The design flood discharge was determined by the Izzard's method as follows;

- Area: Pantuflas Region
- Catchment Area: 6.75 km^2 = 1,668 Acre
- Base Discharge by Izzard's Method,
  Q_o = 1,200 ft^3/sec = 34.6 m^3/sec
- Maximum Peak Discharge (Q)
  $Q = (RF \times LF \times FF) \times Q_o$
  where, Q : Maximum Peak Discharge (m^3/sec)
  RF: Rain Factor 0.4 - 1.6
  LF: Land Use Factor
  FF: Frequency Factor
  and then, RF = 1.6, LF = 1.0, FF = 1.8 (200 years)
  $Q = (1.6 \times 1.0 \times 1.8) \times 34.6\ m^3/sec = 99.6\ m^3/sec$
  $= 100\ m^3/sec$
- Temporary Flow Discharge, Q_t
  Temporary flow discharge is assumed as Q/10 by some precedents.
  $$Q_t = \frac{Q}{10} = \frac{100\ m^3/sec}{10} = 10.0\ m^3/sec$$

2.3 Structure of Dam

- Embankment material is not sufficient for the construction of the earth type dam in the surrounding area. The core type rock fill dam does not require much embankment material comparing with the earth type.
- The foundation of the site is not good condition.
- There is abundant and suitable rock material for the construction of rock fill type dam.
- This type dam is adequate for this site in its stability and economy.

The dam is a central core type rock fill dam for the following reasons. The slope at the upstream side is 1 : 2.5 and the downstream side is 1 : 2.0.

The soil material to compose the central core is planned to take clayey soil at the Pinar Bonito zone which is on the plate of the Rio Grande. It is located at 8.5 km far to the south from the proposed dam site.

The rock material is planned to take from a small hill adjacent to the proposed dam. The planned excavation volume is about 122,000m^3. The rock is andesitic volanic pyroclastic and well weathered. There exists medium hard rocks partly.

2.3.1 Height of Dam

Water depth of dam is calculated from the storage capacity curve (Fig. 2.3.1-1). The total height of dam is shown in the following table.

Dimension of Pantuflas Dam

Total storage capacity (m^3)	1,050,000 m^3
Water depth (m)	25.8 m
Bedrock excavation (m^3)	1.0 m
Overflow depth (m)	2.0 m
Dam freeboard (m)	1.0 m
Total height of dam (m)	29.8 m
Dam crest length (m)	161.8 m
Crest width (m)	7.5 m

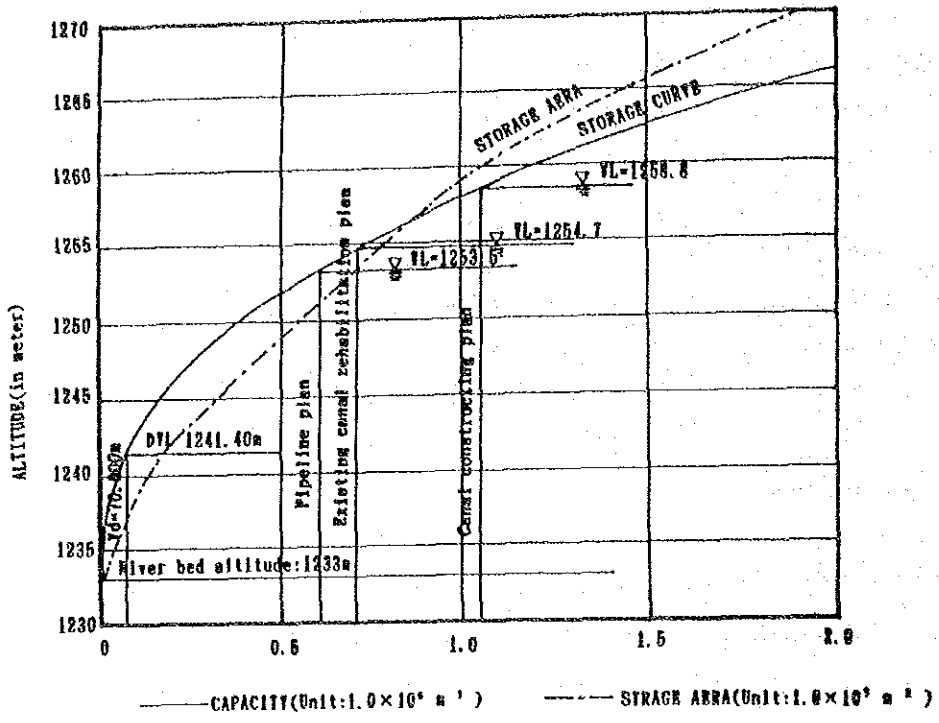


Fig. 2.3.1-1 Storage Capacity Curve of Pantuflas Dam

2.3.2 Spillway

The spillway is planned with 100 m^3/s of the capacity as a side channel type, its length is 20 m and its overflow depth at the crest is 2.0 m. The bed slope of the channel is 1/16, the bed width at the rear is 4.0 m and the one at the front is 8.0 m. The overflow depth at the end of channel is 4.0 m.

The dimensions of the spillway are as follows;

Type	:	Side ditch type
Design discharge	:	Q = 100 m^3/s
Over flow depth	:	h = 2.0 m
Length of side ditch	:	L = 20 m

The structure of the spillway is shown in Fig. 2.3.2-1.

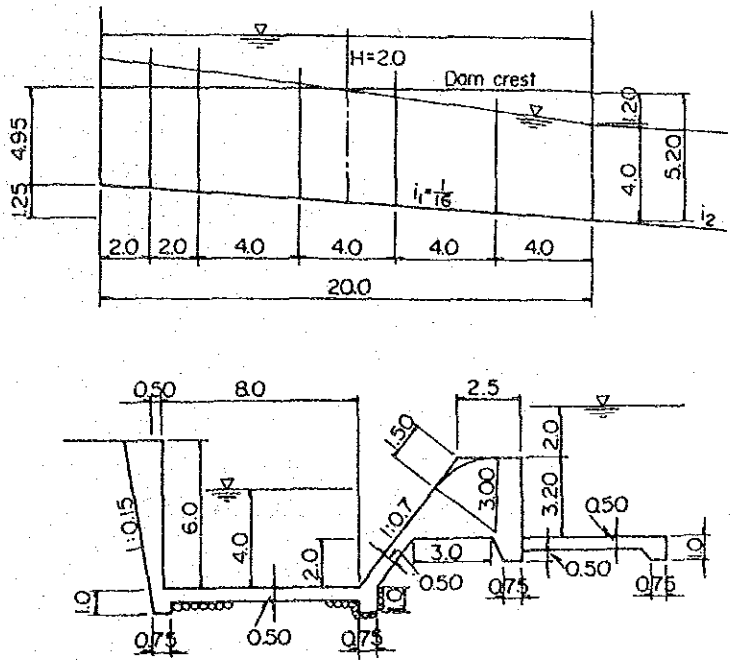


Fig. 2.3.2-1 Structure of Spillway

2.3.3 Construction Volume

(1) Volume Content of Dam

Volume content of each material are calculated as follows.

Core	23,540 m^3
Filter	8,560 m^3
Transition	107,000 m^3
Rock shell	74,900 m^3
Total	214,000 m^3

(2) Cutting and Reclamation on Dam Site and Borrow-pit

- Dam site area : 15,000 m^2
- Quarry site area : 19,000 m^2
- Road site area : 28,000 m^2
  - No. 1 road site L_1 = 450 m
  - No. 2 road site L_2 = 250 m
  - No. 3 road site L_3 = 200 m
  - No. 4 road site L_4 = 500 m
- Borrow-pit : 16,000 m^2 (23,540 m^3 / 1.50 = 16,000)

(3) Surface Soil Removing

- Dam site : 27,000 m^3 ... soft rock I, working by machine or hand
  - (i) removing by machine : 19,500 m^3
  - (ii) removing by hand : 7,500 m^3
- Quarry site : 19,000 m^3 ... soft rock I, working by machine
- Borrow-pit : 8,000 m^3 ... clayey soil

(4) Excavation of Foundation

- Excavation of blanket foundation : 2,000 m^3 (middle rock)
- Excavation of outlet conduit foundation : 2,000 m^3 (soil with gravel and bouldey)

(5) Cleaning Work for Bed Rock

- Cleaning Area : 5,000 m^2

(6) Foundation Work

- Blanket concrete : 2,200 m^3
- Contact grout : 2,000 m^3
- Curtain grout : 5,000 m^3

(7) Embankment

- Core material	:	23,540 m^3
- Filter material	:	8,560 m^3
- Transition material	:	107,000 m^3
- Rock material	:	74,900 m^3
Total (Volume)	:	214,000 m^3

(8) Riprap Work

- upstream side area (m^2)	:	19,200 m^2
- downstream side area (m^2)	:	12,600 m^2
Total	:	31,800 m^2

(9) Outlet conduit concrete : 1,570 m^3

3. Mountain Stream Diversion Works

The location of stream diversion works has been evaluated by considering the following conditions.

- Place of narrow river width to minimize the concrete volume of the diversion works.
- Place nearer to the existing head works to shorten the length of new head race.
- Place where rocks exist on both sides.

Considering these conditions, a place at 310m upstream from the present head works is selected for the stream diversion works. The altitude of the river bed is 1,292.3m and the slope of the river bed between the place and the head works is about 1/75. The deposit at the place is estimated to be about 3 m deep. Survey result of its cross section is shown in Fig. 3.1.1-1.

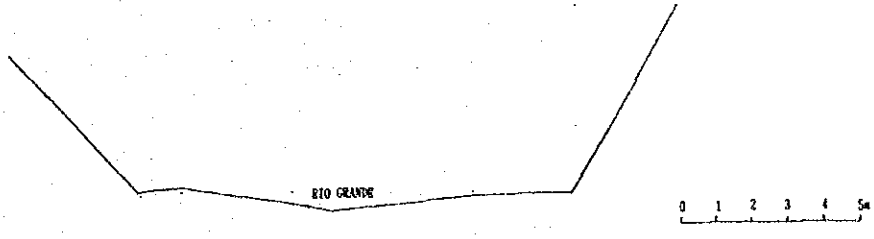


Fig. 3.1.1-1 Sectional Survey Result of Proposed Site for Stream Diversion Works

(1) Type of Stream Diversion Works

The stream diversion works in the Rio Grande should satisfy the following conditions.

- Planned water discharge should be stable notwithstanding acute flow flactuation.
- Water intake should not be harmed as little as possible by flowing earth and sand, branches and leaves, creepers and other floats.
- The stream diversion works should be strong enough against flowen stones, wood and other flowage.
- The structure should be simple and easily maintained with cheap cost.

The following six alternatives are evaluated.

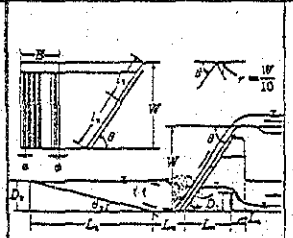
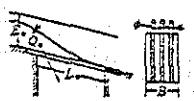
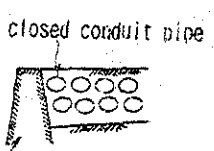
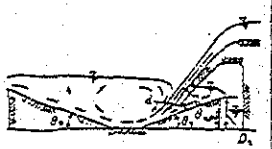
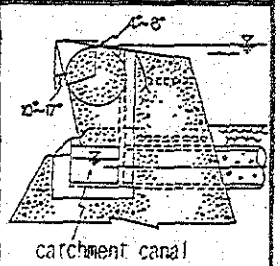
- Bar screen back stream diversion works
- Bar screen bottom stream diversion works
- Water cushion side stream diversion works
- Water catchment closed conduit stream diversion works
- Water cushion back stream diversion works
- Overflow dip dimension clinging intake weir

The result of comparison studies of stream diversion works at the place is shown in Table 3.1.1-1.

The bar screen back stream diversion works is judged as the suitable one for the following reasons.

- Possible to secure a stable design water discharge of 1.0 m^3/s.
- Water intake will not to be harmed much by flowing earth and floats.
- Strong enough against friction and damage
- Easy for operation and maintenance

Table 3.1.1-1 Comparison of Moutain Stream Diversion Works

Type	Bar screen back stream	Bar screen bottom stream	Water cushion side stream	Water catchment closed conduit	Water cushion back stream	Overflow dip dimension clinging intake weir
Shape						
Intake method	-To take water from bars lined with 10-20mm intervals consisting of falling slope and water cushion as structures.	-To take falling water at catchment canal through bar screens which are arranged toward flow direction at the downsteram of check dam or at the shoulder of fixed weir.	-To take water at the side toward torrent flow. -There are natural intake method, intake weir method and water cushion side intake method.	-To collect water in closed coduit pipes of 1.0-1.5m diameters at a cut-off zone possible to hold always full water or the upstream of check dam.	-To take back current water at the back of nap, consisting of falling slope and water cushion as main strustures.	-To take water from catchment canal at the bottom. The top of weir shapes circulation curve, having 4-8 deg. reverse angle at the upstream and 10-17 deg. minus angle at the downstream.
Characteristics	-This is strong against abrasion loss and its rehabilitation is easy. -Blockage with gravels and stones, and floats hardly occurs by setting steel bars at a large angle 55-60 deg. and fixing the bottom end of steel bars.	-Blockage with gravels and stones, and floats occurs often. -Bar screen should be set wide and the width of water flow should be always stable totally.	-Sediment and flow-in of earth, sand and gravels and blockage of trashrack occur often and maintainance is not easy.	-Water catchment per 1m long conduit is about 1.0-1.5 ℓ/sec, a very long and large closed conduit becomes necessary if water discharge is large.	-Water discharge is stable as far as water flows down along induction board and water cushion is in the state of ordinary flow. -Nap induction board is vulnerble to abrasion and fracture. -When the river flow is smaller than double water discharge, this enfolds small floats easily.	-When the river floods and a large quantity of water overflows, water cannot almost be taken.
Water discharge	-Discharge per meter is 0.2-0.3 m 3 /sec when the head is about 2 m.	-Discharge per meter is about 0.1 m 3 /sec.	-Discharge is less than 1.0m³ /sec.	-In case water discharge is about 30-50 ℓ/sec, taking water is comparably stable.	-Discharge per meter is 0.05-0.1 m ³ /sec.	-Maximum discharge per meter is about 10 ℓ/sec.
Evaluation	○	△	△	X	△	X

There are two types of diversion works; viz. fixed type and floating type. The fixed type to make the shielding zone by grout pouring is adopted in this case since the deposit is estimated to be several meters deep and basic rock is anticipated underneath at the place.

(2) Water Level

The water level of the stream diversion works is designed to be the same as the river bed of the place, EL 1293.3 m.

(3) Dimension of Diversion Works

The dimension of diversion works is designed as follows:

- The height is designed as 2.0 m based on the past experience and can expect a discharge of 0.2 - 0.3 $m^3/s/m$.

- The width is designed as 6.0 m adding some surplus in order to secure the designed discharge of 1.0 m^3/s.

4. Rehabilitation of Existing Head Works

The present head works was constructed 42 years ago and deteriorated with broken apron for 15 m width at the left river side.

If the head works is left as it is, it may get fractured, cause lowering of the river bed and effect on the structure at the upstream side. So the following rehabilitation works should take place.

a. To remove the damaged concrete parts and excavate to the base.
b. To install gabion on the base.
c. To fill boulders between concrete and gabion, and complete it with concrete.

5. Head Race

5.1 Head Race Between the Stream Diversion Works and the Existing Head Works

The head race which conducts water to the existing head race should satisfy the following requirements.

- It should be strong enough against flown stones, wood and other flowage.
- It should not reduce flow area of the river.
- Its maintenance cost should be cheap.

Rocks and steep slopes exist on both river sides for 15 m downstream from the place where the stream diversion works will be constructed. After that, there is a narrow dry river bed vegetating on it.
The following head race is planned to satisfy the above requirements.

- The head race is to be burried under the dry river bed in order to maintain flow area of the river and avoid flowage.
- It is to be box culvert of reinforced concrete which is strong against abrasion and flowage.
- It is to be constructed at the right side of the river to connect with the existing head race at the downstream.

(1) Section of Box Culvert

The section of the box culvert is designed as follows:

a. In case of open channel

According to the Hazen-Willam's formula,

$$Q = 0.849 \cdot C \cdot R^{0.63} \cdot I^{0.54} \cdot A$$

where, Q: water discharge (m^3/s)
C: coefficient of water velocity, C = 100
R: hydraulic mean depth (m)
I: hydraulic gradient
A: sectional area (m^2)

Assuming sectional dimension of 1.0 m x 1.0 m and haunch of 0.1 m x 0.1 m.

$A = 1.0 \times 1.0 - 1/2 \times 0.1 \times 0.1 \times 4 = 0.98\ m^2$
$R = A/L = 0.98/(0.8 \times 4 + 0.1 \times \sqrt{2} \times 4) = 0.26\ m$
$Q = 0.849 \times 100 \times 0.26^{0.63} \times (1/75)^{0.54} \times 0.98$
$= 3.46\ m^3/s$

b. In case of closed channel

According to the Manning's formula,

$$Q = 1/n \cdot R^{\frac{2}{3}} \cdot I^{\frac{1}{2}} \cdot A$$

where, n: coefficient of roughness of concrete, n = 0.013

$A = 0.98\ m^2$
$R = 0.98/(0.8 \times 3 + 0.1 \times \sqrt{2} \times 4) = 0.33\ m$

$$Q = 1/0.013 \times 0.33^{\frac{2}{3}} \times (1/75)^{\frac{1}{2}} \times 0.98$$
$= 4.16\ m^3/s$

The assumed section can discharge the design discharge of 1.0 m^3/s in both cases.

(2) Manhole

Manhole is mainly for removing segments and is designed near the existing head works with the dimension of 2.0 m x 1.0 m.

5.2 Rehabilitation of the Existing Head Race

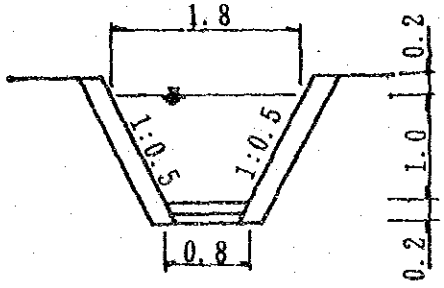
(1) Rehabilitation Method

- The existing box culvert will be used. The leakage portions are to be found and repaired.
- The unlined canal is to be substituted to the canal with wet masonry lining in order to improve its conveyance efficiency.

(2) Section of Open Canal

The section of the open canal with wet masonry lining is designed. The slope of the canal is designed as 1:0.5 to minimize the canal width, since the width of the road running parallel with the canal is not sufficient.

The section of the open canal is set as follows:



According to the Manning's formula,

$$V = 1/n \cdot R^{\frac{2}{3}} \cdot I^{\frac{1}{2}}$$

$$Q = V \cdot A$$

where, n: coefficient of roughness for wet masonry lining,
n = 0.025

$A = 1/2x(0.8+1.8)x1.0 = 1.30\ m^2$

$R = 1.3/(0.8+\sqrt{1.0^2+0.5^2}x2) = 0.428\ m$

$V = 1/0.025x0.428^{\frac{2}{3}}x(1/700)^{\frac{1}{2}}$

$= 0.86\ m/s$

$Q = 0.86x1.30$

$= 1.12\ m^3/s$

The section can discharge 1.0 m^3/s.

6. Water Distribution Plan

(1) Summary

Water distribution system is designed as follows:

- The division works is to be constructed at the altitude of 1,249m. It should be of jet flow type.
- Three main canals, Canal Nueva Constanza, Canal Constanza, Canal Pantuflas are to be constructed.
- Canal Nueva Constanza

  . Pipeline is to be installed till Colonia Hungaro in order not to pass the steep slope of northern mountains of the Valley. Its diameter is 600mm and the elevation of its end is EL 1240m. Its length is 2,900m.

  . The open canal is lined with wet masonry lining and its standard gradient is 1/1,000. After passing the Arroyo Pantuflas by the siphon, it will connect to the Canal Pantuflas. Its length is 10,700m. Six aqueducts and five division works/ confluence works are to be constructed. Four laterals are to be accompanied and their total length is 9,250m.

- Canal Constanza

  · Cleaning, repairing of damaged portions, modification of sectional area and substitution to the canal with wet masonry lining from unlined canal are to be done.
  · New open canal of 8,250m is to be installed after the existing canal.
  · Its total length is 17,850m and fourteen division works/confluence works are to be constructed.
  · Sixteen laterals are to be constructed and their total length is 23,700 m.

- Canal Pantuflas

  · Cleaning, repairing of damaged portion and extension of open canals are to be done.
  · Its total length is 3,550 m and four division works are to be constructed.
  · Six laterals are to be constructed and their total length is 6,200 m.

- Driving channel to distribute water from Pantuflas dam in dry season is to be installed. Since the ground level is changing up-and-down, pipeline of 400 mm diameter is to be installed for 750 m length after Pantuflas dam. Canal is divided into the Canal Constanza and the Canal Pantuflas at the division works P-1. Water to the Canal Constanza is passed through pipeline of 300mm diameter for 850m length and open canal of 850m length.
- Small discharge sump are to be constructed at the end of pipelines. Surplus water can be stored temporarily.
- Box culverts are to be constructed at crossings with the road and the runway.

- The existing small intakes at the Arroyo Pantuflas, the Arroyo Palero and the Canal Constanza are to be rehabilitated and utilized as supplemental water resources. Two small intake gates are to be constructed in small rivers in the Valley for effective utilization of water.
- Chutes are designed where the gradient of open canal is relatively large.

(2) Section of Open Canal

Sections of open canals are designed based on the design water discharge. The following conditions are applied for their designs.

- Open canal is to be lined with wet masonry of three dimentions.
- Standard gradient of open canal is 1/1,000.
- Manning's formula is applied. The coefficient of roughness for wet masonry lining is 0.025.
- The slope of open canal is 1:1.

Mean water discharge is calculated by Manning's formula as follows:.

$$V = 1/n \cdot R^{\frac{2}{3}} \cdot I^{\frac{1}{2}}$$

$$Q = V \cdot A$$

where, Q: mean water discharge (m^3/s)
V: mean water velocity (m/s)
R: hydraulic mean depth (m)
I: hydraulic gradient, I = 1/1,000
n: coefficient of roughness, n = 0.025
A: sectional area (m^2)

The designed section of each open canal is shown in Table 6.1.1-1.

Table 6.1.1-1 Dimensions of Open Canal

Type	Design Discharge (m^3/s)	Width of Bottom Slab B (m)	Water Depth H' (m)	Hydraulic Mean Depth R (m)	Sectional Area A (m^2)	Mean Velocity V (m/s)	Mean Discharge Q (m^3/s)
A	more than 0.6	1.0	0.8	0.44	1.44	0.73	1.05
B	0.6 - 0.4	0.8	0.65	0.36	0.94	0.64	0.60
C	0.4 - 0.3	0.7	0.55	0.30	0.69	0.57	0.39
D	0.3 - 0.2	0.6	0.50	0.27	0.55	0.53	0.29
E	0.2 - 0.1	0.5	0.45	0.24	0.43	0.49	0.21
F	less than 0.1	0.4	0.35	0.19	0.26	0.42	0.11

(3) Diameter of Pipeline

Diameter of pipelines are designed based on the design water discharge. The mean velocity of pipeline is calculated by Hazen-William's formula.

$$V = 0.355 \cdot C \cdot D^{0.63} \cdot I^{0.54}$$
$$Q = 0.279 \cdot C \cdot D^{2.63} \cdot I^{0.54}$$

where, V: mean velocity (m/s)
Q: mean discharge (m^3/s)
C: coefficient of velocity for steel pipe, C = 100
D: diameter of pipe (m)
I: hydraulic gradient

1) Pipeline between diversion works-1 and N-1

Design discharge: 0.31 m^3/s
Material of pipe: steel pipe

Assuming diameter of pipe as 600 mm and water head as 9 m,

$$V = 0.355 \times 100 \times 0.60^{0.63} \times (9/2900)^{0.54}$$
$$= 1.14 m^3/s$$
$$Q = 0.279 \times 100 \times 0.60^{2.63} \times (9/2900)^{0.54}$$
$$= 0.32 m^3/s > 0.31 m^3/s$$

2) Pipeline between Pantuflas dam and division works P-1

Design discharge	:	0.13 m^3/s
Material of pipe	:	steel pipe
EL of full water depth	:	EL 1260.0
EL of division works P-1	:	EL 1211.0
Water head	:	5 meter by using pressure reducing valve

$V = 0.355 \times 100 \times 0.40^{0.63} \times (5/750)^{0.54}$

$= 1.33 m/s$

$Q = 0.279 \times 100 \times 0.40^{2.63} \times (5/750)^{0.54}$

$= 0.17 m^3/s > 0.13 m^3/s$

3) Pipeline between diversion works P-1 and C-7

Design discharge	:	0.05 m^3/s
Material of pipe	:	steel pipe
EL of division works P-1	:	EL 1211.0
EL of pipeline end	:	EL 1185.0
Water head	:	26 meter

$V = 0.355 \times 100 \times 0.30^{0.63} \times (26/850)^{0.54}$

$= 2.53$ m/s

$Q = 0.279 \times 100 \times 0.30^{2.63} \times (26/850)^{0.54}$

$= 0.18\ m^3/s > 0.05\ m^3/s$

4) Pressure reducing equipment

The full water level of Pantuflas dam is EL 1261 m. On the other hand, the altitude of the division works P-1 where ø400 pipeline ends is EL 1210m. The water head of 51m. Pressure reducing equipment is required to lessen the pressure. Six butterfly valves connected in straight line are to be installed for pressure reducing to simplify their procurement and maintenance.

(4) Flume

a. Aqueduct No. 1, 2, 3, 4, 5

Design discharge: 0.2 - 0.3 m^3/s

Width of flume : 0.60 m

Water depth : 0.65 m

According to the Manning's formula,

$A = 0.60 \times 0.65$

$= 0.39\ m^2$

$R = 0.39/(0.60+0.65 \times 2)$

$= 0.205$ m

$V = 1/0.013 \times 0.205^{\frac{2}{3}} \times (1/1,000)^{\frac{1}{2}}$

$= 0.85$ m/s

$Q = 0.85 \times 0.39$

$= 0.33\ m^3/s$

b. Aqueduct No. 6

Design discharge: 0.1 m^3/s
Width of flume : 0.40 m
Water depth : 0.65 m

According to the Manning's formula,

$A = 0.40 \times 0.35$
$= 0.14\ m^2$
$R = 0.14/(0.40+0.35 \times 2)$
$= 0.127$ m

$V = 1/0.013 \times 0.127^{\frac{2}{3}} \times (1/1,000)^{\frac{1}{2}}$
$= 0.62$ m/s
$Q = 0.62 \times 0.14$
$= 0.09\ m^3/s$

(5) Datum of Open Canal

Datum for canals, laterals, division works and confluence works are shown as follows:

a. Main Canal List

Table 6.1.1-2 Canal Nueva Constanza

Type	Length (m)
Pipeline 600	2,900
C	3,500
D	3,300
E	3,400
F	500
Total	13,600

Table 6.1.1-3 Canal Constanza

Type	Length (m)
Pipeline 400	750
Pipeline 300	850
B	500
C	900
D	2,700
E	1,600
Total	7,300

Table 6.1.1-4 Canal Pantuflas

Type	Linear Meter (m)
F	1,600
Total	1,600

b. Lateral List

Table 6.1.1-5 Lateral List of Canal Nueva Constanza

Name	Length (m)	Type	Division works	Irrigated area
N-1	2,100	F	N-1	N-1
N-2	1,000	F	N-2	N-2
N-3	1,500	F	N-3	N-3
N-4	1,400	F	N-4	N-4
N-5	1,900	F	N-5	N-5
N-6	2,700	F	N-6	N-6
N-7	1,400	F	N-7	N-7
N-8	800	F	N-8	N-8
Total	12,800	-	-	-

Table 6.1.1-6 Lateral List of Canal Constanza

Name	Linear meter (m)	Type	Division works	Irrigating area
C-1	1,000	F	DIVISION WORKS-1	C-1
C-2	2,500	F	C-1	C-2
C-3	3,650	F	C-2	C-3
C-4	4,400	F	C-3	C-4
C-5	1,600	F	C-3	C-5
C-6	1,400	F	C-4	C-6
C-7	1,400	F	C-5	C-7
C-8	1,200	F	C-6	C-8
C-9	1,500	F	C-7	C-9
C-10	800	F	C-8	C-10
C-11	2,300	F	C-9,10	C-11
C-12	2,050	F	C-11	C-12
C-13	2,850	F	C-12	C-13
Total	26,650	-	-	-

Table 6.1.1-7 Lateral List of Canal Pantuflas

Name	Linear meter (m)	Type	Division works	Irrigating area
P-1	1,600	F	P-1	P-1
P-2	1,300	F	P-2	P-2
P-3	1,900	F	P-3	P-3
P-4	600	F	P-4	P-4
Total	5,400	-	-	-

7. Drainage Plan

The following drainage improvement works area to be taken place.

a. Drainage canal 1, 2, 3 and 4 are to be constructed. The structure should be unlined canal.

b. Maintenance of drainage canal 5 should be done.

c. The lateral 2 utilized for both irrigation and drainage canals is to be diverted to a drainage canal by reexcavation.
The cross section of the drainage canal is to be trapezoidal and its depth is to be 1.0m.

ANNEX P : COST ESTIMATION AND IMPLEMENTATION

ANNEX P : COST ESTIMATION AND IMPLEMENTATION

LIST OF TABLES

LIST OF FIGURES

ANNEX P : COST ESTIMATION AND IMPLEMENTATION

1. Construction Cost

1.1 Construction Schedule

(1) Construction Period

Construction period is decided as two years, considering the total quantities of construction, similar scale of previous projects in the neighboring area and similar kind of construction works.

Time of construction of each civil work is arranged so as to effect earlier economic benefit of the project eliminating water shortage, considering quantity and deployment of the proposed construction equipment and relationship among each civil work.

(2) Preparatory Works

Preparatory works will be conducted in the first one and half years, of which one year is for detailed design and preparation of tender documents and half year is for bidding and its evaluation. Topographic survey of the intake structure and other major structures, route survey of the irrigation and drainage canals and road networks and geological investigation of the said structures are included in the detailed design.

(3) Construction of Facilities

Construction of facilities will be commenced in the earliest stage of the whole construction schedule and will be completed in two years so that the project benefit can be obtained as early as possible after eliminating water shortage.

(4) Temporary Works

The access road, provision of borrow area, the contractor's camp office etc. will be made as temporary works by the contractor.

(5) Working Hours and Days

The construction works are planned to be carried out with net working period of 7hrs/day and 25 working days/month except the earth work which will be carried out with 20 to 22 working days/month due to suspension by rainfall.

Table 1.1.1-1 Implementation Schedule of the Constanza Valley Irrigation Project

Description	1989	1990	1991	1992	1993	Remarks
Feasibility Study						
Pre-Engineering						
Detail Design						
Tendering						
Construction						
1 Project Facilities						
2 Project Administration						
3 Consulting Services						
4 Civil Works						
4.1 Preparatory Works						
4.2 Dam						
(a) Foundation Treatment						
(b) Dam body						
(c) Spillway						
(d) Intake Facilities						
4.3 Diversion System						
(a) Diversion Weir						
(b) Driving Canal						
4.4 Canal Network System						
(a) Main Canal						
(b) Lateral Canal						
(c) Drainage Canal						
4.5 Others						

1.2 Project Cost

1.2.1 Condition of Cost Estimation

The Project cost is estimated under the following conditions.

(1) Equipment Cost

The construction works will be executed on contract basis. The construction machinery and equipment required for construction will be provided by the contractor. Accordingly, only depreciation costs of machinery and equipment are included to the equipment cost.

(2) Unit Cost

The unit cost of construction works is estimated on the basis of the prevailing unit prices of labour and materials in Dominican Republic.

The construction works are considered to be carried out on a contract basis through the international competitive tender.

The unit prices used for estimation of the project cost consists of the following items.

1) Labour unit prices per day

Description	Price (RD$)
Foreman	49.0
Skilled labour	34.0
Unskilled labour	29.0
Operator	42.0
Driver	33.0
Carpenter	36.0
Mason	45.0
Electrician	37.0

2) Unit prices of materials

Description	Unit	Price (Q)
Portland cement	bag	40
White cement	bag	90
Reinforcement	ton	4,050
Wood	m^3	935
Crushed stone	m^3	88.0
Sand	m^3	66.0
Gasoline	liter	1.59
Diesel oil	liter	0.74
Dynamite	kg	38.76
Percussion cop	Number	6.46

3) Proportion of foreign and local currencies

Proportion of the foreign and local currencies for the construction materials and equipment was applied as shown in the following table.

Description	Foreign currency(%)	Local currency(%)
Cement	80	20
Steel bar	80	20
Lumber	0	100
Fuel & oil	100	0
Labour	0	100
Explosive	100	0
Description cost of construction equipment	100	0

(3) Construction Cost

The construction cost is divided into the foreign and local currency portions. The local currency portion is estimated on the basis of the current price in the Dominican Republic as of October, 1989 and the foreign currency portion is estimated on the CIF price at Santo Domingo. Construction cost is estimated based on unit cost for individual working items.

(4) Indirect Cost

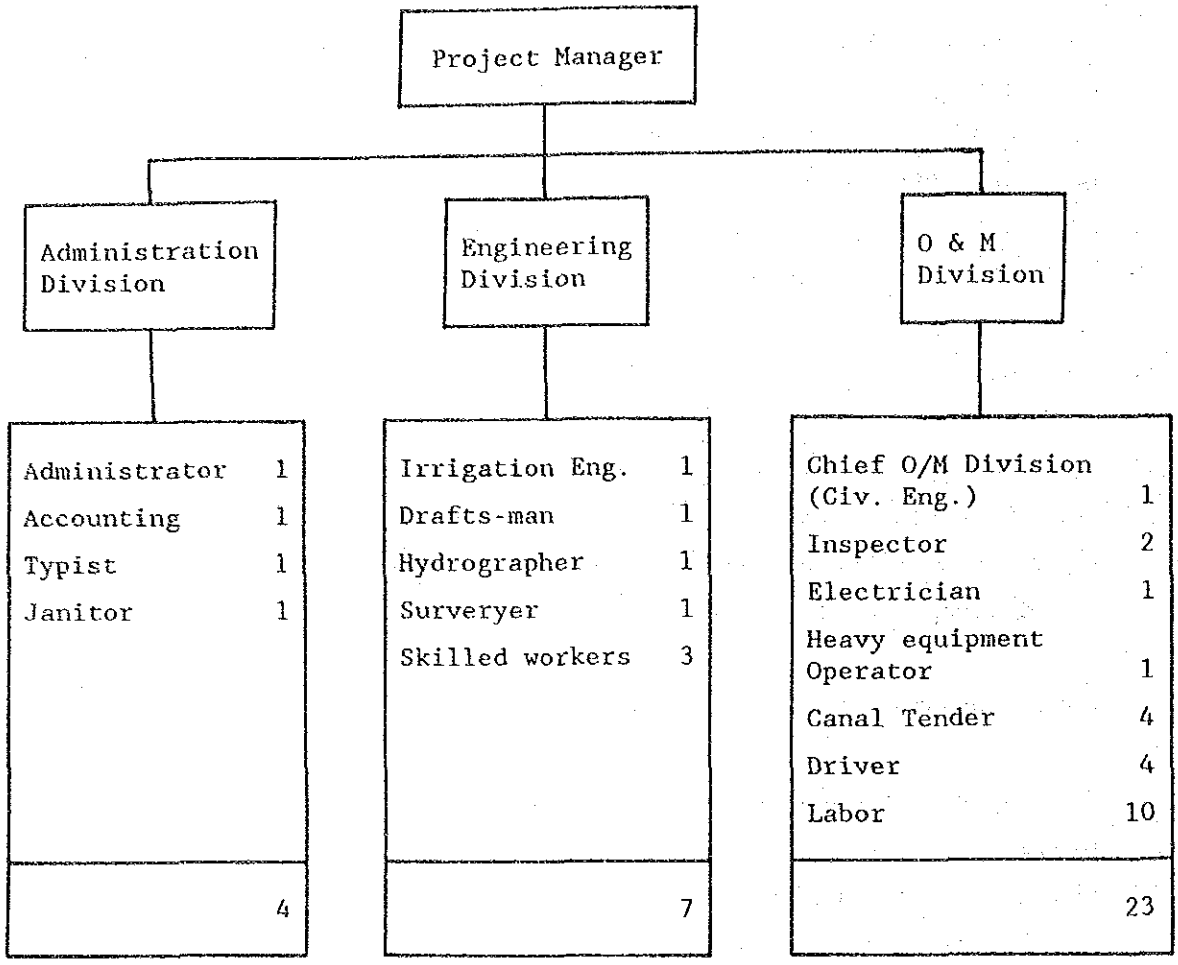
Indirect cost considered of O&M Equipment cost, engineering and administration cost. O&M equipment cost is provided for procurement of necessary equipment for maintenance of irrigation and drainage facilities.

1.2.2 Operation and Maintenance Cost

The operation and maintenance cost annually required for the project is composed of the salaries of O&M organization staff and the cost of operation and maintenance of O&M equipment and facilities. The estimated operation and maintenance cost is as follows.

(1) Staff and Facility of Operation and Maintenance for Constanza Irrigation Project.

1) O & M staff



2) Transportation and equipment

* Transportation	No.
Vehicle Station Wagon	1
Pick Up	3
Motor Cycle (125cc)	10

* Equipment	
Backhoe Excavator (0.15m^3)	1
Grader (3.7m)	1
Dump Truck (6ton)	1
Submergible pump (50mm)	1

(2) Calculation of O & M Cost

Operation and Maintenance Cost

Items	O & M Cost
	RD$
- Salary and Wages	380,350
- Equipment	261,224
- Material and Supplies	34,056
- Administration and General Expenditure	57,038
Total	732,568

Unit cost 732,568/1,510/2.4 = 202 RD$/ha

1) Salaries and wages

	Description	Month	No. person	Annual Salary	Total
1	Manager	D$2,000 (12+1)	1	26,000	26,000
2	Administration Division				
	Administrator	D$1,000 (12+1)	1	13,000	13,000
	Accounting	D$800 (12+1)	1	10,400	10,400
	Typist	D$750 (12+1)	1	9,750	9,750
	Janitor	D$650 (12+1)	1	8,450	8,450
	Sub Total				41,600
3	Engineering Division				
	Irrigation Engineer	D$1,800 (12+1)	1	23,400	23,400
	Draft man	D$750 (12+1)	1	9,750	9,750
	Hydrographer	D$750 (12+1)	1	7,750	9,750
	Surveyor	D$900 (12+1)	1	11,700	11,700
	Skilled labor	D$750 (12+1)	3	9,750	29,250
	Sub Total				83,850

4 O & M Division

Chief O/M Division				
(Civ. Eng.)	D$1,800 (12+1)	1	23,400	23,400
Inspector	D$750 (12+1)	2	9,750	19,500
Electrician	D$1,000 (12+1)	1	13,000	13,000
Heavy equipment				
Operator	D$800 (12+1)	1	10,400	10,400
Canal Tender	D$750 (12+1)	4	9,750	39,000
Driver	D$750 (12+1)	4	9,750	39,000
Labor	D$650 (12+1)	10	8,450	84,500
Sub Total				228,800
Total				380,250

2) Equipment for O & M

1 Depreciation Cost

	Quantity	Rate	Cost	Depreciation Cost (10%)
				RD$
Backhoe Excavator ($0.15m^3$)	1	586,000	586,000	58,600
Grader (3.7m)	1	1,047,000	1,047,000	104,700
Dump Truck (6ton)	1	250,000	250,000	25,000
Submerged pump (50mm)	1	4,000	4,000	400
Vehicle Station Wagon	1	184,000	184,000	18,400
Pick Up (1ton)	3	69,000	207,000	20,700
Motor Cycle (125cc)	10	23,000	230,000	23,000
Sub Total				254,800

2 Fuel and Oil

Heavy equipment

3 units x 10km/day x 200 day x 0.41 /km x 3.0 D$/3.78 lit

= RD$1,905

Vehicles

4 units x 30km/day x 300 day x 0.14 l/km x 3.0 D$/3.78 lit

= RD$4,000

Motor cycle

10 units x 30km/day x 300 day x 0.05 l/km x 3.0 D$/3.78 lit

= RD$3,571

Others (10%) = RD$948

Sub Total RD$10,424

Total RD$261,224

3) Materials and Supplies

Maintenance of Irrigation Canal

Main Canal

37.9km x 600RD$/km = 22,740RD$

Laterial Canal

27.4km x 300RD$/km = 8,220RD$

Others (10%)

30,960 x 0.10 = 3,096RD$

Total 34,056RD$

4) Administration and General Expenditure
(15% of salary)

380,250 x 15% = 57,038RD$

Grand Total 732,568RD$

1.2.3 Construction Cost

Construction cost for the civil works is shown in Table 1.2.2-1.

Table 1.2.2-1 Summary of Cost Estimation of Civil Works

Description	Amount RD$		Total Amount
	Foreign Currency	Local Currency	
1. Preparatory Works	1,917,543	1,257,600	3,175,143
2. Foundation Treatment	1,358,990	5,551,679	6,910,669
3. Dam Body	20,612,030	3,738,968	24,350,998
4. Spillway	1,263,470	2,724,775	3,988,245
5. Intake Facilities	332,831	454,604	787,435
6. Diversion Weir	180,762	307,340	488,102
7. Driving Canal	646,581	710,323	1,356,904
8. Main Canal	8,989,020	4,899,622	13,888,642
9. Lateral Canal	4,657,553	6,739,831	11,397,384
10. Drainage	303,220	32,258	335,478
Total	40,262,000	26,417,000	66,679,000

Table 1.2.2-2(1) Cost Estimation of Civil Works

Description	Quantity	Unit	Unit Cost		Amount		Total
			Foreign Currency	Local Currency	Foreign Currency	Local Currency	
(1)Preparatory Works		LS			1,917,543	1,257,600	3,175,143
(2)Foundation Treatment							
Excavation	4,200	cu.m	28.35	15.04	119,070	63,168	182,238
Cleaning of Bed Rock	5,000	cu.m	8.34	32.17	42,150	160,850	203,000
Grouting	7,000	m	130.44	135.48	913,080	948,360	1,861,440
Blanket Concrete	2,200	cu.m	-	476.53	-	1,048,366	1,048,366
Outlet Conduit Conc.	1,570	cu.m	-	1,380.85	-	2,167,935	2,167,935
Temporary Work		LS			161,145	658,302	819,447
Miscellaneous		LS			123,545	504,698	628,243
Total of (2)					1,358,990	5,551,679	6,910,669
(3)Dam Body							
Cutting & Reclamation	78,200	sq.m	0.34	0.71	26,588	55,522	82,110
Stripping	54,000	cu.m	28.32	3.68	1,529,280	198,720	1,728,000
Embankment Core 1	18,830	cu.m	33.67	2.29	634,006	43,120	677,126
Core 2	4,710	cu.m	29.51	8.48	138,992	39,941	178,933
Filter	8,560	cu.m	11.40	107.97	97,584	924,223	1,021,807
Transition	107,000	cu.m	44.76	2.78	4,789,320	297,460	5,086,780
Rock Shell	74,900	cu.m	104.27	14.78	7,809,823	1,107,022	8,916,845
Riprap	31,800	sq.m	39.89	9.11	1,268,502	289,698	1,558,200
Temporary Work		LS			2,444,114	443,356	2,887,470
Miscellaneous		LS			1,873,821	339,906	2,213,727
Total of (3)					20,612,030	3,738,968	24,350,998
(4)Spillway							
Excavation	1,300	cu.m	21.43	1.58	27,859	2,054	29,913
Rock Excavation (1)	2,400	cu.m	29.93	1.92	71,832	4,608	76,440
Rock Excavation (2)	6,000	cu.m	28.35	15.04	170,100	90,240	260,340
Reinforced Concrete	3,000	cu.m	243.00	685.69	729,000	2,057,070	2,786,070

Table 1.2.2-2(2) Cost Estimation of Civil Works

Description	Quantity	Unit	Unit Cost		Amount		Total
			Foreign Currency	Local Currency	Foreign Currency	Local Currency	
Temporary Work		LS			149,818	323,096	472,914
Miscellaneous		LS			114,861	247,707	362,568
Total of (4)					1,263,470	2,724,775	3,988,245
(5)Intake Facilities							
Foundation work		LS			149,926	323,104	473,030
Intake Valve	5	NOs	10,454.80	491.25	52,274	2,456	54,730
Spindle Pipe	245.5	m	242.54	8.17	59,543	2,006	61,549
R.C.Pipe		LS			-	31,805	31,805
Air Pipe	14	m	97.46	-	1,364	-	1,364
Temporary Work		LS			39,467	53,906	93,373
Miscellaneous		LS			30,257	41,327	71,584
Total of (5)					332,831	454,604	787,435
(6)Diversion Weir							
Excavation	735	cu.m	9.93	1.27	7,299	933	8,232
Rock Excavation	163	cu.m	23.56	13.44	3,840	2,191	6,031
Backfill	138	cu.m	10.42	0.98	1,438	135	1,573
Spoiling	760	cu.m	8.41	0.79	6,392	600	6,992
Lean Concrete	3.0	cu.m	195.00	479.31	585	1,438	2,023
Reinforced Concrete	147.0	cu.m	490.90	658.23	72,162	96,760	168,922
Grouting	90	cu.m	294.16	18.88	26,475	1,699	28,174
Gabion	874	cu.m	-	150.00	-	131,000	131,000
Bar Screen	8.1	ton	3,050.00	1,000.00	24,705	8,100	32,805
Temporary Work		LS			21,434	36,444	57,878
Miscellaneous		LS			16,432	27,940	44,372
Total of (6)					180,762	307,340	488,102
(7)Driving Canal							

Table 1.2.2-2(3) Cost Estimation of Civil Works

Description	Quantity	Unit	Unit Cost		Amount		Total
			Foreign Currency	Local Currency	Foreign Currency	Local Currency	
Excavation	8,922	cu.m	9.93	1.27	88,595	11,331	99,926
Embankment	3,776	cu.m	18.27	1.73	68,988	6,532	75,520
Backfill	4,281	cu.m	10.42	0.98	44,608	4,195	48,803
Spoiling	865	cu.m	8.41	0.79	7,275	683	7,958
Lean Concrete	192.0	cu.m	195.00	479.31	37,440	92,028	129,468
Reinforced Concrete	373.0	cu.m	490.90	658.23	183,106	245,519	428,625
Wet Masonry	5,408	sq.m	15.00	37.21	81,120	201,232	282,352
Temporary Work		LS			76,670	84,228	160,898
Miscellaneous		LS			58,779	64,575	123,354
Total of (7)					646,581	710,323	1,356,904
(8)Main Canal							
(a)Canal							
Excavation	25,276	cu.m	9.93	1.27	250,991	32,101	283,092
Embankment	21,720	cu.m	18.27	1.73	396,824	37,576	434,400
Spoiling	3,556	cu.m	8.41	0.79	29,906	2,809	32,715
Wet Masonry	55,723	sq.m	15.00	37.21	835,845	2,073,453	2,909,298
Temporary Work		LS			227,035	321,891	548,926
Sub-total of (a)					1,740,601	2,467,830	4,208,431
(b)Irrigation Structure							
Division Work	1	NOs			36,482	51,327	87,809
Aqueduct	6	NOs			233,518	343,083	576,601
Shute	2	NOs			45,023	56,172	101,195
Siphone	1	NOs			312,875	265,505	578,380
Small Intake	1	NOs			440,276	380,222	820,498
Box culvert	1	NOs			12,612	10,170	22,782
Pipeline		LS			5,350,449	879,893	6,230,342
Sub-total of (b)					6,431,235	1,986,372	8,417,607

Table 1.2.2-2(4) Cost Estimation of Civil Works

Description	Quantity	Unit	Unit Cost		Amount		Total
			Foreign Currency	Local Currency	Foreign Currency	Local Currency	
(c)Miscellaneous		LS			817,184	445,420	1,262,604
Total of (8)					8,989,020	4,899,622	13,888,642
(9)Lateral Canal							
(a)Canal							
Excavation	34,535	cu.m	9.93	1.27	342,933	43,859	386,792
Embankment	34,535	cu.m	18.27	1.73	630,954	59,745	690,700
Wet Masonry	108,089	sq.m	15.00	37.21	1,621,335	4,021,992	5,643,327
Temporary Work		LS			389,283	518,840	1,008,123
Sub-total of (a)					2,984,505	4,744,437	7,728,942
(b)Irrigation Structure							
Division Work	25	NOs			278,521	420,320	698,841
Small Intake	1	NOs			135,606	110,729	246,335
Farm Pond	21				835,507	851,633	1,687,140
Sub-total of (b)					1,249 634	1,382,682	2,632,316
(c)Miscellaneous					423,414	612,712	1,036,126
Total of (9)					4,657,553	6,739,831	11,397,384
(10)Drainage							
Excavation		cu.m	9.93	1.27	84,405	10,795	95,200
Embankment		cu.m	18.27	1.73	155,295	14,705	170,000
Temporary Work		LS			35,955	3,825	39,780
Miscellaneous		LS			27,565	2,933	30,498
Total of (10)					303,220	32,258	335,478
Grand Total					40,262,000	26,417,000	66,679,000

2. Implementation

The project is roughly divided into two stages; Construction Stage and Operation and maintenance stage.

2.1 Executing Agency of the Construction

Considering the administration system in the government organization of the Dominican Republic and evaluating the experiences in execution of similar type of projects, INDRHI will be justified to be the executing agency of the project since the major components of the project are of irrigation and drainage facilities.

INDRHI has sufficient experiences and is competent in carrying out detailed design, construction and O/M of the irrigation and drainage facilities.

The previous executing mode of similar projects in the Dominican Republic shows that most of the large scale of the projects were carried out in contract basis and small scale were carried out in force account basis. Therefore, it is considered that contract basis will be appropriate for the construction of the project.

In this connection, at the implementation of the project, it is recommended that the following modes shall be taken by INDRHI.

a. to employ an engineering consultants for carrying out detailed design including topographic survey and geological investigation, preparation of tender documents, tender evaluation and construction supervision.

b. to construct the project facilities by selected and qualified contractors.

2.2 Financing

The foreign currency portion of the Project will be financed by the international financing institute. While, the local currency portion will be appropriated by the government of the Dominican Republic.

2.3 Operation and Maintenance Policy

This project intends for the enlargement of irrigation facilities at the present irrigated area in Constanza Valley. Therefore the present irrigation system which is mainly controlled by INDRHI should be considered as the basic for the operation and maintenance. On the other hand, voluntary intension of farmers who obtain the irrigation benefit are to be highly esteemed. Association of water control is to be established in the Valley and operation and maintenance of this system is to be trusted to the association.

INDRHI will have the role of advisory organization. Collection of irrigation fee is to be taken place by the association. The cost for the operation and maintenance is to be furnished as the irrigation cost as much possible and burden of cost for INDRHI is to be lightened.

The organization including agricultural production and guidance of circulation is to be established for the purpose of permanent management of the project. The organization is to manage the project smoothly from not only the aspect of facilities but also agricultural management. Basically the operation and maintenance of the project is to be executed by beneficiaries. Its organization chart is shown below.

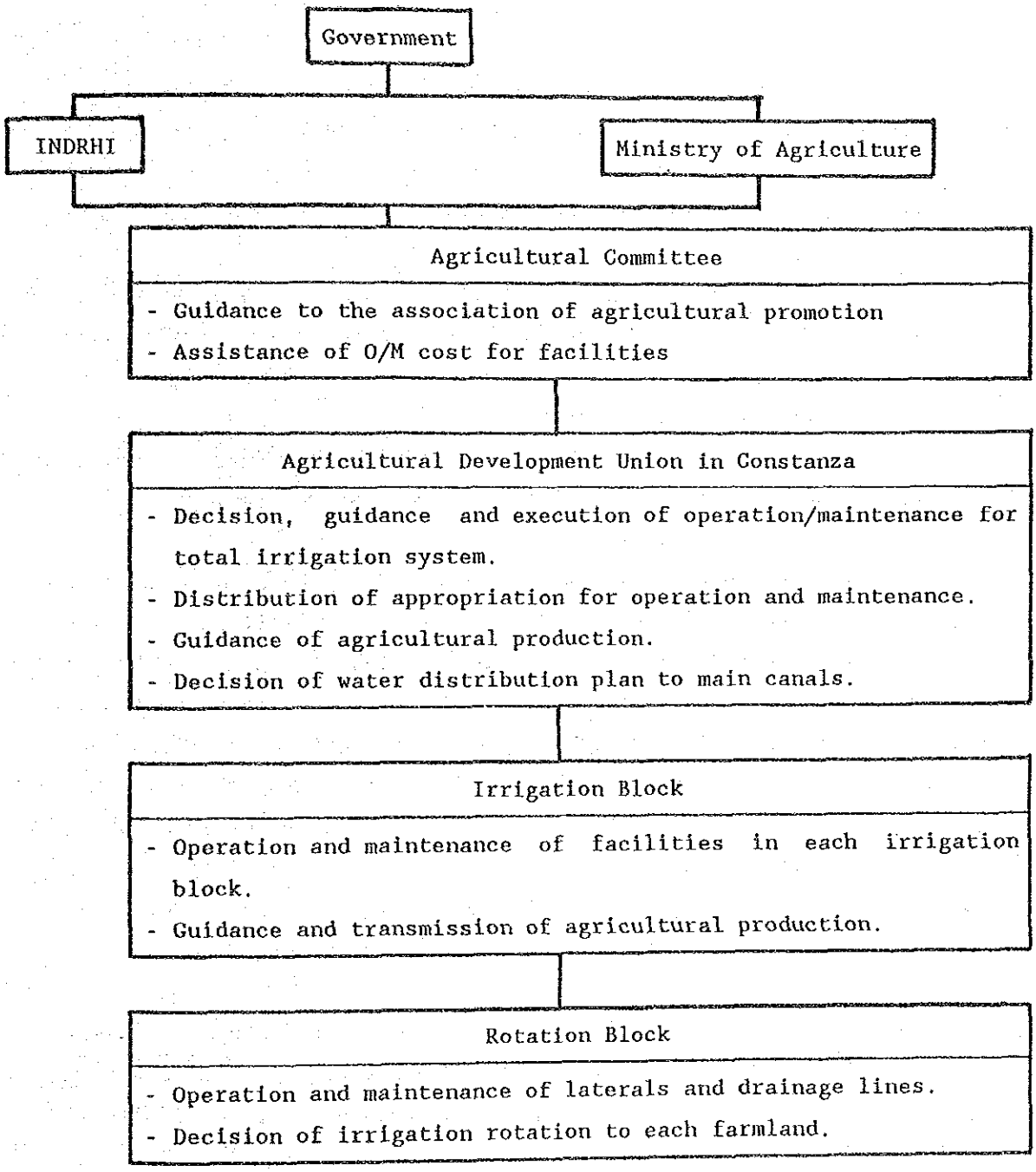


Fig. 2.3.1-1 Organization Chart of Operation and Maintenance

2.3.1 Direction of Operation and Maintenance

The direction of operation and maintenance is as follows.

- Divide the project area into 21 irrigation blocks.
- Organize farmer's union in each irrigation block.
- Organize irrigation union in each main canal.
- Organize agricultural development union which controls all irrigated area in the Valley.

Beneficiaries in the irrigation block will be the members of each irrigation association. The operation and maintenance will be executed by the irrigation association.

2.3.2 System of Operation and Maintenance

The system for operation and maintenance is to be organized in order to make adequate use of project facilities. The agricultural committee which is constituted by INDRHI, Ministry of Agriculture and Agriculture Development Union in Constanza, decides the direction of the project. The cost for operation and maintenance is to be furnished by beneficiaries in principle, but the rate of assistance by the government is to be decided by the committee in case that the burden charge of the beneficiaries is too high. It also guide and give advice to the problems which is difficult to be solved by the Agricultural Development Union.

The Agricultural Development Union in Constanza is the organization responsible to carry out the project. It has two sections of water management and guidance of agricultural production.

Each section carries on the following works.

(1) Water Control Section

- Control of irrigation area and water demand
- Collection of water charge and necessary information for its control.
- Analysis of information and planning of water distribution plan.
- Discharge from Pantuflas dam
- Distribution of appropriation for control of water distribution and for operation and maintenance.
- Guidance and indication to the irrigation association.

(2) Guidance Section of Agricultural Production

- Guidance for technical improvement of crop production.
- Guidance for common purchase of productive materials.
- Guidance for common sales of agricultural products.
- Collection of market information.

Actual operation and control are to be executed by the irrigation association, the farmer's union and each irrigation block laterals and main canals are to be managed by the irrigation block and the irrigation association respectively.

ANNEX Q : PROJECT EVALUATION

ANNEX Q : PROJECT EVALUATION

LIST OF TABLES

Table 1.1 Benefit by Each Crop(Economic price)

Crop	Cropping Area ha	Per hectare Yield t/ha	Unit Price RD$/t	Gross Profit RD$	Product Cost RD$	Net Profit RD$	Total Net Profit RD$
Without Project							
Garlic	885	6.4	13,800	88,320	53,995	34,325	30,377,625
Potato	978	19.9	2,670	53,133	21,074	32,059	31,353,702
Kidney beans	419	1.2	8,800	10,560	4,452	6,108	2,559,252
Onion	326	12.0	3,890	46,680	26,948	19,732	6,432,632
Lettuce	233	21.6	850	18,360	9,037	9,323	2,172,259
Carrot	280	17.9	1,760	31,504	11,276	20,228	5,663,840
Beet	186	27.9	770	21,483	9,246	12,237	2,276,082
Other veg.	181	22.4	1,600	35,840	16,684	19,156	3,467,236
Export Veg.							
Graminae							
Total							84,302,628
With Project							
Garlic	888	8.1	13,800	111,780	55,967	55,813	49,561,944
Potato	888	23.5	2,670	62,745	22,825	39,920	35,448,960
Kidney beans	296	1.3	8,800	11,440	5,938	5,502	1,628,592
Onion	296	13.1	3,890	50,959	28,670	22,289	6,597,544
Lettuce	182	23.5	850	19,975	10,658	9,317	1,695,694
Carrot	219	19.6	1,760	34,496	12,875	21,621	4,734,999
Beet	145	30.5	770	23,485	11,123	12,362	1,792,490
Other veg.	142	26.2	1,600	41,920	19,643	22,277	3,163,334
Export Veg.	200	26.2	1,600	55,754	19,643	36,111	7,222,200
Graminae	296	8.0	730	5,840	4,567	1,273	376,808
Total							112,222,565

Crop benefit = Net profit with project - Net profit without project
= RD$ 112,222,565 - RD$ 84,302,628 = RD$ 27,919,937

Table 1.2 Benefit by Each Crop(Financial price)

Crop	Cropping Area ha	Per hectare Yield t/ha	Unit Price RD$/t	Gross Profit RD$	Product Cost RD$	Net Profit RD$	Total Net Profit RD$
Without Project							
Garlic	885	6.4	13,800	88,320	52,163	36,157	31,998,945
Potato	978	19.9	2,670	53,133	19,682	33,451	32,715,078
Kidney beans	419	1.2	8,800	10,560	4,933	5,627	2,357,713
Onion	326	12.0	3,890	46,680	26,189	20,491	6,680,066
Lettuce	233	21.6	850	18,360	11,877	6,483	1,510,539
Carrot	280	17.9	1,760	31,504	13,526	17,978	5,033,840
Beet	186	27.9	770	21,483	11,024	10,459	1,945,374
Other veg.	181	22.4	1,600	35,840	21,349	14,491	2,622,871
Export Veg.							
Graminae							
Total							84,864,426
With Project							
Garlic	888	8.1	13,800	111,780	54,426	57,354	50,930,352
Potato	888	23.5	2,670	62,745	21,511	41,234	36,615,792
Kidney beans	296	1.3	8,800	11,440	6,405	5,035	1,490,360
Onion	296	13.1	3,890	50,959	27,994	22,965	6,797,640
Lettuce	182	23.5	850	19,975	13,514	6,461	1,175,902
Carrot	219	19.6	1,760	34,496	15,120	19,376	4,243,344
Beet	145	30.5	770	23,485	12,697	10,788	1,564,260
Other veg.	142	26.2	1,600	41,920	24,504	17,416	2,473,072
Export Veg.	200	26.2	1,600	41,920	24,504	17,416	3,483,200
Graminae	296	8.0	730	5,840	5,126	714	211,344
Total							108,985,266

Crop benefit = Net profit with project - Net profit without project
= RD$ 108,985,266 - RD$ 84,864,426 = RD$ 24,120,840

Table 2.1(1) Production Cost by Each Crop per Unit Area

(Financial and Economic Price)

Unit:RDS

	Conversion factor	Garlic		Potato		Kidney been		Onion		Lettuce	
		Financial	Economy	Financial	Economy	Financial	Economy	Financial	Economy	Financial	Economy
Without Project											
Cost											
Seed	1.33	27.072	36.006	6.680	8.884	588	782	11.634	15.473	133	177
Fertilizer											
Organic	——										
Chemical	1.33	2.528	3.362	1.968	2.617	638	849	1.965	2.613	1.275	1.696
Pesticide	1.33	2.985	3.970	3.775	5.021	470	625	1.678	2.232	570	758
Rental machinery	——	576	576	458	458	544	544	717	717	528	528
Water charge	——	56	56	56	56	56	56	56	56	56	56
Labor											
Family	1.00	4.120	4.120	1.680	1.680	720	720	2.480	2.480	2.800	2.800
Employed	0.44	8.240	3.626	3.320	1.461	1.480	651	5.000	2.200	5.620	2.473
Others	——	2.279	2.279	897	897	225	225	1.177	1.177	549	549
Interest	——	4.307	——	848	——	212	——	1.482	——	346	——
Total		52.163	53.995	19.682	21.074	4.933	4.452	26.189	26.948	11.877	9.037
With Project											
Cost											
Seed	1.33	27.072	36.006	6.680	8.884	588	782	11.634	15.473	133	177
Fertilizer											
Organic		500	500	500	500	500	500	500	500	500	500
Chemical	1.33	2.653	3.528	2.064	2.745	667	887	2.054	2.732	1.336	1.777
Pesticide	1.33	2.985	3.970	3.775	5.021	470	625	1.678	2.232	570	758
Rental machinery		576	576	458	458	544	544	717	717	528	528
Water charge		648	795	648	795	648	795	648	795	648	795
Labor											
Family	1.00	4.360	4.360	1.840	1.840	800	800	2.640	2.640	2.920	2.920
Employed	0.44	8.760	3.854	3.640	1.602	1.620	713	5.280	2.323	5.860	2.578
Others		2.378	2.378	980	980	292	292	1.258	1.258	625	625
Interest		4.494		926		276	——	1.585	——	394	——
Total		54.426	55.967	21.511	22.825	6.405	5.938	27.994	28.670	13.514	10.658

Table 2.1(2) Production Cost by Each Crop per Unit Area

(Financial and Economic Price)

Unit:RD$

	Conversion factor	Carrot		Beet		Vegetables		Graminae	
		Financial	Economy	Financial	Economy	Financial	Economy	Financial	Economy
Without Project									
Cost									
Seed	1.33	568	755	1.198	1.593	693	922		
Fertilizer									
Organic	—								
Chemical	1.33	1.333	1.733	1.610	2.141	2.661	3.539		
Pesticide	1.33	2.208	2.937	723	723	2.719	3.616		
Rental machinery	—	467	467	480	480	608	608		
Water charge	—	56	56	56	56	56	56		
Labor									
Family	1.00	2.520	2.520	2.000	2.000	4.240	4.240		
Employed	0.44	5.000	2.200	3.980	1.751	8.480	3.731		
Others	—	608	608	502	502	973	973		
Interest	—	766	——	475	——	919	——		
Total		13.526	11.276	11.024	9.246	21.349	16.684		
With Project									
Cost									
Seed	1.33	568	755	1.198	1.593	693	922	361	480
Fertilizer									
Organic	—	500	500	500	500	500	500	500	500
Chemical	1.33	1.394	1.854	1.682	2.237	2.782	3.700	469	624
Pesticide	1.33	2.208	2.937	723	962	2.719	2.616	322	428
Rental machinery	—	467	467	480	480	608	608	320	320
Water charge	—	648	795	648	795	648	795	648	795
Labor									
Family	1.00	2.600	2.600	2.120	2.120	4.480	4.480	640	640
Employed	0.44	5.200	2.288	4.220	1.857	8.980	4.951	1.260	554
Others	—	679	679	579	579	1.071	1.071	226	226
Interest	—	856	——	547	——	2.023	——	380	——
Total		15.120	12.375	12.697	11.123	24.504	19.643	5.126	4.567

Table 3.1 Cash Flow of Economic Cost and Benefit

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	798	0	0	798	0	1.000	798	0
2	19165	0	0	19165	0	0.868	16641	0
3	59180	0	0	59180	-8430	0.754	44617	-6355
4	36007	316	0	36323	-25290	0.655	23777	-16555
5	0	478	0	478	19544	0.568	272	11109
6	0	478	0	478	22336	0.494	236	11023
7	0	478	0	478	25128	0.429	205	10768
8	0	478	0	478	27920	0.372	178	10388
9	0	478	0	478	27920	0.323	154	9020
10	0	478	0	478	27920	0.281	134	7832
11	0	478	0	478	27920	0.244	116	6800
12	0	478	0	478	27920	0.211	101	5904
13	0	478	0	478	27920	0.184	88	5127
14	0	478	3389	3867	27920	0.159	617	4451
15	0	478	0	478	27920	0.138	66	3865
16	0	478	0	478	27920	0.120	57	3356
17	0	478	0	478	27920	0.104	50	2914
18	0	478	0	478	27920	0.091	43	2530
19	0	478	0	478	27920	0.079	38	2197
20	0	478	0	478	27920	0.068	33	1908
21	0	478	0	478	27920	0.059	28	1656
22	0	478	0	478	27920	0.052	25	1438
23	0	478	0	478	27920	0.045	21	1249
24	0	478	3389	3867	27920	0.039	150	1084
25	0	478	0	478	27920	0.034	16	941
26	0	478	0	478	27920	0.029	14	817
27	0	478	0	478	27920	0.025	12	710
28	0	478	0	478	27920	0.022	11	616
29	0	478	0	478	27920	0.019	9	535
30	0	478	0	478	27920	0.017	8	465
31	0	478	0	478	27920	0.014	7	403
32	0	478	0	478	27920	0.013	6	350
33	0	478	0	478	27920	0.011	5	304
34	0	478	3389	3867	27920	0.009	37	264
35	0	478	0	478	27920	0.008	4	229
36	0	478	0	478	27920	0.007	3	199
37	0	478	0	478	27920	0.006	3	173
38	0	478	0	478	27920	0.005	3	150
39	0	478	0	478	27920	0.005	2	130
40	0	478	0	478	27920	0.004	2	113
41	0	478	0	478	27920	0.004	2	98
42	0	478	0	478	27920	0.003	1	85
43	0	478	0	478	27920	0.003	1	74
44	0	478	3389	3867	27920	0.002	9	64
45	0	478	0	478	27920	0.002	1	56
46	0	478	0	478	27920	0.002	1	48
47	0	478	0	478	27920	0.002	1	42
48	0	478	0	478	27920	0.001	1	37
49	0	478	0	478	27920	0.001	1	32
50	0	478	0	478	27920	0.001	0	28
Total	115150	22304	13556	151010	1233848	7.585	88604	88674

B / C =1.000790
B - C =69.99711
E I R R = 0.1517

Table 3.2 Economic Net Present Value and Benefit-Cost Ratio (discount rate 12%)

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	798	0	0	798	0	1.000	798	0
2	19165	0	0	19165	0	0.893	17112	0
3	59180	0	0	59180	-8430	0.797	47178	-6720
4	36007	316	0	36323	-25290	0.712	25854	-18001
5	0	478	0	478	19544	0.636	304	12421
6	0	478	0	478	22336	0.567	271	12674
7	0	478	0	478	25128	0.507	242	12731
8	0	478	0	478	27920	0.452	216	12630
9	0	478	0	478	27920	0.404	193	11276
10	0	478	0	478	27920	0.361	172	10068
11	0	478	0	478	27920	0.322	154	8989
12	0	478	0	478	27920	0.287	137	8026
13	0	478	0	478	27920	0.257	123	7166
14	0	478	3389	3867	27920	0.229	886	6399
15	0	478	0	478	27920	0.205	98	5713
16	0	478	0	478	27920	0.183	87	5101
17	0	478	0	478	27920	0.163	78	4554
18	0	478	0	478	27920	0.146	70	4066
19	0	478	0	478	27920	0.130	62	3631
20	0	478	0	478	27920	0.116	55	3242
21	0	478	0	478	27920	0.104	50	2894
22	0	478	0	478	27920	0.093	44	2584
23	0	478	0	478	27920	0.083	40	2307
24	0	478	3389	3867	27920	0.074	285	2060
25	0	478	0	478	27920	0.066	31	1839
26	0	478	0	478	27920	0.059	28	1642
27	0	478	0	478	27920	0.053	25	1466
28	0	478	0	478	27920	0.047	22	1309
29	0	478	0	478	27920	0.042	20	1169
30	0	478	0	478	27920	0.037	18	1044
31	0	478	0	478	27920	0.033	16	932
32	0	478	0	478	27920	0.030	14	832
33	0	478	0	478	27920	0.027	13	743
34	0	478	3389	3867	27920	0.024	92	663
35	0	478	0	478	27920	0.021	10	592
36	0	478	0	478	27920	0.019	9	529
37	0	478	0	478	27920	0.017	8	472
38	0	478	0	478	27920	0.015	7	422
39	0	478	0	478	27920	0.013	6	376
40	0	478	0	478	27920	0.012	6	336
41	0	478	0	478	27920	0.011	5	300
42	0	478	0	478	27920	0.010	5	268
43	0	478	0	478	27920	0.009	4	239
44	0	478	3389	3867	27920	0.008	30	214
45	0	478	0	478	27920	0.007	3	191
46	0	478	0	478	27920	0.006	3	170
47	0	478	0	478	27920	0.005	3	152
48	0	478	0	478	27920	0.005	2	136
49	0	478	0	478	27920	0.004	2	121
50	0	478	0	478	27920	0.004	2	108
Total	115150	22304	13556	151010	1233848	9.301	94895	130078

B / C =1.370768
B - C =35183.93

Table 4.1 Cash Flow of Economic Cost and Benefit

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replace ment Cost	Total		Discount Rate	Cost	Benefit
1	640	0	0	640	0	1.000	640	0
2	17726	0	0	17726	0	0.883	15653	0
3	57217	0	0	57217	-8486	0.780	44620	-6618
4	40236	484	0	40720	-25459	0.689	28042	-17532
5	0	732	0	732	16884	0.608	445	10268
6	0	732	0	732	19296	0.537	393	10363
7	0	732	0	732	21708	0.474	347	10295
8	0	732	0	732	24120	0.419	307	10101
9	0	732	0	732	24120	0.370	271	8920
10	0	732	0	732	24120	0.327	239	7877
11	0	732	0	732	24120	0.288	211	6956
12	0	732	0	732	24120	0.255	186	6143
13	0	732	0	732	24120	0.225	165	5425
14	0	732	0	732	24120	0.199	145	4790
15	0	732	0	732	24120	0.175	128	4230
16	0	732	0	732	24120	0.155	113	3736
17	0	732	0	732	24120	0.137	100	3299
18	0	732	0	732	24120	0.121	88	2913
19	0	732	0	732	24120	0.107	78	2573
20	0	732	0	732	24120	0.094	69	2272
21	0	732	0	732	24120	0.083	61	2006
22	0	732	0	732	24120	0.073	54	1772
23	0	732	0	732	24120	0.065	47	1565
24	0	732	0	732	24120	0.057	42	1382
25	0	732	0	732	24120	0.051	37	1220
26	0	732	0	732	24120	0.045	33	1077
27	0	732	0	732	24120	0.039	29	951
28	0	732	0	732	24120	0.035	25	840
29	0	732	0	732	24120	0.031	23	742
30	0	732	0	732	24120	0.027	20	655
31	0	732	0	732	24120	0.024	18	579
32	0	732	0	732	24120	0.021	16	511
33	0	732	0	732	24120	0.019	14	451
34	0	732	0	732	24120	0.017	12	398
35	0	732	0	732	24120	0.015	11	352
36	0	732	0	732	24120	0.013	9	311
37	0	732	0	732	24120	0.011	8	274
38	0	732	0	732	24120	0.010	7	242
39	0	732	0	732	24120	0.009	6	214
40	0	732	0	732	24120	0.008	6	189
41	0	732	0	732	24120	0.007	5	167
42	0	732	0	732	24120	0.006	4	147
43	0	732	0	732	24120	0.005	4	130
44	0	732	0	732	24120	0.005	3	115
45	0	732	0	732	24120	0.004	3	101
46	0	732	0	732	24120	0.004	3	90
47	0	732	0	732	24120	0.003	2	79
48	0	732	0	732	24120	0.003	2	70
49	0	732	0	732	24120	0.003	2	62
50	0	732	0	732	24120	0.002	2	54
Total	115819	34156	0	149975	1061103	8.536	92750	92759

B / C =1.000096
B - C =8.980800
F I R R = 0.1324

Table 4.2 Economic Net Present Value and Benefit-Cost Ratio
(discount rate 12%)

(Unit : RD$ 1,000)

Year In Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	640	0	0	640	0	1.000	640	0
2	17726	0	0	17726	0	0.893	15827	0
3	57217	0	0	57217	-8486	0.797	45613	-6765
4	40236	484	0	40720	-25459	0.712	28984	-18121
5	0	732	0	732	16884	0.636	465	10730
6	0	732	0	732	19296	0.567	415	10949
7	0	732	0	732	21708	0.507	371	10998
8	0	732	0	732	24120	0.452	331	10911
9	0	732	0	732	24120	0.404	296	9742
10	0	732	0	732	24120	0.361	264	8698
11	0	732	0	732	24120	0.322	236	7766
12	0	732	0	732	24120	0.287	210	6934
13	0	732	0	732	24120	0.257	188	6191
14	0	732	0	732	24120	0.229	168	5528
15	0	732	0	732	24120	0.205	150	4935
16	0	732	0	732	24120	0.183	134	4407
17	0	732	0	732	24120	0.163	119	3934
18	0	732	0	732	24120	0.146	107	3513
19	0	732	0	732	24120	0.130	95	3137
20	0	732	0	732	24120	0.116	85	2800
21	0	732	0	732	24120	0.104	76	2500
22	0	732	0	732	24120	0.093	68	2233
23	0	732	0	732	24120	0.083	60	1993
24	0	732	0	732	24120	0.074	54	1780
25	0	732	0	732	24120	0.066	48	1589
26	0	732	0	732	24120	0.059	43	1419
27	0	732	0	732	24120	0.053	38	1267
28	0	732	0	732	24120	0.047	34	1131
29	0	732	0	732	24120	0.042	31	1010
30	0	732	0	732	24120	0.037	27	902
31	0	732	0	732	24120	0.033	24	805
32	0	732	0	732	24120	0.030	22	719
33	0	732	0	732	24120	0.027	19	642
34	0	732	0	732	24120	0.024	17	573
35	0	732	0	732	24120	0.021	16	512
36	0	732	0	732	24120	0.019	14	457
37	0	732	0	732	24120	0.017	12	408
38	0	732	0	732	24120	0.015	11	364
39	0	732	0	732	24120	0.013	10	325
40	0	732	0	732	24120	0.012	9	290
41	0	732	0	732	24120	0.011	8	259
42	0	732	0	732	24120	0.010	7	231
43	0	732	0	732	24120	0.009	6	207
44	0	732	0	732	24120	0.008	6	185
45	0	732	0	732	24120	0.007	5	165
46	0	732	0	732	24120	0.006	4	147
47	0	732	0	732	24120	0.005	4	131
48	0	732	0	732	24120	0.005	4	117
49	0	732	0	732	24120	0.004	3	105
50	0	732	0	732	24120	0.004	3	93
Total	115819	34156	0	149975	1061103	9.301	95382	108845

B / C =1.141149
B - C =13463.06

Table 5.1 Economic Sensitivity Analysis(Increase of Construction cost by 10%)

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	878	0	0	878	0	1.000	878	0
2	21082	0	0	21082	0	0.876	18461	0
3	65098	0	0	65098	-8430	0.767	49916	-6464
4	39608	316	0	39924	-25290	0.671	26806	-16981
5	0	478	0	478	19544	0.588	281	11491
6	0	478	0	478	22336	0.515	246	11499
7	0	478	0	478	25128	0.451	215	11328
8	0	478	0	478	27920	0.395	189	11022
9	0	478	0	478	27920	0.346	165	9651
10	0	478	0	478	27920	0.303	145	8451
11	0	478	0	478	27920	0.265	127	7400
12	0	478	0	478	27920	0.232	111	6480
13	0	478	0	478	27920	0.203	97	5674
14	0	478	3389	3867	27920	0.178	688	4969
15	0	478	0	478	27920	0.156	74	4351
16	0	478	0	478	27920	0.136	65	3810
17	0	478	0	478	27920	0.119	57	3336
18	0	478	0	478	27920	0.105	50	2921
19	0	478	0	478	27920	0.092	44	2558
20	0	478	0	478	27920	0.080	38	2240
21	0	478	0	478	27920	0.070	34	1962
22	0	478	0	478	27920	0.062	29	1718
23	0	478	0	478	27920	0.054	26	1504
24	0	478	3389	3867	27920	0.047	182	1317
25	0	478	0	478	27920	0.041	20	1153
26	0	478	0	478	27920	0.036	17	1010
27	0	478	0	478	27920	0.032	15	884
28	0	478	0	478	27920	0.028	13	774
29	0	478	0	478	27920	0.024	12	678
30	0	478	0	478	27920	0.021	10	594
31	0	478	0	478	27920	0.019	9	520
32	0	478	0	478	27920	0.016	8	455
33	0	478	0	478	27920	0.014	7	399
34	0	478	3389	3867	27920	0.013	48	349
35	0	478	0	478	27920	0.011	5	306
36	0	478	0	478	27920	0.010	5	268
37	0	478	0	478	27920	0.008	4	234
38	0	478	0	478	27920	0.007	4	205
39	0	478	0	478	27920	0.006	3	180
40	0	478	0	478	27920	0.006	3	157
41	0	478	0	478	27920	0.005	2	138
42	0	478	0	478	27920	0.004	2	121
43	0	478	0	478	27920	0.004	2	106
44	0	478	3389	3867	27920	0.003	13	93
45	0	478	0	478	27920	0.003	1	81
46	0	478	0	478	27920	0.003	1	71
47	0	478	0	478	27920	0.002	1	62
48	0	478	0	478	27920	0.002	1	54
49	0	478	0	478	27920	0.002	1	48
50	0	478	0	478	27920	0.001	1	42
Total	126666	22304	13556	162526	1233848	8.032	99132	99220

B / C =1.000890
B - C =88.27449
E I R R = 0.142

Table 5.2 Economic sensitivity Analysis(Decrease of Project Benefit by 10%)

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	798	0	0	798	0	1.000	798	0
2	19165	0	0	19165	0	0.869	16659	0
3	59180	0	0	59180	-8430	0.756	44717	-6370
4	36007	316	0	36323	-25290	0.657	23858	-16611
5	0	478	0	478	17590	0.571	273	10043
6	0	478	0	478	20102	0.496	237	11086
7	0	478	0	478	22615	0.431	206	10841
8	0	478	0	478	25128	0.375	179	10471
9	0	478	0	478	25128	0.326	156	9102
10	0	478	0	478	25128	0.283	135	7912
11	0	478	0	478	25128	0.246	118	6877
12	0	478	0	478	25128	0.214	102	5978
13	0	478	0	478	25128	0.186	89	5197
14	0	478	3389	3867	25128	0.162	626	4517
15	0	478	0	478	25128	0.141	67	3927
16	0	478	0	478	25128	0.122	58	3413
17	0	478	0	478	25128	0.106	51	2967
18	0	478	0	478	25128	0.092	44	2579
19	0	478	0	478	25128	0.080	38	2242
20	0	478	0	478	25128	0.070	33	1949
21	0	478	0	478	25128	0.061	29	1694
22	0	478	0	478	25128	0.053	25	1473
23	0	478	0	478	25128	0.046	22	1280
24	0	478	3389	3867	25128	0.040	154	1113
25	0	478	0	478	25128	0.035	17	967
26	0	478	0	478	25128	0.030	14	841
27	0	478	0	478	25128	0.026	13	731
28	0	478	0	478	25128	0.023	11	635
29	0	478	0	478	25128	0.020	9	552
30	0	478	0	478	25128	0.017	8	480
31	0	478	0	478	25128	0.015	7	417
32	0	478	0	478	25128	0.013	6	363
33	0	478	0	478	25128	0.011	5	315
34	0	478	3389	3867	25128	0.010	38	274
35	0	478	0	478	25128	0.009	4	238
36	0	478	0	478	25128	0.007	4	207
37	0	478	0	478	25128	0.006	3	180
38	0	478	0	478	25128	0.006	3	156
39	0	478	0	478	25128	0.005	2	136
40	0	478	0	478	25128	0.004	2	118
41	0	478	0	478	25128	0.004	2	103
42	0	478	0	478	25128	0.003	2	89
43	0	478	0	478	25128	0.003	1	78
44	0	478	3389	3867	25128	0.002	9	68
45	0	478	0	478	25128	0.002	1	59
46	0	478	0	478	25128	0.002	1	51
47	0	478	0	478	25128	0.002	1	44
48	0	478	0	478	25128	0.001	1	39
49	0	478	0	478	25128	0.001	1	34
50	0	478	0	478	25128	0.001	0	29
Total	115150	22304	13556	151010	1107091	7.642	88842	88884

B / C =1.000474
B - C =42.15806
E I R R = 0.1504

Table 5.3 Economic Sensitivity Analysis (Increase of Production Cost by 10%)

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	798	0	0	798	0	1.000	798	0
2	19165	0	0	19165	0	0.868	16636	0
3	59180	0	0	59180	-7540	0.754	44593	-5682
4	36007	316	0	36323	-22619	0.654	23759	-14795
5	0	478	0	478	19152	0.568	271	10874
6	0	478	0	478	21888	0.493	236	10788
7	0	478	0	478	24624	0.428	205	10535
8	0	478	0	478	27360	0.371	178	10161
9	0	478	0	478	27360	0.322	154	8821
10	0	478	0	478	27360	0.280	134	7657
11	0	478	0	478	27360	0.243	116	6646
12	0	478	0	478	27360	0.211	101	5770
13	0	478	0	478	27360	0.183	87	5008
14	0	478	3389	3867	27360	0.159	614	4347
15	0	478	0	478	27360	0.138	66	3774
16	0	478	0	478	27360	0.120	57	3276
17	0	478	0	478	27360	0.104	50	2844
18	0	478	0	478	27360	0.090	43	2468
19	0	478	0	478	27360	0.078	37	2143
20	0	478	0	478	27360	0.068	32	1860
21	0	478	0	478	27360	0.059	28	1615
22	0	478	0	478	27360	0.051	24	1402
23	0	478	0	478	27360	0.044	21	1217
24	0	478	3389	3867	27360	0.039	149	1056
25	0	478	0	478	27360	0.034	16	917
26	0	478	0	478	27360	0.029	14	796
27	0	478	0	478	27360	0.025	12	691
28	0	478	0	478	27360	0.022	10	600
29	0	478	0	478	27360	0.019	9	521
30	0	478	0	478	27360	0.017	8	452
31	0	478	0	478	27360	0.014	7	392
32	0	478	0	478	27360	0.012	6	340
33	0	478	0	478	27360	0.011	5	296
34	0	478	3389	3867	27360	0.009	36	257
35	0	478	0	478	27360	0.008	4	223
36	0	478	0	478	27360	0.007	3	193
37	0	478	0	478	27360	0.006	3	168
38	0	478	0	478	27360	0.005	3	146
39	0	478	0	478	27360	0.005	2	126
40	0	478	0	478	27360	0.004	2	110
41	0	478	0	478	27360	0.003	2	95
42	0	478	0	478	27360	0.003	1	83
43	0	478	0	478	27360	0.003	1	72
44	0	478	3389	3867	27360	0.002	9	62
45	0	478	0	478	27360	0.002	1	54
46	0	478	0	478	27360	0.002	1	47
47	0	478	0	478	27360	0.001	1	41
48	0	478	0	478	27360	0.001	1	35
49	0	478	0	478	27360	0.001	1	31
50	0	478	0	478	27360	0.001	0	27
Total	115150	22304	13556	151010	1211985	7.573	88549	88558

B / C =1.000094
B - C =8.387346
E I R R = 0.152

Table 5.4 Financial Sensitivity Analysis (Increase of Construction Cost by 10%)

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replace ment Cost	Total		Discount Rate	Cost	Benefit
1	704	0	0	704	0	1.000	704	0
2	19499	0	0	19499	0	0.890	17352	0
3	62939	0	0	62939	-8486	0.792	49845	-6721
4	44260	484	0	44744	-25459	0.705	31534	-17943
5	0	732	0	732	16884	0.627	459	10589
6	0	732	0	732	19296	0.558	409	10770
7	0	732	0	732	21708	0.497	364	10782
8	0	732	0	732	24120	0.442	324	10662
9	0	732	0	732	24120	0.393	288	9488
10	0	732	0	732	24120	0.350	256	8444
11	0	732	0	732	24120	0.312	228	7514
12	0	732	0	732	24120	0.277	203	6687
13	0	732	0	732	24120	0.247	181	5951
14	0	732	0	732	24120	0.220	161	5296
15	0	732	0	732	24120	0.195	143	4713
16	0	732	0	732	24120	0.174	127	4194
17	0	732	0	732	24120	0.155	113	3732
18	0	732	0	732	24120	0.138	101	3321
19	0	732	0	732	24120	0.123	90	2956
20	0	732	0	732	24120	0.109	80	2630
21	0	732	0	732	24120	0.097	71	2341
22	0	732	0	732	24120	0.086	63	2083
23	0	732	0	732	24120	0.077	56	1854
24	0	732	0	732	24120	0.068	50	1650
25	0	732	0	732	24120	0.061	45	1468
26	0	732	0	732	24120	0.054	40	1307
27	0	732	0	732	24120	0.048	35	1163
28	0	732	0	732	24120	0.043	31	1035
29	0	732	0	732	24120	0.038	28	921
30	0	732	0	732	24120	0.034	25	819
31	0	732	0	732	24120	0.030	22	729
32	0	732	0	732	24120	0.027	20	649
33	0	732	0	732	24120	0.024	18	578
34	0	732	0	732	24120	0.021	16	514
35	0	732	0	732	24120	0.019	14	457
36	0	732	0	732	24120	0.017	12	407
37	0	732	0	732	24120	0.015	11	362
38	0	732	0	732	24120	0.013	10	322
39	0	732	0	732	24120	0.012	9	287
40	0	732	0	732	24120	0.011	8	255
41	0	732	0	732	24120	0.009	7	227
42	0	732	0	732	24120	0.008	6	202
43	0	732	0	732	24120	0.007	5	180
44	0	732	0	732	24120	0.007	5	160
45	0	732	0	732	24120	0.006	4	142
46	0	732	0	732	24120	0.005	4	127
47	0	732	0	732	24120	0.005	3	113
48	0	732	0	732	24120	0.004	3	100
49	0	732	0	732	24120	0.004	3	89
50	0	732	0	732	24120	0.003	2	80
Total	127402	34156	0	161558	1061103	9.057	103587	103687

B / C =1.000969
B - C =100.4204
F I R R = 0.1237

Table 5.5 Financial Sensitivity Analysis (Decrease of Project Benefit by 10%)

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	640	0	0	640	0	1.000	640	0
2	17726	0	0	17726	0	0.893	15825	0
3	57217	0	0	57217	-8486	0.797	45605	-6764
4	40236	484	0	40720	-25459	0.712	28976	-18116
5	0	732	0	732	15196	0.635	465	9654
6	0	732	0	732	17366	0.567	415	9850
7	0	732	0	732	19573	0.506	371	9911
8	0	732	0	732	21708	0.452	331	9813
9	0	732	0	732	21708	0.404	295	8761
10	0	732	0	732	21708	0.360	264	7822
11	0	732	0	732	21708	0.322	235	6983
12	0	732	0	732	21708	0.287	210	6234
13	0	732	0	732	21708	0.256	188	5566
14	0	732	0	732	21708	0.229	168	4969
15	0	732	0	732	21708	0.204	150	4436
16	0	732	0	732	21708	0.182	134	3961
17	0	732	0	732	21708	0.163	119	3536
18	0	732	0	732	21708	0.145	106	3157
19	0	732	0	732	21708	0.130	95	2818
20	0	732	0	732	21708	0.116	85	2516
21	0	732	0	732	21708	0.103	76	2246
22	0	732	0	732	21708	0.092	68	2006
23	0	732	0	732	21708	0.082	60	1790
24	0	732	0	732	21708	0.074	54	1599
25	0	732	0	732	21708	0.066	48	1427
26	0	732	0	732	21708	0.059	43	1274
27	0	732	0	732	21708	0.052	38	1137
28	0	732	0	732	21708	0.047	34	1016
29	0	732	0	732	21708	0.042	31	907
30	0	732	0	732	21708	0.037	27	809
31	0	732	0	732	21708	0.033	24	723
32	0	732	0	732	21708	0.030	22	645
33	0	732	0	732	21708	0.027	19	576
34	0	732	0	732	21708	0.024	17	514
35	0	732	0	732	21708	0.021	15	459
36	0	732	0	732	21708	0.019	14	410
37	0	732	0	732	21708	0.017	12	366
38	0	732	0	732	21708	0.015	11	327
39	0	732	0	732	21708	0.013	10	292
40	0	732	0	732	21708	0.012	9	260
41	0	732	0	732	21708	0.011	8	232
42	0	732	0	732	21708	0.010	7	208
43	0	732	0	732	21708	0.009	6	185
44	0	732	0	732	21708	0.008	6	165
45	0	732	0	732	21708	0.007	5	148
46	0	732	0	732	21708	0.006	4	132
47	0	732	0	732	21708	0.005	4	118
48	0	732	0	732	21708	0.005	4	105
49	0	732	0	732	21708	0.004	3	94
50	0	732	0	732	21708	0.004	3	84
Total	115819	34156	0	149975	951634	9.294	95360	95361

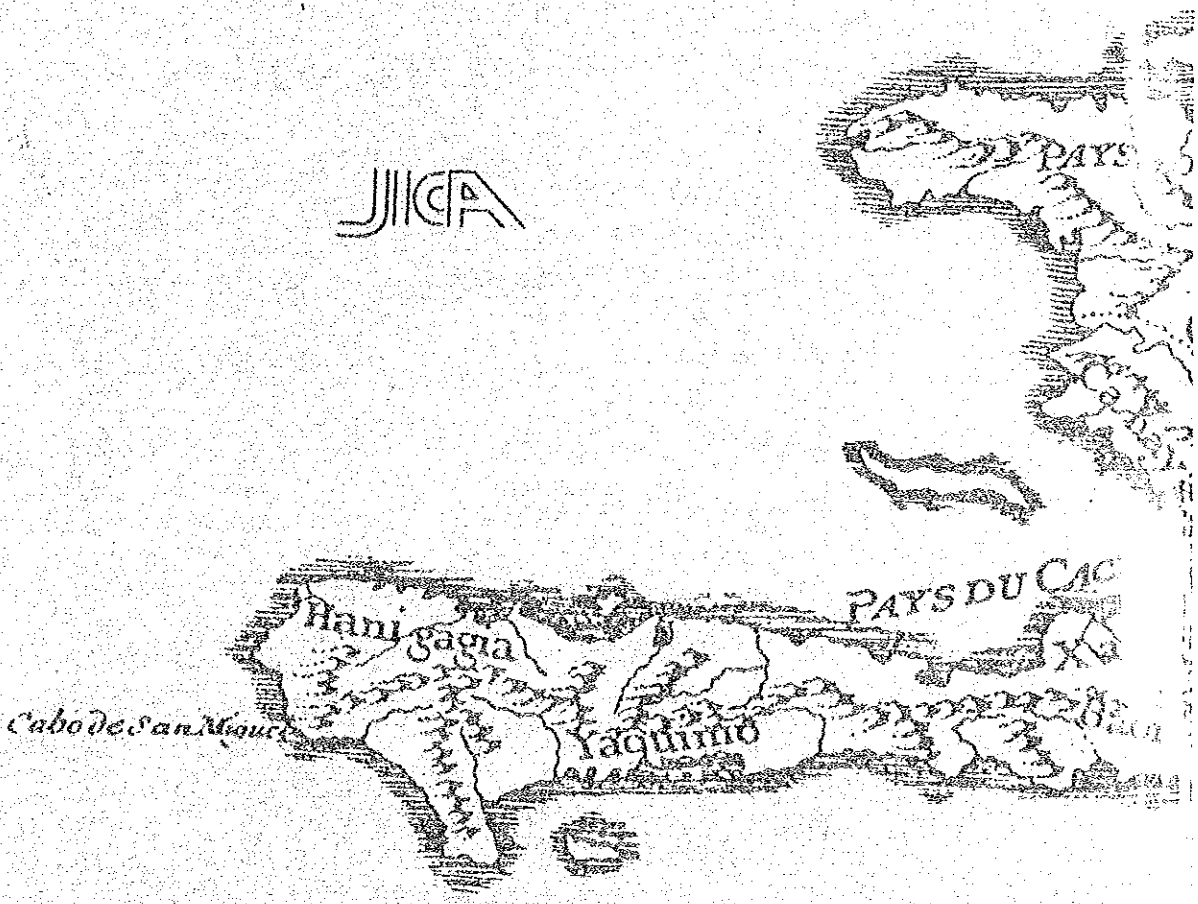
B / C =1.000013
B - C =1.294353
F I R R = 0.1201

Table 5.6 Financial Sensitivity Analysis (Increase of Production Cost by 10%)

(Unit : RD$ 1,000)

Year in Order	Cost				Benefit	Present Value		
	Const. Cost	O/M Cost	Replacement Cost	Total		Discount Rate	Cost	Benefit
1	640	0	0	640	0	1.000	640	0
2	17726	0	0	17726	0	0.884	15665	0
3	57217	0	0	57217	-7602	0.781	44683	-5937
4	40236	484	0	40720	-22805	0.690	28101	-15738
5	0	732	0	732	16420	0.610	446	10014
6	0	732	0	732	18766	0.539	394	10114
7	0	732	0	732	21111	0.476	349	10054
8	0	732	0	732	23457	0.421	308	9872
9	0	732	0	732	23457	0.372	272	8724
10	0	732	0	732	23457	0.329	241	7710
11	0	732	0	732	23457	0.290	213	6813
12	0	732	0	732	23457	0.257	188	6021
13	0	732	0	732	23457	0.227	166	5321
14	0	732	0	732	23457	0.200	147	4702
15	0	732	0	732	23457	0.177	130	4155
16	0	732	0	732	23457	0.157	115	3672
17	0	732	0	732	23457	0.138	101	3245
18	0	732	0	732	23457	0.122	89	2867
19	0	732	0	732	23457	0.108	79	2534
20	0	732	0	732	23457	0.095	70	2239
21	0	732	0	732	23457	0.084	62	1979
22	0	732	0	732	23457	0.075	55	1749
23	0	732	0	732	23457	0.066	48	1545
24	0	732	0	732	23457	0.058	43	1366
25	0	732	0	732	23457	0.051	38	1207
26	0	732	0	732	23457	0.045	33	1066
27	0	732	0	732	23457	0.040	29	942
28	0	732	0	732	23457	0.036	26	833
29	0	732	0	732	23457	0.031	23	736
30	0	732	0	732	23457	0.028	20	650
31	0	732	0	732	23457	0.025	18	575
32	0	732	0	732	23457	0.022	16	508
33	0	732	0	732	23457	0.019	14	449
34	0	732	0	732	23457	0.017	12	397
35	0	732	0	732	23457	0.015	11	351
36	0	732	0	732	23457	0.013	10	310
37	0	732	0	732	23457	0.012	9	274
38	0	732	0	732	23457	0.010	8	242
39	0	732	0	732	23457	0.009	7	214
40	0	732	0	732	23457	0.008	6	189
41	0	732	0	732	23457	0.007	5	167
42	0	732	0	732	23457	0.006	5	148
43	0	732	0	732	23457	0.006	4	130
44	0	732	0	732	23457	0.005	4	115
45	0	732	0	732	23457	0.004	3	102
46	0	732	0	732	23457	0.004	3	90
47	0	732	0	732	23457	0.003	2	80
48	0	732	0	732	23457	0.003	2	70
49	0	732	0	732	23457	0.003	2	62
50	0	732	0	732	23457	0.002	2	55
Total	115819	34156	0	149975	1034541	8.581	92914	92981

B / C =1.000713
B - C =66.28342
F I R R = 0.1316


JICA
PAYS
PAYS DU CAC
Rani gagna
Yaquimo
Cabo de San Miguel