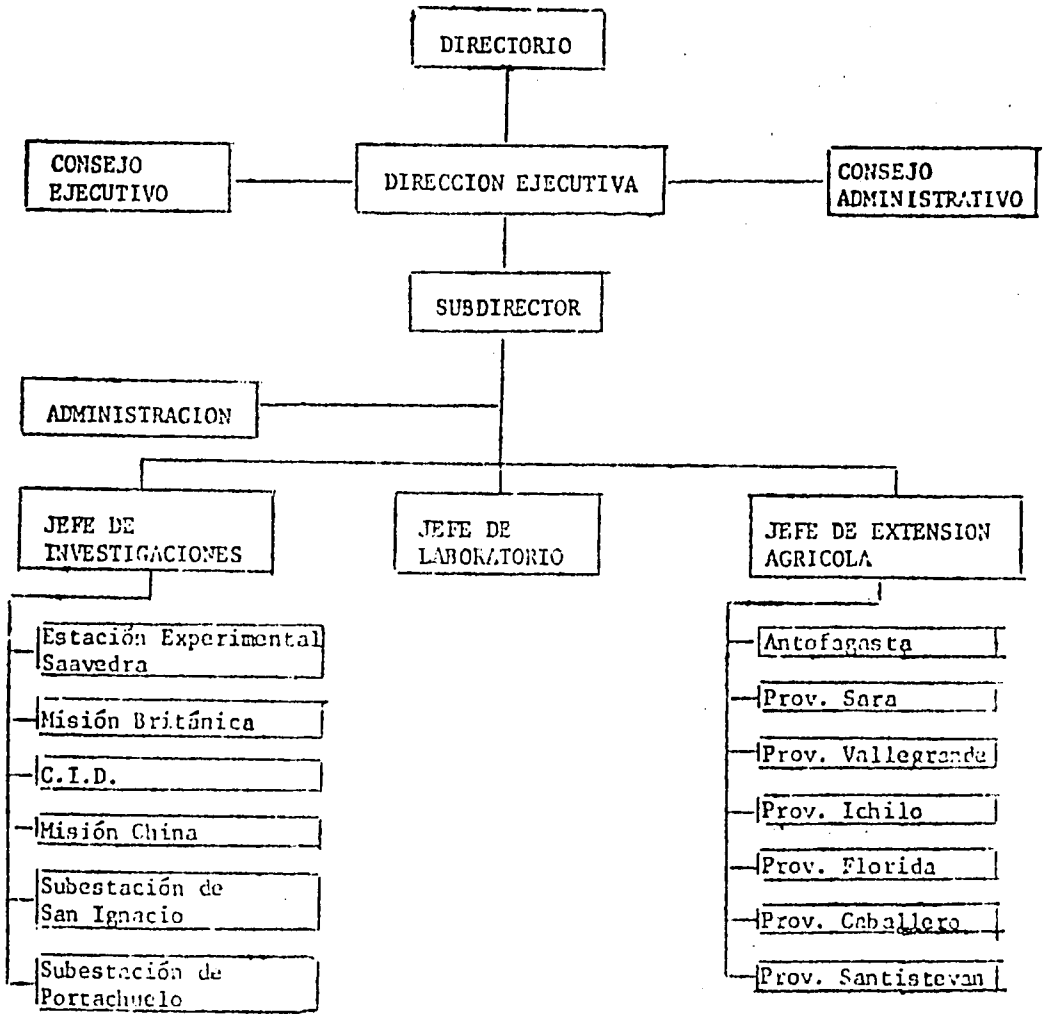
amplification of the study of other production factors; considering the importance of these other factors in variety response, it is likely that failure to adequately consider them cast doubt on the reliability of the results from many of the variety tests.

14. The CIAT extension organization consists of a central office in Santa Cruz and seven provincial agencies. Each extension agency is staffed by one extension agent. Thus, for the entire Department of Santa Cruz there are seven extension agents. If all were concentrated in the colonization area they would provide one agent for roughly every 2,000 colonial families.

ORGANIGRAMA ACTUAL DEL CIAT



ORGANIGRAMA PROPUESTO PARA EL CIAT



BOLIVIA
THE TECHNOLOGY DEVELOPMENT AND DELIVERY SYSTEM

1. The project design assumes that all groups involved will have equal concern for all elements of the program. Adaptive research, extension, organization and cooperative development, financial services, family and home development and youth services are effectively merged, as all entities would be dealing with the same families who all have a common need and desire for the services provided by the services entities.

2. The cycle of involvement would begin with bi-weekly meetings at the nucleos, attended by all members of the 40 resident families. The established nucleos are already organized, and they are represented in an organization at their respective NADEPAS (nine nucleos). Typically, the agenda would have two points. The first would be devoted to articulating goals and problems faced in goal pursuit, community business (resolving issues) and advancing plans and strategies. The second part of the meeting would be devoted to teaching and learning farming and home-making skills. For the most part, these exercises would be in the form of separate, method demonstrations addressing timely aspects of farming systems, health and nutrition improvement, family living and skills that support youth problems.

3. Following the completed subcycle of bi-weekly, nucleo meetings, there would be a subcycle of NADEPA meetings of the representatives of the

nucleos. Again, the agenda for the assembly would include a review of goals, problems, plans and community business. Upon the completion of business, the group would inspect and evaluate pertinent aspects of the proposed farming systems, including farmer implemented result demonstrations and field trials.

4. Monthly representatives of the NADEPAS would meet at the Agricultural Community Center. The seated agenda would be the same as that followed at the nucleo and NADEPA meetings, with the participation of the project director and his complete technical staff. Following the adaptive research work at the Center, the overriding purpose of which is to improve the proposed farming systems, and make the appropriate comments and evaluations to the research/extension personnel.

5. A variation of the Train-and-Visit system (David Benor, Washington: World Bank, 1974) would be used to teach the skills proposed in the project. This would begin with training for the Agrónomo técnicos and other service personnel posted at the NADEPA centers, at the Agricultural/Community Center, or implemented by the Center at the appropriate setting in the project area.

The skills taught would be those required by the settlers to implement the proposed farming systems. Specific skills would be taught to the NADEPA level service personnel three weeks in advance of their requirement by the farmers. The following week, the NADEPA-posted service person-

nel would assemble the nucleo extension auxiliaries and other nucleo-posted personnel and teach them the skills just learned. These same skills would then become the "practical" items of the forth nightly nucleo meetings. The NADEPA-posted service personnel and the nucleo auxiliaries would follow up to provide on-the-sport assistance to the settlers as they use the skills in their farm and home work.

6. The above procedure would apply equally to all technical services offered. A means whereby the settlers may monitor the overall project program was presented above. Conversely, the project director and the central project staff would become known in its nucleos and remain up to date of their programs, progress and problems.

BOLIVIA
SAN JULIAN COLONIZATION RURAL YOUTH DEVELOPMENT

1. The educational objective of the proposed project is to endow in the youth rural social values and skills, economic and technical skills and leadership and representation skills in adequate measure to assure them an equitable and responsible role in the further socio-economic development of the country. The minimal academic skills required for modern farming and home-making are literacy at the command form level in a modern language (e.g., Spanish) and mathematics through long division. This level of education is pressumed to be acquirable in the first five years of the Bolivian education system. The first two grades are offered by MEC teachers in the nucleos where school shelters are provided. The third, fourth and fifth years are similarly offered at the NADEPA centers. The proposed project will support this system by providing transportation for its pupils from the núcleos to the NADEPAS and back. It will also provide minimal, basic teaching materials and supplies not available from MEC.

2. While the teachers will have important roles in teaching national heritage, their efforts would be supplemented by a network of volunteer workers from among the adult settlers. The proposed project would provide the services of a rural youth extension worker (4-C Club agent) who would assist in organizing a vigorous, community-sponsored 4-C Club programs. Its purposes would be to (a) motivate the youth to aspire for

socio-economic advancement and to show them that their goals are achievable in their present environment, (b) teach farming and home management skills, (c) teach leadership and representation skills, (d) teach social responsibility and (e) provide relevance to the academic learning program.

3. Hierarchy of adult sponsors would be organized, which would be reinforced by the project's extension staff.

4. The youth would acquire parts of their skills by implementing three types of projects. One would be a nucleo-level, group productive enterprise designed to introduce practical farming and some home-making skills. The second would be an individual, productive enterprise designed to reinforce the skills learned from the group exercises, or additional skills, and to launch the member in a long-term program of self-capitalization and farming. The third project would be of a community service nature, to teach the value of a member's service to his or her social system. Leadership would be taught through holding elected offices in the system. Representation would be taught through representative participation in the hierarchical pattern of the organization, extending from the nucleo to the National Capital.

5. Members would be recruited no later than the third year, agewise, and kept in the program until they reach commonly accepted adulthood, wheather they have completed the fifth year of school or not. At that

point they would enter and reinforce the adult organizations fostered by the project.

BOLIVIA

SAN JULIAN COLONIZATION
ENVIRONMENTAL IMPACT
ENVIRONMENTAL IMPACT

A. The Site

1. The project encompasses approximately 50,000 hectares of flat, alluvial plain on the eastern bank of Rio Grande. The dominant soils are sandy loams, silt loams and silty-clay loams. Distinct upland marshes resulting from "tight" or poorly-drained and heavy soils are interspersed in the project site.

2. The vegetation is climax forest consisting of large tropical hardwoods (over 100 species) and mixed tropical undergrowth. The better known hardwoods are being removed for lumber at a rapid rate.

B. Current Situation and Trend

3. Slash-and-burn agriculture is practiced. Trees are felled and the forest floor is burned off. Crops are grown for three years, then abandoned, due to the unmanageable invasion of weeds and secondary harwood growth. The farmer who abandons the plot sets a new cycle in motion on an adjoining or nearby plot.

4. There is a mechanized variation of the method which has been prevalent on the west side of the Rio Grande, which under favorable circumstances might be introduced in the east bank. All trees are removed by their roots by bulldozer and the land goes into single, annual cropping with large-scale mechanical cultivation. Wind

erosion becomes evident to serious in a few years, but is then arrested by the buildup of coarse grass and other weeds. Frequently, ten years from the time the land is cleared, it is effectively abandoned to pasture, which is low yielding.

C. The Project

Settlement

5. The project consists of two areas, one designated as San Julian North and one designated San Julian South. The former area consists of approximately 250,000 hectares along an 80 kilometer, all-weather road which is joined by 5 kilometer, dry weather feeder roads at 5 kilometer intervals. This area is divided into 8,000 hectare blocks, which are subdivided into 40, 50 hectare parcels, each granted to one single family unit for farm exploitation. Forty-five núcleos have been settled, and the remaining fifty-five will have been settled by 1981. The núcleos are separated by 500 meter forest zones (green belts), which total 25,000 hectares.

Agriculture

6. The agronomic design of the project is extended from the hypothesis that weeds can be controlled, thus a permanent agriculture can be maintained indefinitely on the project soils by maintaining continuous, manageable ground cover. This is to be accomplished with one or more of six combinations of intercropping and multiple cropping. The systems include supplementary weeding by mechanical means or the use of U.S., EPA approved herbicides.

D. Impact

Flora

7. (a) Without the Project. The climax vegetation on the farm parcels is removed at the rate of one to three hectares a year and abandoned to invading grass and regrowth of brush after three years cultivation. Eventually, the land will likely be used for browse-type pasture and kept under control by severe, low-productive grazing. There are no plans for managing the green belts, thus it could be supposed that the current practice of indiscriminately harvesting marketable timber will continue.

8.(b) With the Project. Farmed Land: The project proposes to defeat the encroachment of weeds and undesirable forbs by maintaining continuous ground cover, thus eliminating the need to abandon cleared land. This should permit an orderly expansion of the farmed area at a slower rate of removal of the climax vegetation.

9. Parcel Forests. The project proposes to assist farmers in maintaining and managing their allotments of native forest not required for cultivation, to produce commercial timber. Where feasible, the climax species are to be interplanted with industrial tree crops, such as cacao and coconut palm.

10. Green Belts. The project proposes that the approximately 25,000 hectares of green belt bordering the núcleos be titled to

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NADEPAs (9-block areas) in which they lie and managed as combined timber and wildlife refuge. Thus, the climax vegetation would be maintained in perpetuity.

11. Control Area. A 2,000 hectare marsh and a green belt around it would be reserved and kept undisturbed in perpetuity, thus protecting the climax flora in that area.

Fauna

12. An estimate of the presence of the major species of fauna inhabiting the San Julian North area of the project site is given in Table 1, which also gives our best estimate of the impact of human encroachment on them with and without the project.

13. (a) Without the Project. Without providing a sizeable, relatively impenetrable refuge, the jaguar, puma, ocelot, tapir, huaso, peccary, turkey, papagayo, and cap iguana would disappear.

14. Alligator, wild pig, cotomonde and sloth would decrease.

15. Paca, agoti, monkey, obossum, squirrel, partridge, and other birds would adapt and withstand the pressure from the invading population.

16. (b) With the Project. It is assumed that the project will, by government decree, establish at least 2,500 hectares, including a marsh of approximately 2,000 hectares, as a wildlife refuge. It is recognized that the major impact of this act in the short-term will be to protect the flora, which will contribute to the food chain

and cover of the fauna. It is not anticipated that in the foreseeable future that the Government would be able to effectively protect a refuge area from hunting.

17. The jaguar, ocelot, puma, tapir, huaso, peccary, papagayo, and turkey would retreat to the refuge and adjust to the food supply. The cap iguana would retreat from the project area.

18. The alligator and wild pig would decrease.

19. The black iguana and cotomonde would decrease under the pressure of hunting but survive.

20. The sloth would decrease in proportion to the decrease in its host species.

21. The paca, agoti, opossum, squirrel and birds other than parrots would adapt. The monkey would adapt, barring the pressure from commercial trappers.

22. Partridge, doves, parrots, and hurina will increase in response to increased feed supply. Waterfowl (herons) will increase in response to improved distribution of standing water (borrow pits).

D. San Julian South

23. The area known as San Julian South will be unpenetrated by road and uninhabited at the initiation of the project. Making exceptions for climatic differences, the same fauna inhabiting the San Julian North area can be expected to be present.

E. Conclusions

24.1 The environment of San Julian North will be improved by the project with (a) the designation of the 500-meters green belts as permanent forests; (b) the designation and enforcement of one or more climax zone wildlife refuges of sufficient size to host the larger animals and birds.

25.2 The fauna of San Julian South will be reduced in proportion to the reduction in the food chain, in destruction of cover and pursuit by man. All species can be maintained in reduced numbers by providing refuges.

Table 1

Estimated Impact of Settling the San Julian Project Area on its Fauna

Species	Present Number	Without the Project	With the Project
Jaguar	Few	Disappear	Retreat to refuge
Ocelot	Plenty	"	" " "
Puma	Few	"	" " "
Tapir	Few	"	" " "
Huasol/	Plenty	"	" " "
Hurina2/	Plenty	Withstand	Increase
Peccary	Plenty	Disappear	Retreat to refuge
Wild pig3/	Plenty	Decrease	Decrease
Alligator	Few	Decrease	Decrease
Black iguana	Plenty	Decrease	Decrease and survive
South American porcupine	Few	Withstand	Withstand
Paca	Few	Adapt and withstand	Adapt and withstand
Agoti	Few	Adapt and withstand	Adapt and withstand
Cap iguana	Few	Disappear	Disappear
Cotomonde	Plenty	Decrease	Decrease but survive
Monkey	Plenty	Adapt and withstand	Adapt and withstand
Rabbit	Few	Increase	Increase
Opossum	Plenty	Adapt and withstand	Adapt and withstand
Squirrel	Few	Adapt and withstand	Adapt and withstand
Sloth	Plenty	Decrease in proportion to host species	Decrease in proportion to host species

1. Medium size deer, similar to the North American white tail.
2. Small forest deer.
3. Chanca de tropa, like to readjust to the remaining woodland area.

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TABLE 1
(Cont.)

Species	Present Number	Without the Project	With the Project
Turkey	Few	Disappear	Retreat to refuge
Papagayo[4]	Few	Disappear	Retreat to refuge
Waterfowl	Few	Increase	Increase
Partridge[5]	Plenty	Adapt and withstand	Increase
Dove[6]	Plenty	Adapt and withstand	Increase
Other birds	Plenty	Adapt and withstand	Adapt and withstand

4. Giant, colorful parrot.
5. All species present
6. All species present.

ANNEX 17

SAN JULIAN COLONIZATION AND CONSOLIDATION WORKING PAPERS

1. San Julian Consolidation Project - Engineering Analysis
2. Farming System for the San Julian Colonization Area
3. Marketing Study
4. San Julian Consolidation - Financial Services
5. San Julian Consolidation - Social Analysis
6. The Economics of the Proposed Farming System.