CHAPTER 4 COMPENSATION

4.1 Land Acquisition

4.1.1 Rural Area

The rural areas is the land which is used for agriculture, livestock, forest and conservation, and is not conditioned as city territory. The city suburbs are not included. Land, water resources, ecosystem and buildings that exist in there are also included.

(1) Unit Price in Rural Area

The rural area (farmland) currently confirmed at the river basin is classified into two groups. It is dike with revetment and dike without revetment.

Table 4.1 **Classification of Agriculture Area**

Dike with revetment	Along-river area	Erosion area
		Under-production area
	Not neighboring part of the river	
Dike without revetment	Neighboring part of the river	
	Not neighboring part of the river	

Unit price for farmland (sol /1ha) by river basin was set up on the following criteria.

- Formal information is collected from the irrigation association according to river basin.
- Farmland price by market information
- Interview with farmhouses.

Table 4.2 **Unit Price for Land Acquisition in Rural Areas**

River basin	Dike with revetment (sol/ha)			Dike without revetment (sol / ha)		Predominant crop
	Along-river area		Not neighboring part of river	Neighboring part of river	Not neighboring part of river	
	Erosion	Under-production				
Canete	24,786.00	33,048.00	46,818.00	41,310.00	55,080.00	Maíze, Manzana
Chincha	19,278.00	24,786.00	35,802.00	33,048.00	41,310.00	Algodón, Maíze
Pisco	16,524.00	22,032.00	33,048.00	30,294.00	38,556.00	Algodón, Maíze
Camana	68,850.00	82,620.00	137,700.00	123,930.00	151,470.00	Rice
Majes	68,850.00	82,620.00	151,470.00	137,700.00	165,240.00	Rice

Remark: Including tax (3%), Source: Arrangement based on the information of irrigation association

The main factors of the price fluctuation for each river basin are as follows.

- The annual water use volume (campaign), and the required water resources volume calculated from land use
- Quality of soil in farmland and climates
- Cultivated crops and average yield of crops

(2) Inundate Areas in the Rural Area

The inundate area which is directly related to the project is a) land without riverbank protection, b) eroding land along riverside, and c) land under production.

Figure 4.1 **Dike without Revetment in Farmland/ Area along River/ Erosion Area**

Figure 4.2 **Dike without Revetment in Farmland/ Area along River/ Area under Production**

(3) Canete River Basin:

The areas to be scheduled land-acquisition in the Canete River basin is area of 1.24 ha in the eroded farmland, and 0.93 ha in the under- production farmland.

Table 4.3 **Land Acquisition for Farmland in the Canete River Basin**

Critical Point	Location	Farmland (ha)		
		Along-river area		
		Bank side	Erosion	Under-production
Ca – 02	6+700 - 8+300	Left		
		Right		0.01
Ca - 03	10+100 - 11+200	Left	1.24	0.69
		Right		
Ca - 05	25+000 - 26+600	Left		
		Right		0.23
Total			**1.24**	**0.93**

(4) Chincha River Basin:

In the Chincha River basin, the eroded farmland is area of 2.54 ha, and the under-production farmland is area of 1.28 ha.

Table 4.4 **Land Acquisition for Farmland in the Chincha River Basin**

Critical Point	Location	Farmland (ha)		
		Along-river area		
		Bank side	Erosion	Under-production
Ch - 01	2+900 - 4+900	Left	0.77	
		Right		
Ch - 03	23+900 - 24+400	Left		
		Right	0.69	
Ma - 01	2+400 - 4+800	Left	0.40	
		Right		0.80
Ma - 02	7+800 - 10+400	Left	0.68	
		Right		0.48
Total			**2.54**	**1.28**

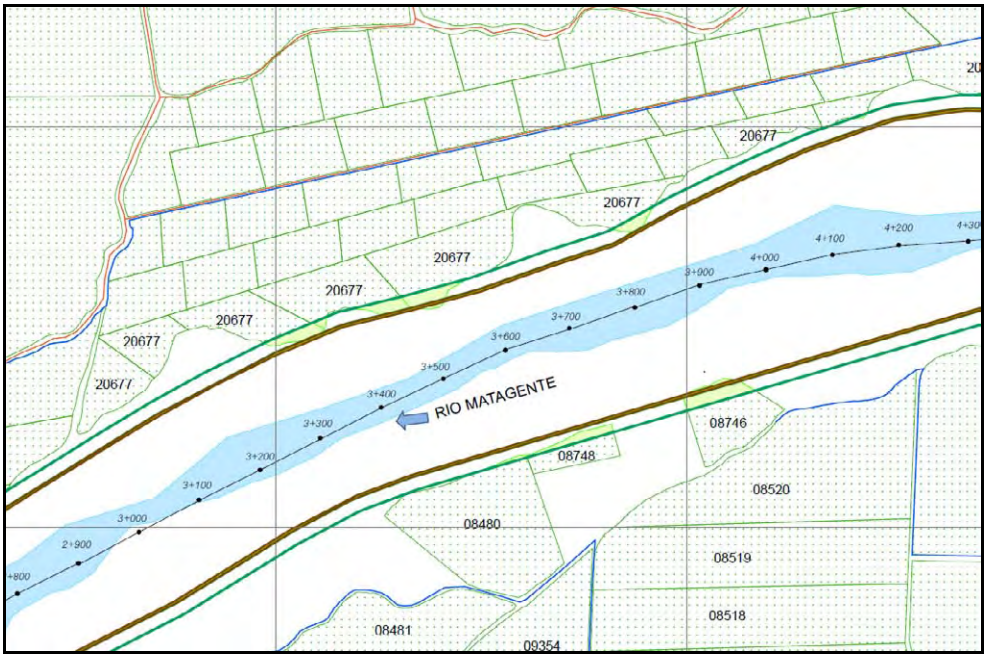

Figure 4.3 **Land Aquisition in the Chincha River Basin (MA-01)**

(5) Pisco River Basin:

The area of land-acquisition schedule in the Pisco River basin is area of 17.07 ha in the eroded farmland and 3.20 ha in the under- production farmland.

Table 4.5 **Land Acquisition for Farmland in the Pisco River Basin**

Critical Point	Location	Farmland (ha)		
		Along-river area		
		Bank side	Erosion	Under-production
Pi – 01	2+900 - 5+000	Left	0.31	
		Right		
Pi – 02	6+400 - 7+900	Left		1.17
		Right		
Pi – 04	19+500 - 20+500	Left	3.28	
		Right		
Pi – 05	25+900 - 26+700	Left		2.03
		Right		
Pi – 06	34+500 - 36+500	Left		
		Right	13.48	
Total			**17.07**	**3.20**

Many of farmlands to be scheduled land-acquisition are concentrated in retarding reservoirs (PI-06).

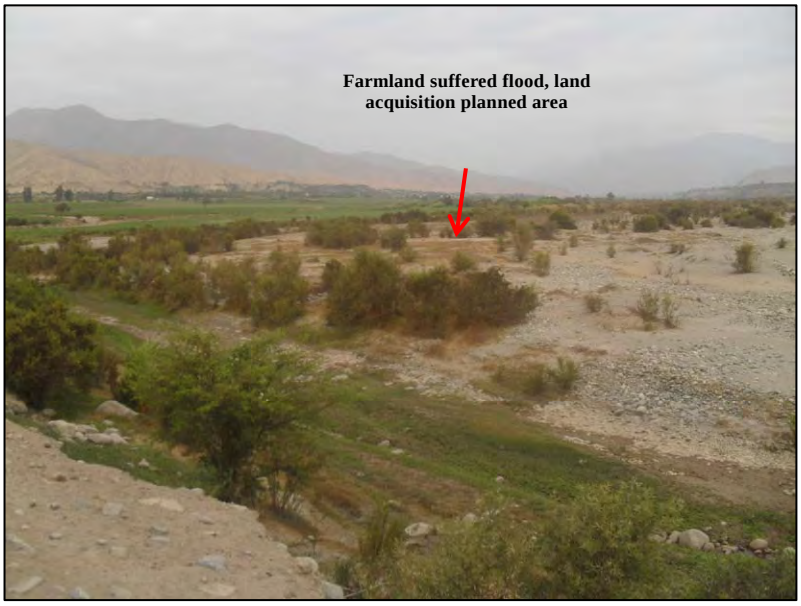

Figure 4.4 **Left-Bank Side in the Pisco River (PI-06), Land Acquisition Area**

(6) Camana River Basin:

According to the afforestation type (Type II) proposed in the river basin, the land-acquisition area in MC-03 point is area of 2.94 ha.

Table 4.6 **Land Acquisition for Farmland in the Camana River Basin**

Critical Point	Location	Farmland (ha)		
		Along-river area		
		Bank side	Erosion	Under-production
MC-03	11+000 - 17+000	Left		2.94
		Right		
Total				**2.94**

(7) Majes River Baisin:

The land acquisition of the under-production farmland is required of each object place. Sum total area reaches at 8.39 ha.

Table 4.7 **Land Acquisition for Farmland in the Majes River Basin**

Critical Point	Location	Farmland (ha)		
		Along-river area		
		Bank side	Erosion	Under-production
MC-04	48+000 - 50+500	Left		0.79
		Right		
MC-05	52+000 - 56+000	Left		2.41
		Right		
MC-06	59+000 - 62+500	Left		2.01
		Right		2.31
MC-07	64+500 - 66+500	Left		0.49
		Right		0.38
Total				**8.39**

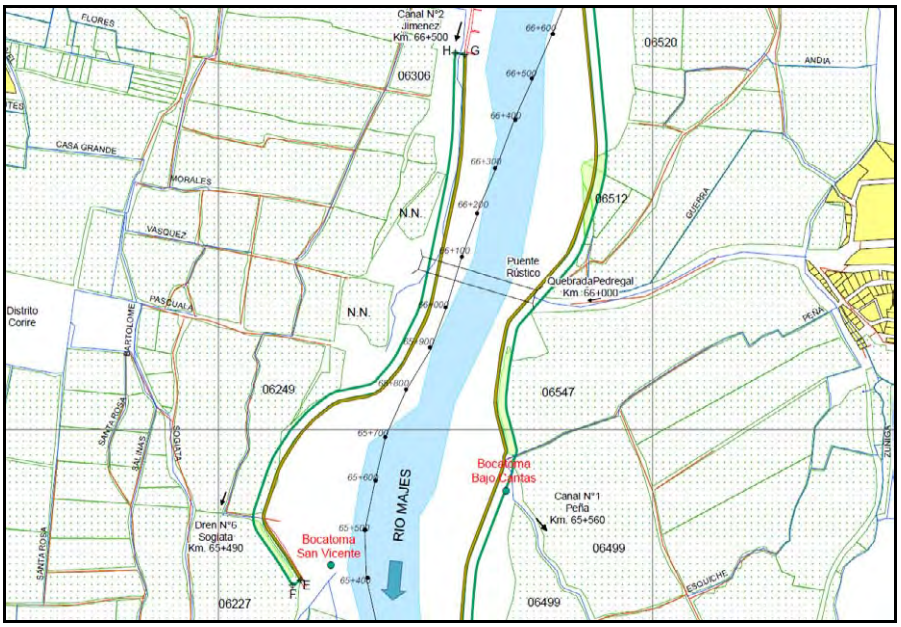

Figure 4.5 **Land Aquisition in the Majes River Basin (MC-07)**

(8) Land-acquisition Cost for Rural Area

The land acquisition cost in rural area in each river basin is calculated by multiplying the inundate area by the unit price. In this time, the calculation is carried out as of January, 2012.

Table 4.8 **Land Acquisition Cost in Rural Area in the Canete River Basin**

Critical Point	Location	Farmland (ha)			Unit Price (Sol / ha)		Land Acquisition Cost (Sol)		
		Along-river area			Along-River area				
		Bank side	Erosion area	Under-Production	Erosion area	Under-Production	Erosion area	Under-Production	Total
Ca - 02	6+700 - 8+300	Left			24,786	33,048			
		Right		0.01	24,786	33,048		330	330
Ca - 03	10+100 - 11+200	Left	1.24	0.69	24,786	33,048	30,735	22,803	53,538
		Right			24,786	33,048			
Ca - 05	25+000 - 26+600	Left			24,786	33,048			
		Right		0.23	24,786	33,048		7,601	7,601
Total			**1.24**	**0.93**			**30,735**	**30,735**	**61,469**

Table 4.9 **Land Acquisition Cost in Rural Area in the Chincha River Basin**

Critical Point	Location	Farmland (ha)			Unit Price (Sol / ha)		Land Acquisition Cost (Sol)		
		Along-river area			Along-river area				
		Bank side	Erosion area	Under-Production	Erosion area	Under-Production	Bank side	Erosion area	Under-Production
Ch - 01	2+900 - 4+900	Left	0.77		19,278	24,786	14,844		14,844
		Right			19,278	24,786			
Ch - 03	23+900 - 24+400	Left			19,278	24,786			
		Right	0.69		19,278	24,786	13,302		13,302
Ma - 01	2+400 - 4+800	Left	0.40		19,278	24,786	7,711		7,711
		Right		0.80	19,278	24,786		19,829	19,829
Ma - 02	7+800 - 10+400	Left	0.68		19,278	24,786	13,109		13,109
		Right		0.48	19,278	24,786		11,897	11,897
Total			**2.54**	**1.28**			**48,966**	**31,726**	**80,692**

Table 4.10 **Land Acquisition Cost in Rural Area in the Pisco River Basin**

Critical Point	Location	Farmland (ha)			Unit Price (Sol / ha)		Land Acquisition Cost (Sol)		
		Along-river area			Along- river area				
		Bank side	Erosion area	Under-Production	Erosion area	Under-Production	Bank side	Erosion area	Under-Production
Pi - 01	2+900 - 5+000	Left	0.31		16,524	22,032	5,122		5,122
		Right			16,524	22,032			
Pi - 02	6+400 - 7+900	Left		1.17	16,524	22,032		25,777	25,777
		Right			16,524	22,032			
Pi - 04	19+500 - 20+500	Left	3.28		16,524	22,032	54,199		54,199
		Right			16,524	22,032			
Pi - 05	25+900 - 26+700	Left		2.03	16,524	22,032		44,725	44,725
		Right			16,524	22,032			
Pi - 06	34+500 - 36+500	Left			16,524	22,032			
		Right	13.48		16,524	22,032	222,744		222,744
Total			**17.07**	**3.20**			**282,065**	**70,502**	**352,567**

Table 4.11 **Land Acquisition Cost in Rural Area in the Camana River Basin**

Critical Point	Location	Farmland (ha)			Unit Price (Sol / ha)		Land Acquisition Cost (Sol)		
		Along- river area			Along-river area				
		Bank side	Erosion area	Under-Production	Erosion area	Under-Production	Bank side	Erosion area	Under-Production
MC-03	11+000 - 17+000	Left		2.94	68,850	82,620		242,903	242,903
		Right			68,850	82,620			
Total				**2.94**				**242,903**	**242,903**

Table 4.12 **Land Acquisition Cost in Rural Area in the Majes River Basin**

Critical Point	Location	Farmland (ha)			Unit Price (Sol / ha)		Land Acquisition Cost (Sol)		
		Along-river area			Along-river area				
		Bank side	Erosion area	Under-Production	Erosion area	Under-Production	Bank side	Erosion area	Under-Production
MC-04	48+000 - 50+500	Left		0.79	68,850	82,620		65,270	65,270
		Right			68,850	82,620			
MC-05	52+000 - 56+000	Left		2.41	68,850	82,620		199,114	199,114
		Right			68,850	82,620			
MC-06	59+000 - 62+500	Left		2.01	68,850	82,620		166,066	166,066
		Right		2.31	68,850	82,620		190,852	190,852
MC-07	64+500 - 66+500	Left		0.49	68,850	82,620		40,484	40,484
		Right		0.38	68,850	82,620		31,396	31,396
Total					**8.39**				**693,182**

The grand total cost for land acquisition in the rural area by private sector price is 1,430,813 sols. The summarized table according to each area is shown below.

Table 4.13 **Total Cost for Land Acquisition in Rural Areas**

River Basin	Farmland (ha)		Land acquisition cost (Sol)		
	Along-river area				
	Erosion area	Under-production	Erosion area	Under-production	Total
Canete	1.24	0.93	30,735	30,735	61,469
Chincha	2.54	1.28	48,966	31,726	80,692
Pisco	17.07	3.20	282,065	70,502	352,567
Camana		2.94		242,903	242,903
Majes		8.39		693,182	693,182
Total	**20.85**	**16.74**	**361,765**	**1,069,048**	**1,430,813**

4.1.2 Urban Areas

Urban area is defined as a village and area used for urban function such as housing, commerce, industry, or others. Even if there is no building, it is land with the general public services (power supply, water supply and sewage, etc.) as a village.

The urban areas to be scheduled land acquisition have buildings and/or lands fundamentally. These areas are located on the riverside in the study area of the project, and many of them are received fundamental public services such as water supply, sewerage and electricity services, etc.

(1) Unit Price in Urban-areas

The building of the urban areas related to the project is classified into two groups.

- Public infrastructure and housing.

The classification according to the kind of building material is as follows similarly.

- Construction (brick), Adobe (sun-dried brick) and Kincha (sticks/ small logs)

Table 4.14 **Classification by Buildings in Urban Area**

Classification	Category	Materials
Public Infrastructure	I	Building I(Brick)
Housing	II	Building II(Brick)
	III	Adobe (Sun-dried brick)
	IV	Kincha

Based on the data of the formal construction price table in the desert area computed by the Ministry of Construction and Housing, the average unit price for every category was calculated.

Table 4.15 **Unit Price for Building Construction (Sol x m^2)**

Category	Structure		Finnish				Power, Sanitation Facility
	Fence & Column	**Ceiling**	**Floor**	**Door & Window**	**External Facing**	**Toilet**	
I	Brick or same materials / Concrete column and beam	Light-weigh t ceiling or concrete aslope roof tile	First grade floor board / domestic produced ceramic Venetian tile (40x40) / Laminated flooring	Aluminum window, hard wooden door (Mahogany or same materials) / Colored or laminated reinforcing glass	Using brick on the front	Domestic produced toilet / White tile	Cool water / Single phase electricity / Telephone
	"C"	"B"	"D"	"C"	"E"	"D"	"F"
589.03	**174.29**	**154.01**	**73.30**	**72.61**	**68.16**	**21.81**	**24.85**
II	Brick and same materials / Concrete column and beam	Light-weigh t ceiling or concrete roof tile	Second grade floor board / Domestic product ceramic Benicia tile (30x30) / Flat stone, pebble, etc.	Iron or aluminum window / wooden door (Mahogany or same materials) / Transparent window (4)	Materials mixing of cement and sand or lime / Water-thin ned paint	Partly white tile toilet	Cool water, Single phase electricity /, Telephone
	"C"	"C"	"E"	"F"	"F"	"E"	"F"
478.55	**174.29**	**128.57**	**49.11**	**40.85**	**48.05**	**12.83**	**24.85**
III	Adobe (sun- dried brick)	Zinc roof / Fiber concrete or usual wooden beam	Polished concrete, brick, usual board	Usual wooden frame door / PVC or wooden window	Painted brick, concrete plate or same materials	White toilet without tile	Cool water / Single phase electricity / Telephone
	"E"	"F"	"H"	"G"	"H"	"F"	"F"
227.17	**118.82**	**16.73**	**18.58**	**22.13**	**15.81**	**9.55**	**25.55**
IV	Kincha or reed	Wood, reed, earth	Compacted soil	Wooden materials		Second grade tile toilet, cast iron or granite	Cool water / Single phase electricity
	"G"	"G"	"I"	"H"		"G"	"G"
99.06	**52.82**	**11.54**	**3.72**	**11.07**		**6.59**	**13.32**

Source: Ministry of Housing Construction, Formal Unit Price Table of Housing Construction in Desert Area, October 31, 2011, R.M. Nº220-2011-VIVIENDA

Table 4.16 **Unit Price for Land Acquisition in Urban Area**

River Basin	Category	Materials	Unit Price (Sol / m2)		Land acquisition cost/ Construction cost (Sol / m2)	Land acquisition cost (Sol / m2)
			Housing construction	Area		
Canete, Chincha, Pisco	II	Housing construction II(Brick)	478.55	108.00	586.55	108.00
	III	Adobe (Sun-dried brick)	227.17		335.17	
	IV	Kincha	99.06		207.06	
Camana, Majes	I	Public construction I (Brick)	589.03	135.00	724.03	135.00
	II	Housing construction II(Brick)	478.55		613.55	
	III	Adobe (Sun-dried brick)	227.17		362.17	
	IV	Kincha	99.06		234.06	

Source: Arrangement based on data of Ministry of Housing Construction

(2) Inundation Areas in Urban Areas

There are urban inundation areas in the Canete, Chincha and Majes River basins.

Canete River Basin:

The afforestation area of zone Ca-01 (km 4+200-5+200) crosses the Urbanito Village and the Pedro Cruz Village. These villages are in the right bank of the Canete River, and are surrounded by house buildings. The collapsed buildings in the inundation areas were shown in the following table according to the main materials.

Table 4.17 **Inundation Area of Urban Area in the Canete River Basin**

Critical Point	Location	Area with buildings (m2)			Area without buildings (m2)
		Housing construction II (Brick)	Adobe (Sun-dried brick)	Kincha	
Ca – 01	4+200 - 5+200	387.18	1,161.53	2,323.07	967.94
Total		**387.18**	**1,161.53**	**2,323.07**	**967.94**

Figure 4.6 **Right-bank Side of URBANITO Village in the Canete River**

Chincha River Basin:

In the right-bank side of the Matagente River, the Chacarilla Village is near the El Carmen bridge. This village is located on extension of the dike (afforestation area), and the land acquisition is needed.

Table 4.18 **Inundation Area of Urban Area in the Chincha River Basin**

Critical Point	Location	Area with buildings (m2)			Area without buildings (m2)
		Housing construction II (Brick)	Adobe (Sun-dried brick)	Kincha	
Ma - 02	7+800 - 10+400	402.77	419.62	191.55	1,164.24
Total		**402.77**	**419.62**	**191.55**	**1,164.24**

Figure 4.7 **CHACARILLA Village**

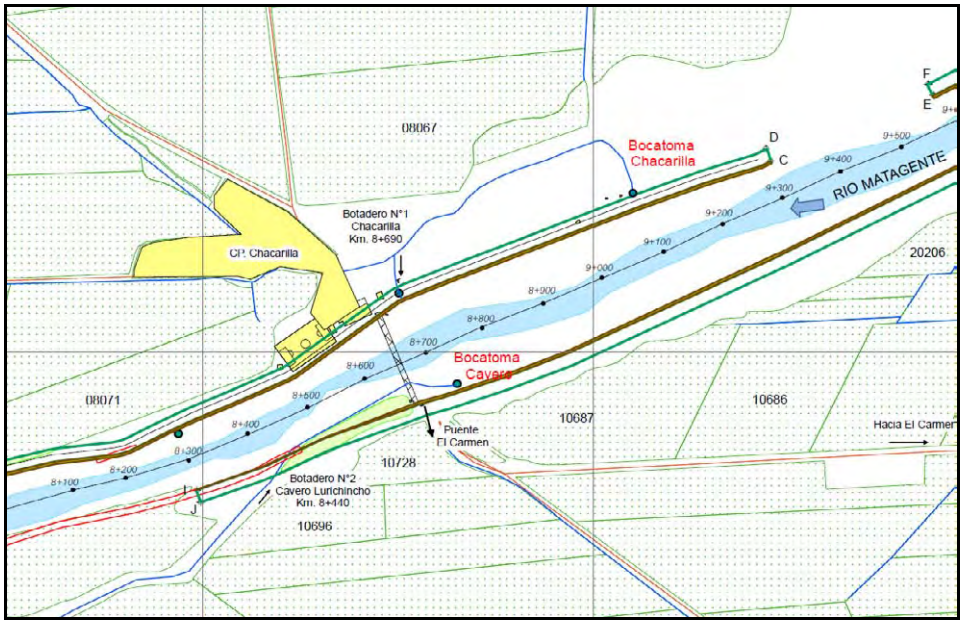

Figure 4.8 **Inundation Area of Urban Area in Chincha River Basin (Ma-02)**

Majes River Basin:

The Punta Colorada Village is located near the Colorado Bridge in the right-bank side of the Majes River. Since residences, church and recreational areas are located in this village, and afforestation area (MC-06) is included, the land acquisition is required.

According to observation by the field reconnaissance, buildings with 2 stories and buildings of adobe (sun-drying brick) are many.

Figure 4.9 **PUNTA COLORADA Village**

Table 4.19 **Inundation Area of Urban Area in the Majes-Camana River Basin**

Critical Point	Location Location	Area with buildings (m2)			Area without buildings (m2)
		Housing construction II (Brick)	Adobe (Sun-dried brick)	Adobe (Sun-dried brick)	
Total		**569.06**	**3,969.28**	**2,599.25**	**1,642.13**

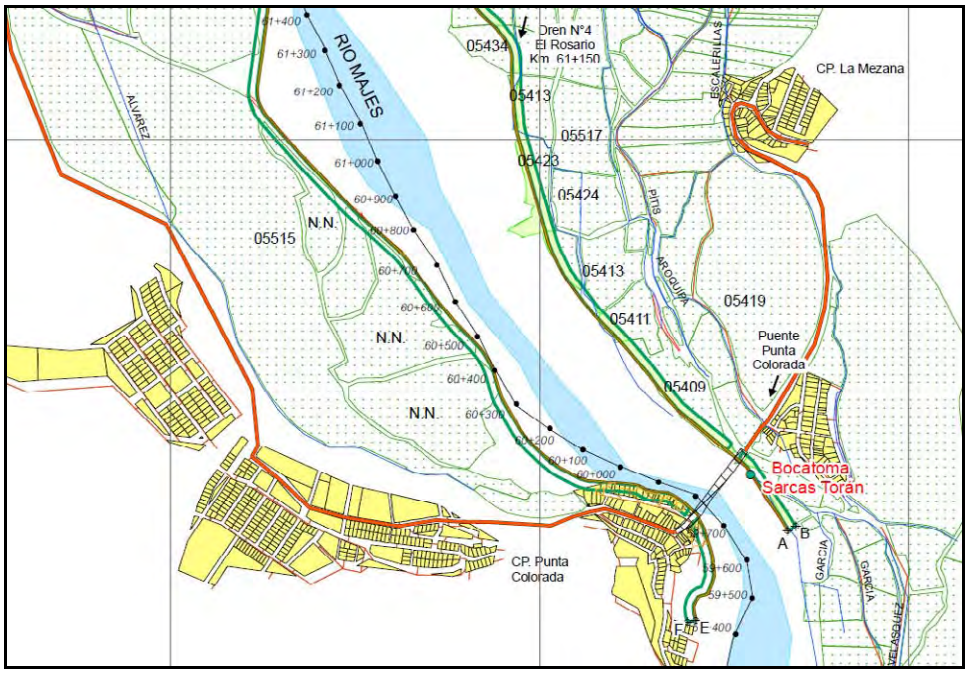

Figure 4.10 **Inundation Area of Urban Area in the Majes River Basin (MC-06)**

Figure 4.11 **PUNTA COLORADA Village**

(3) Land-acquisition Cost in Urban Areas

The land-acquisition cost in urban areas was calculated according to the existence of buildings. The cost was calculated by multiplying building area by unit price when there is building, and land area by unit price when there is not building (Cost as of January, 2012).

Table 4.20 **Land Acquisition Cost in Urban Area in the Canete River Basin**

Critical Point	Location	Area with buildings (m2)			Area without buildings (m2)	Land acquisition cost (Sol)				
		Housing constructionII (Brick)	Adobe (Sun-dried brick)	Kincha		Housing constructionII (Brick)	Adobe (Sun-dried brick)	Kincha	Area Without buildings	Total
Ca - 01	4+200 – 5+200	387.18	1,161.53	2,323.07	967.94	227,100	389,310	481,015	104,538	1,201,963
Total		**387.18**	**1,161.53**	**2,323.07**	**967.94**	**227,100**	**389,310**	**481,015**	**104,538**	**1,201,963**

Table 4.21 **Land Acquisition Cost in Urban Area in the Chincha River Basin**

Critical Point	Location	Area with buildings (m2)			Area without buildings (m2)	Land acquisition cost (Sol)				
		Housing constructionII (Brick)	Adobe (Sun-dried brick)	Kincha		Housing constructionII (Brick)	Adobe (Sun-dried brick)	Kincha	Area Without buildings	Total
Ma - 02	7+800 – 10+400	402.77	419.62	191.55	1,164.24	236,245	140,644	39,662	125,738	542,289
Total		**402.77**	**419.62**	**191.55**	**1,164.24**	**236,245**	**140,644**	**39,662**	**125,738**	**542,289**

Table 4.22 **Land Acquisition Cost in Urban Area in the Majes River Basin**

Critical Point	Location	Area with buildings (m2)			Area without buildings (m2)	Land acquisition cost (Sol)				
		Housing constructionII (Brick)	Adobe (Sun-dried brick)	Kincha		Housing constructionII (Brick)	Adobe (Sun-dried brick)	Kincha	Area Without buildings	Total
MC-06	59+000 – 62+500	569.06	3,969.28	2,599.25	1,642.13	412,017	2,435,352	941,370	221,688	4,010,426
Total		**569.06**	**3,969.28**	**2,599.25**	**1,642.13**	**412,017**	**2,435,352**	**941,370**	**221,688**	**4,010,426**

(4) The Total Cost for Land Acquisition in Urban Areas

The total cost for land acquisition in market price is 5,754,678 sols. The table is shown according to each river basin.

Table 4. 23 **Summary of Land Acquisition Cost in Urban Areas**

River Basin	Area with buildings (m2)				Area without buildings (m2)	Land acquisition cost (Sol)					
	Public Construc-tion I (Brick)	Housing Construction II (Brick)	Adobe (Sun-dried brick)	Kincha		Public Construc-tion I (Brick)	Housing Construc-tionII (Brick)	Adobe (Sun-dried brick)	Kincha	Area Without buildings	**Total**
Canete		387.18	1,161.53	2,323.07	967.94		227,100	389,310	481,015	104,538	1,201,963
Chincha		402.77	419.62	191.55	1,164.24		236,245	140,644	39,662	125,738	542,289
Pisco											
Camana											
Majes	569.06	3,969.28	2,599.25		1,642.13	412,017	2,435,352	941,370		221,688	4,010,426
Total	**569.06**		**2,599.25**	**2,514.62**	**3,774.31**	**412,017**		**1,471,324**	**520,677**	**451,963**	**5,754,678**

4.2 Compensation for Infrastructures

4.2.1 Water Resources Infrastructure

There is the functioning water-resources infrastructure in/near the dike. Compensation for infrastructure is needed in order to continue the function. Infrastructure compensation is mainly for the structure of intakes, drainages, canals, and drain ditches.

(1) Unit Price for Water-resources Infrastructure

In order to calculate the unit price, the construction design of general intake and discharge structure was carried out, quantities for each facility were calculated, and the unit price used for the proposed project was set.

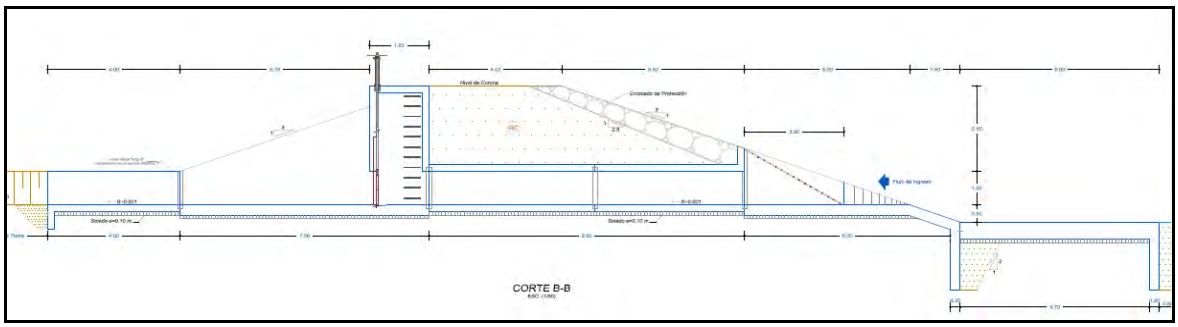

Figure 4.12 **Typical Design for Intake Structure (Type I)**

Table 4.24 **Unit Price of Compensation for Water Resources Infrastructure**

Intake Structure (Sol / unit)		Drainage Structure (Sol / unit)		Canal Structure (Sol / m)	
Type I Q> 0.0 - 1.0 m3/s	Type II Q> 1.0 - 1.5 m3/s	Type I Q> 0.0 - 1.0 m3/s	Type II Q> 1.0 - 1.5 m3/s	Type I Q> 0.0 - 0.5 m3/s	Type II Q> 0.5 - 1.0 m3/s
97,270.91	103,178.81	94,859.54	97,755.68	59.54	119.08

(2) Identification of Water-Resources Infrastructure

As for the facilities required for compensation, the locations, the discharge and the length of canals and drain ditches are identified by the information from the local irrigation associations and the field reconnaissance.

Canete River Basin:

The compensation for water resources infrastructures such as drainage structures and canal structures is mainly needed.

Table 4.25 **Water Resources Infrastructure in the Canete River Basin**

Critical Point	Location	Drainage Structure		Canal Structure		
		Name	Q (m3/s)	Name	Q (m3/s)	L (m)
Ca - 01	4+200 - 5+200	Pachacamilla	1.25			
		Mendieta	0.60			
Ca - 02	6+700 - 8+300			Ascona	0.20	202.00
Ca - 03	10+100 - 11+200	Palo Herbay	0.80			
TOTAL						**202.00**

Figure 4.13 **PACHACAMILLA Drainage (Ca-01)**

Chincha River Basin:

The compensation for the intake structures (Puquio Santo, Chacarilla, and Cavero) and drainage structures (Perez and La Altura) in the Matagente River is needed.

Table 4.26 **Water Resources Infrastructure in the Chincha River Basin**

Critical Point	Location	Intake Structure		Drainage Structure	
		Name	Q (m3/s)	Name	Q (m3/s)
Ma - 01	2+400 - 4+800	Puquio Santo	0.50	Pérez	0.4
Ma - 02	7+800 - 10+400	Chacarilla	0.50	La Altura	0.8
		Cavero	1.50		
Total					

Figure 4.14 **CAVERO Drainage Structure Constructed by the Area's Residents (Ma - 02)**

Pisco River Basin:

There is the Toma Baca canal.

Table 4.27 **Water Resources Infrastructure in the Pisco River Basin**

Critical Point	Location	Canal Structure		
		Name	Q (m3/s)	L (m)
Pi – 02	6+400 - 7+900	TomaBaca	0.3	70
Total				70

Camana River Basin:

The Montes Nuevos intake structure was confirmed.

Table 4.28 **Water Resources Infrastructure in the Camana River Basin**

Critical point	Location	Intake Structure	
		Name	Q (m3/s)
MC-01	0+000 - 4+500	Montes Nuevos	1.00
Total			

Majes River Basin:

At the Majes River basin, the intake structure (Bajo Cantas), the drainage structure (Vizcardo, Pampa Blanca, El Rosario, Sogiata), the canal structures and the drain ditches were confirmed. The Pedregal River is flowing into the Majes River similarly.

Table 4.29 **Water Resources Infrastructure in the Majes River Basin**

Critical Point	Location	Intake structure		Drainage Structure		Canal Structure / Drain Ditch		
		Name	Q (m3/s)	Name	Q (m3/s)	Name	Q (m3/s)	L (m)
MC-04	48+000 - 50+500			Vizcardo	0.30			
MC-05	52+000 - 56+000			Pampa Blanca	0.20	Pampa Blanca	0.3	350
MC-06	59+000 - 62+500			El Rosario	0.25			
MC-07	64+500 - 66+500	Bajo Cantas	0.70	Sogiata	0.30	Peña	0.25	69.81
				Qda. Pedregal	100.00	Jiménez	0.20	475.00
Total								544.81

Figure 4.15 **PAMPA BLANCA Drain Ditch (MC-05)**

(3) Compensation cost for Water Resources Infrastructure

The compensation cost for water-resources infrastructure was calculated according to the type (I or II) and the classifications (intake structure, drainage structure and canal/ drain ditch) (cost as of January, 2012).

Table 4.30 **Compensation Cost for Water Resources Infrastructure in the Canete River Basin**

Critical point	Location	Drainage structure		Canal structure		Total Cost for Improvement (Sol)
		Name	Compensation cost	Name	Compensation cost	
Ca - 01	4+200 - 5+200	Pachacamilla	97,755.68			192,615.22
		Mendieta	94,859.54			
Ca - 02	6+700 - 8+300			Ascona	12,027.08	12,027.08
Ca - 03	10+100 - 11+200	Palo Herbay	94,859.54			94,859.54
Total			**287,474.77**		**12,027.08**	**299,501.85**

Table 4.31 **Compensation Cost for Water Resources Infrastructure in the Chincha River Basin**

Critical point	Location	Drainage structure		Canal structure		Total Cost for Improvement (Sol)
		Name	Compensation cost	Name	Compensation cost	
Ma – 01	2+400 - 4+800	Puquio Santo	97,270.91	Pérez	94,859.54	192,130.45
Ma – 02	7+800 - 10+400	Chacarilla	97,270.91	La Altura	94,859.54	295,309.26
		Cavero	103,178.81			
Total			**297,720.63**		**189,719.09**	**487,439.72**

Table 4.32 **Compensation Cost for Water Resources Infrastructure in the Pisco River Basin**

Critical point	Location	Canal structure		Total Cost for Improvement (Sol)
		Name	Compensation cost	
Pi - 02	6+400 - 7+900	TomaBaca	4167.8	4,167.80
Total			**4,167.80**	**4,167.80**

Table 4.33 **Compensation Cost for Water Resources Infrastructure in the Camana River Basin**

Critical point	Location	Intake structure		Total Cost for Improvement (Sol)
		Name	Compensation cost	
MC-01	0+000 - 4+500	Montes Nuevos	97,270.91	97,270.91
Total			**97,270.91**	**97,270.91**

Table 4.34 **Compensation Cost for Water Resources Infrastructure in the Majes River Basin**

Critical point	Location	Intake structure		Drainage structure		Canal structure / Drain Ditch		Total Cost for Improvement (Sol)
		Name	Compensation cost	Name	Compensation cost	Name	Compensation cost	
MC-04	48+000 - 50+500			Vizcardo	94,859.54			94,859.54
MC-05	52+000 - 56+000			Pampa Blanca	94,859.54	Pampa Blanca	20,839.00	115,698.54
MC-06	59+000 - 62+500			El Rosario	94,859.54			94,859.54
MC-07	64+500 - 66+500	Bajo Cantas	97,270.91	Sogiata	94,859.54	Peña	4,156.49	762,163.21
				Qda. Pedregal	537,594.77	Jiménez	28,281.50	
Total			**97,270.91**		**917,032.95**		**53,276.99**	**1,067,580.85**

(4) Total compensation cost for water resources infrastructure

The total compensation cost for the water-resources infrastructure according to each river basin is 1,955,961 in sols (private sector price) as shown in the following tables.

Table 4.35 **Total Compensation Cost for Water Resources Infrastructure**

River basin	Infrastructure suffered flood			Compensation cost (Sol)			
	Intake structure (Nº)	Drainage structure (Nº)	Canal Structure / Drain ditch (m)	Intake structure (Nº)	Drainage structure (Nº)	Canal Structure / Drain ditch (m)	Total
Canete		3.00	202.00		287,475	12,027	299,502

Chincha	3.00	2.00		297,721	189,719		487,440
Pisco			70.00			4,168	4,168
Camana	1.00			97,271			97,271
Majes	1.00	5.00	544.81	97,271	917,033	53,277	1,067,581
Total	**5.00**	**10.00**	**816.81**	**492,262**	**1,394,227**	**69,472**	**1,955,961**

4.2.2 Road Infrastructures

The compensation or rearrangement of roads in the afforestation area is needed.

(1) Unit Price of Road Infrastructure

There are three type roads such as national road, regional road and local road. The unit price of road construction per 1km was calculated as the average cost.

Table 4.36 **Compensation Unit Price for Road Infrastructures**

National Road (Sol / m)	**Regional Road (Sol / m)**		**Local Road (Sol / m)**	
Paved Road	**Paved Road**	**Unpaved Road**	**Paved Road**	**Unpaved Walkway**
1176.27	823.39	619.09	371.45	247.64

Source: Arrangement of based on the data of Ministry of Transport

(2) Road Infrastructure Classification

Road and afforestation area cross in zone Ca-02 and Ca-05 in the Canete River basin.

Table 4.37 **Road Infrastructure in the Canete River Basin**

Critical Point	**Location**	**Regional Road**		**Local Road**	
		Paved Road (m)	**Unpaved Road (m)**	**Paved Road (m)**	**Unpaved Road (m)**
Ca - 02	6+700 - 8+300				234.00
Ca - 05	25+000 - 26+600	180.00			
Total		**180.00**			**234.00**

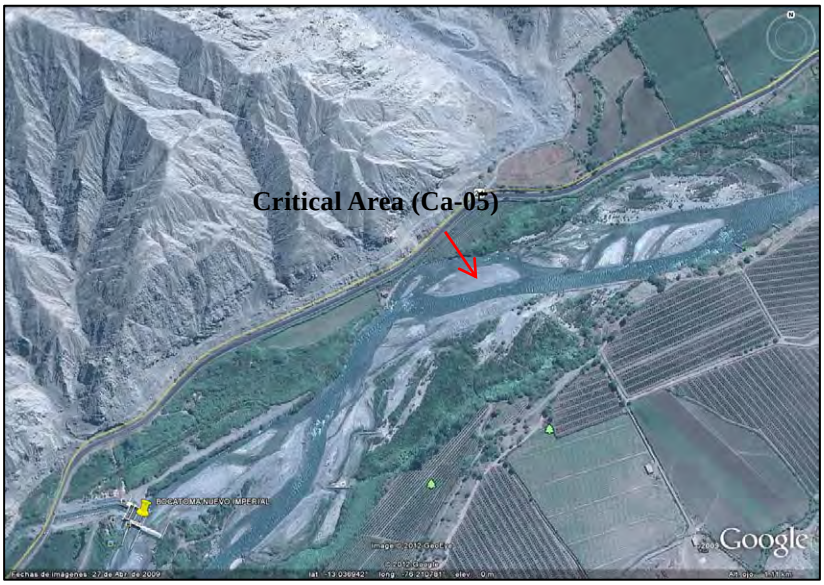

Figure 4.16 **SAN VICENTE – LUNAHUANA Regional Road**

(3) Compensation cost for road infrastructures

The compensation cost for road infrastructures was calculated by road type and road length required compensation (cost as of January, 2012).

Table 4.38 **Compensation Cost for Road Infrastructures in the Canete River Basin**

Critical Point	Location	Regional Road		Local Road		Total Compensation Cost (Sol)
		Paved Road (m)	Compensation Cost	Paved Road (m)	Compensation Cost	
Ca - 02	6+700 - 8+300			234.00	57,947.76	57,947.76
Ca - 05	25+000 - 26+600	180.00	148,210.20			148,210.20
Total		**180.00**	**148,210.20**	**234.00**	**57,947.76**	**206,157.96**

4.3 Total Cost for Land Acquisition and Compensation

4.3.1 Total Market Price

Area of land acquisition and compensation cost in rural-areas and urban-areas (water resources and road infrastructures) in market price are summarized as follows.

Table 4.39 **Summary of Land Acquisition and Compensation Cost by Market Price**

River Basin	Land Acquisition		Compensation for Water Resources Infrastructure			Compensation for Road Infrastructure			Total
	Rural Area	Urban Area	Intake	Drainage	Canal	National Road	Regional Road	Local Road	
Caneye	61,469	1,201,963	0	287,475	12,027	0	148,210	57,948	1,769,092
Chincha	80,692	542,289	297,721	189,719	0	0	0	0	1,110,421
Pisco	352,567	0	0	0	4,168	0	0	0	356,735
Camana	242,903	0	97,271	0	0	0	0	0	340,174
Majes	693,182	4,010,426	97,271	917,033	53,277	0	0	0	5,771,188
Total	**1,430,813**	**5,754,678**	**492,262**	**1,394,227**	**69,472**	**0**	**148,210**	**57,948**	**9,347,610**

4.3.2 Total Social Price

In order to change market price into social price, the following criteria is based on.

- The land-acquisition cost in rural area at market price is only tax (3%). The conversion factor (CF) is set as 0.97.
- The land-acquisition cost in urban area at market price includes consumption tax (18%). The conversion factor (CF) is set as 0.847.
- The conversion factor (CS) of the compensation cost for water resources infrastructure was obtained from data of water resources projects.
- The conversion factor (CF) of the compensation cost for road infrastructure was obtained from SNIP of Ministry of Economy and Finance (Resolucion Directoral No.003-2011-EF/68.01: Annex SNIP 10-V3.1, FC=0.79).

Table 4.40 **Conversion Factor for Social Price (CF)**

Object Item	Coefficient
Land Acquisition for Rural Area	0.970
Land Acquisition for Urban Area	0.847
Water Resources Infrastructure	0.827
Road Infrastructure	0.790

Table 4.41 **Summary of Land Acquisition and Compensation Cost – Social Price -**

River Basin	Land Acquisition		Compensation for Water Resources Infrastructure			Compensation for Road Infrastructure			Total
	Rural Area	Urban Area	Intake	Drainage	Canal	National Road	Regional Road	Local Road	
Canete	59,625	1,018,063	0	237,742	9,946	0	117,086	45,779	1,488,241
Chincha	78,271	459,319	246,215	156,898	0	0	0	0	940,703
Pisco	341,990	0	0	0	3,447	0	0	0	345,437
Camana	235,616	0	80,443	0	0	0	0	0	316,059
Majes	672,386	3,396,831	80,443	758,386	44,060	0	0	0	4,952,106
Total	**1,387,889**	**4,874,212**	**407,101**	**1,153,026**	**57,453**	**0**	**117,086**	**45,779**	**8,042,545**

4.4 Standard Design of Water-Resources Infrastructure for Compensation

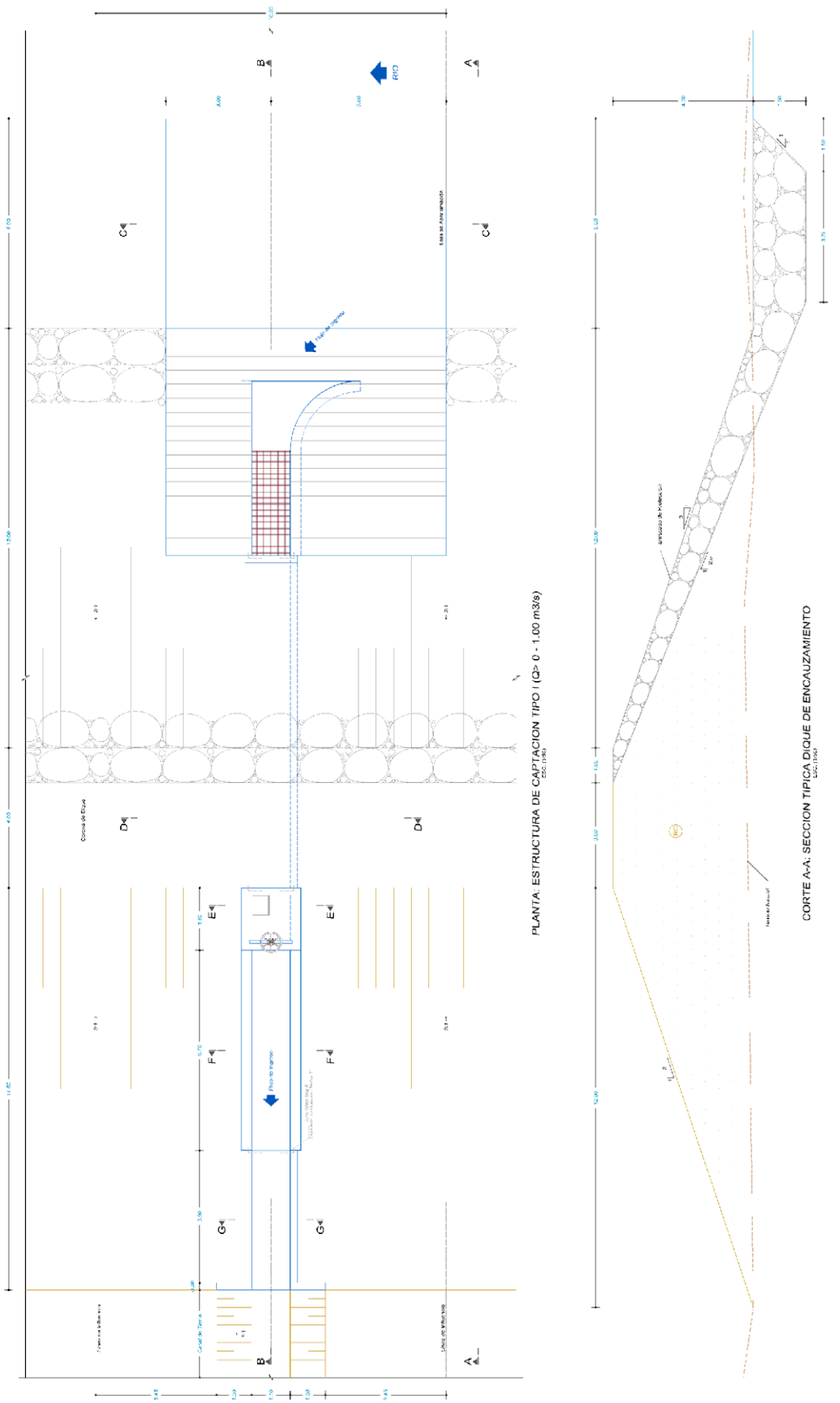

Figure 4.17 **Structure Drawing of Intake Facility Type I (1/2)**

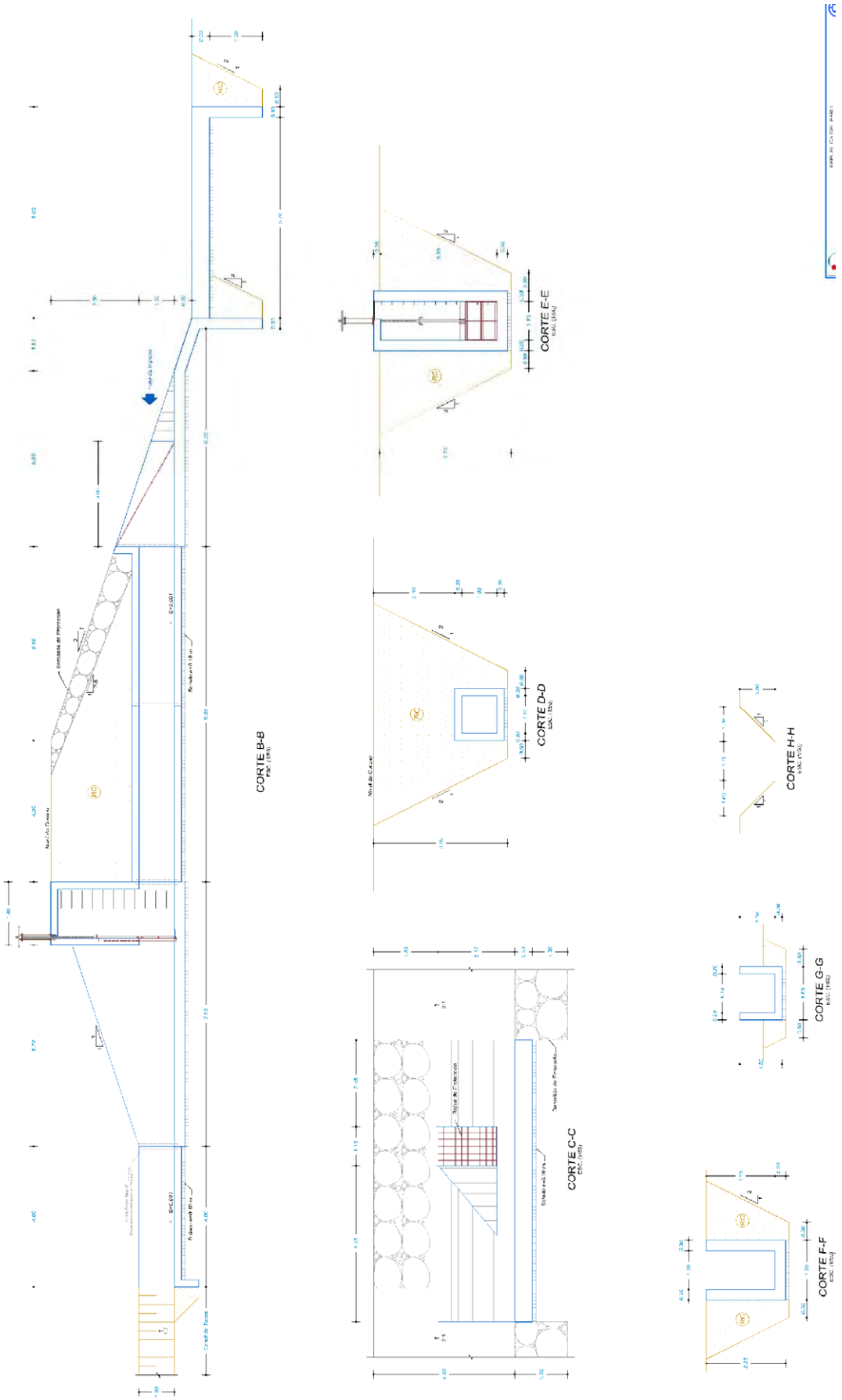

Figure 4.17 **Structure Drawing of Intake Facility Type I (2/2)**

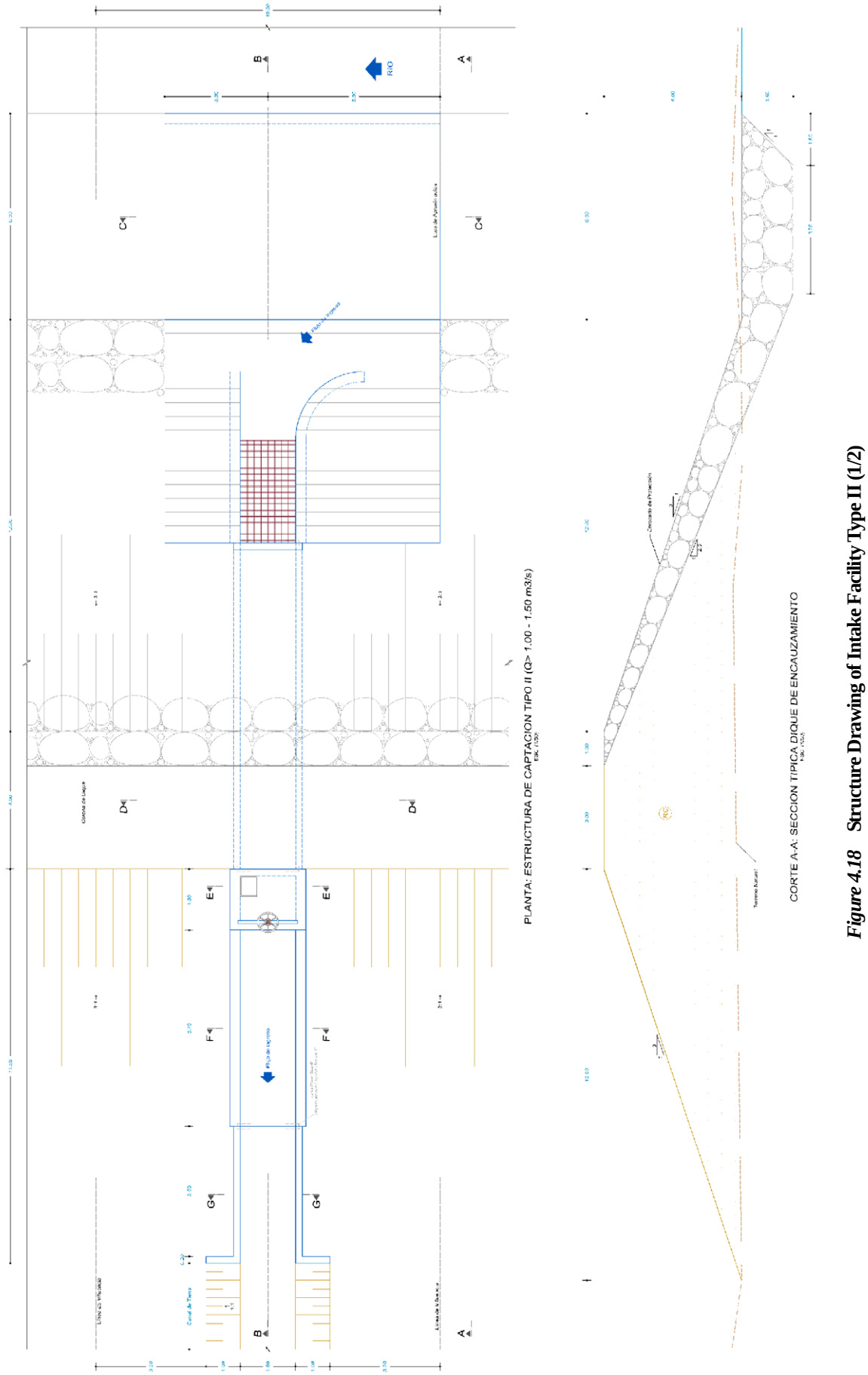

Figure 4.18 **Structure Drawing of Intake Facility Type II (1/2)**

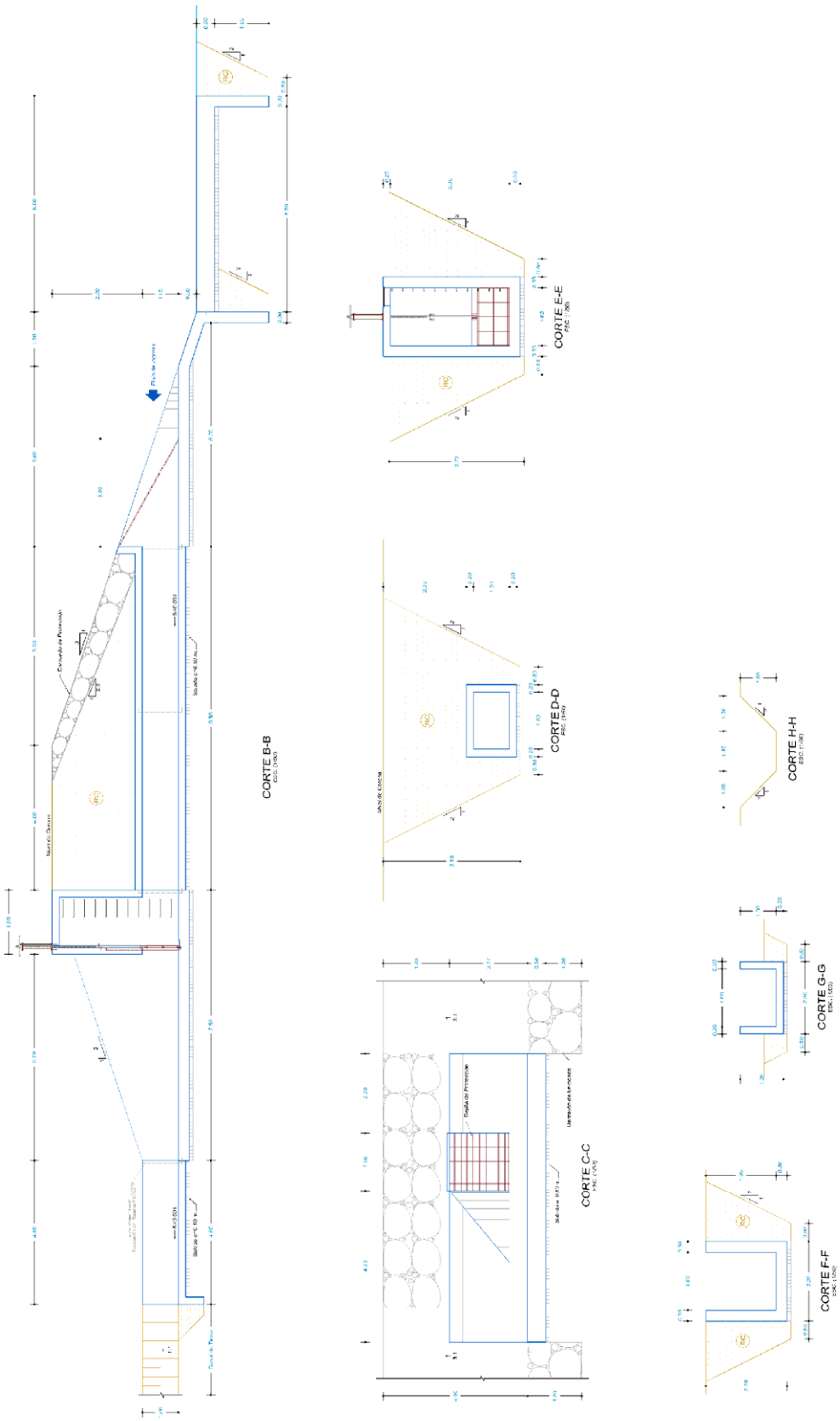

Figure 4.18 **Structure Drawing of Intake Facility Type II (2/2)**

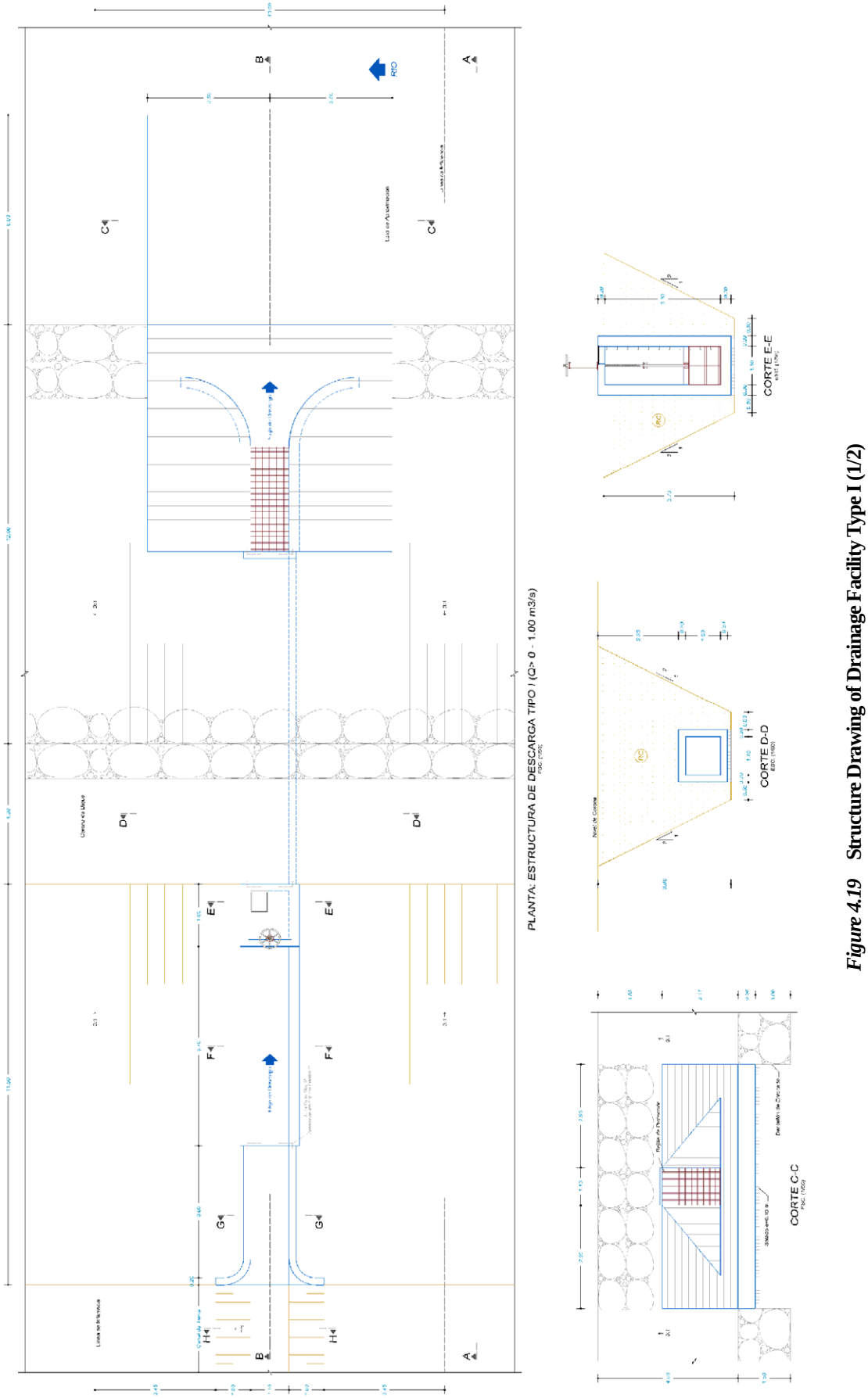

Figure 4.19 **Structure Drawing of Drainage Facility Type I (1/2)**

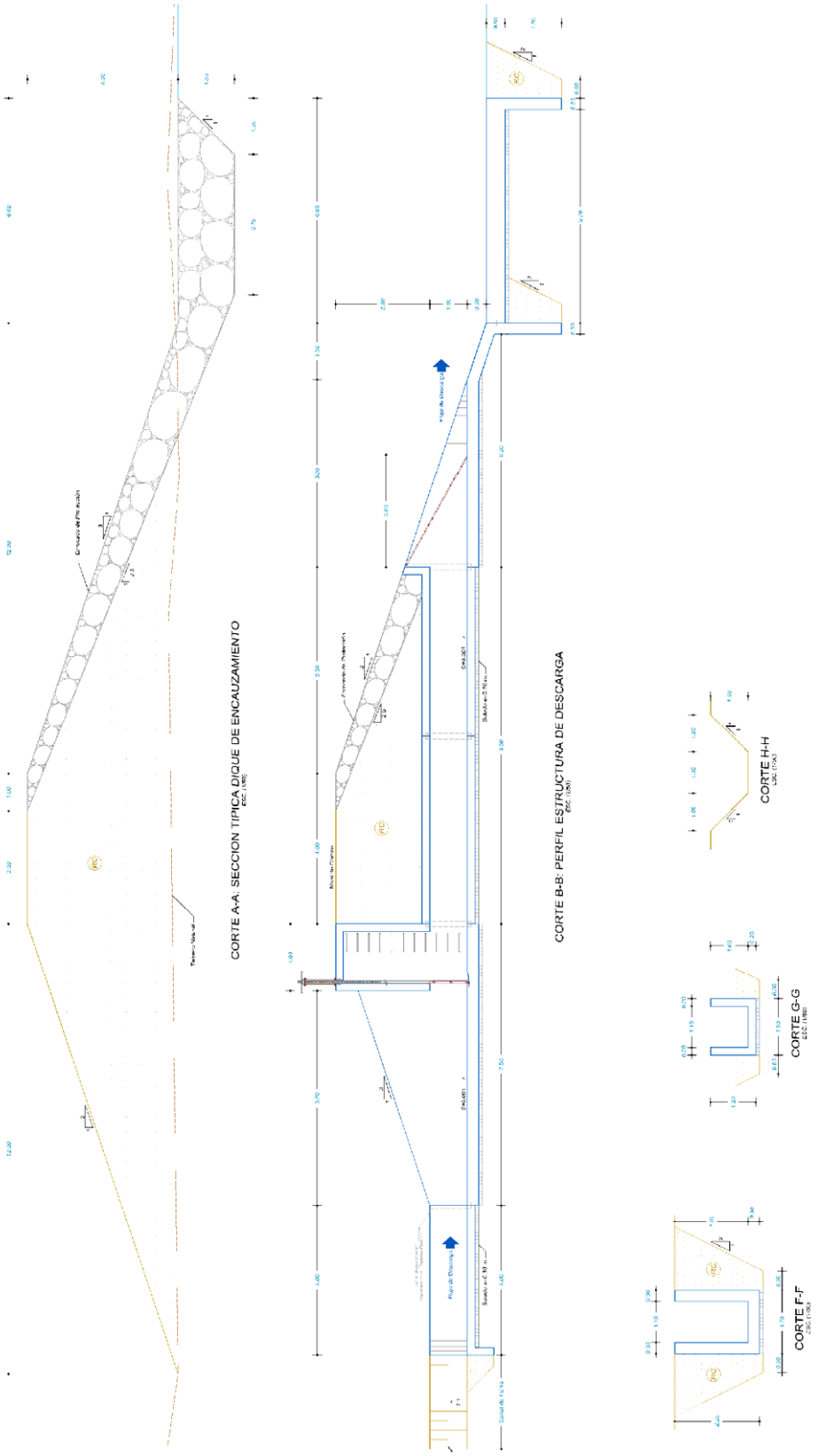

Figure 4.19 **Structure Drawing of Drainage Facility Type I (2/2)**

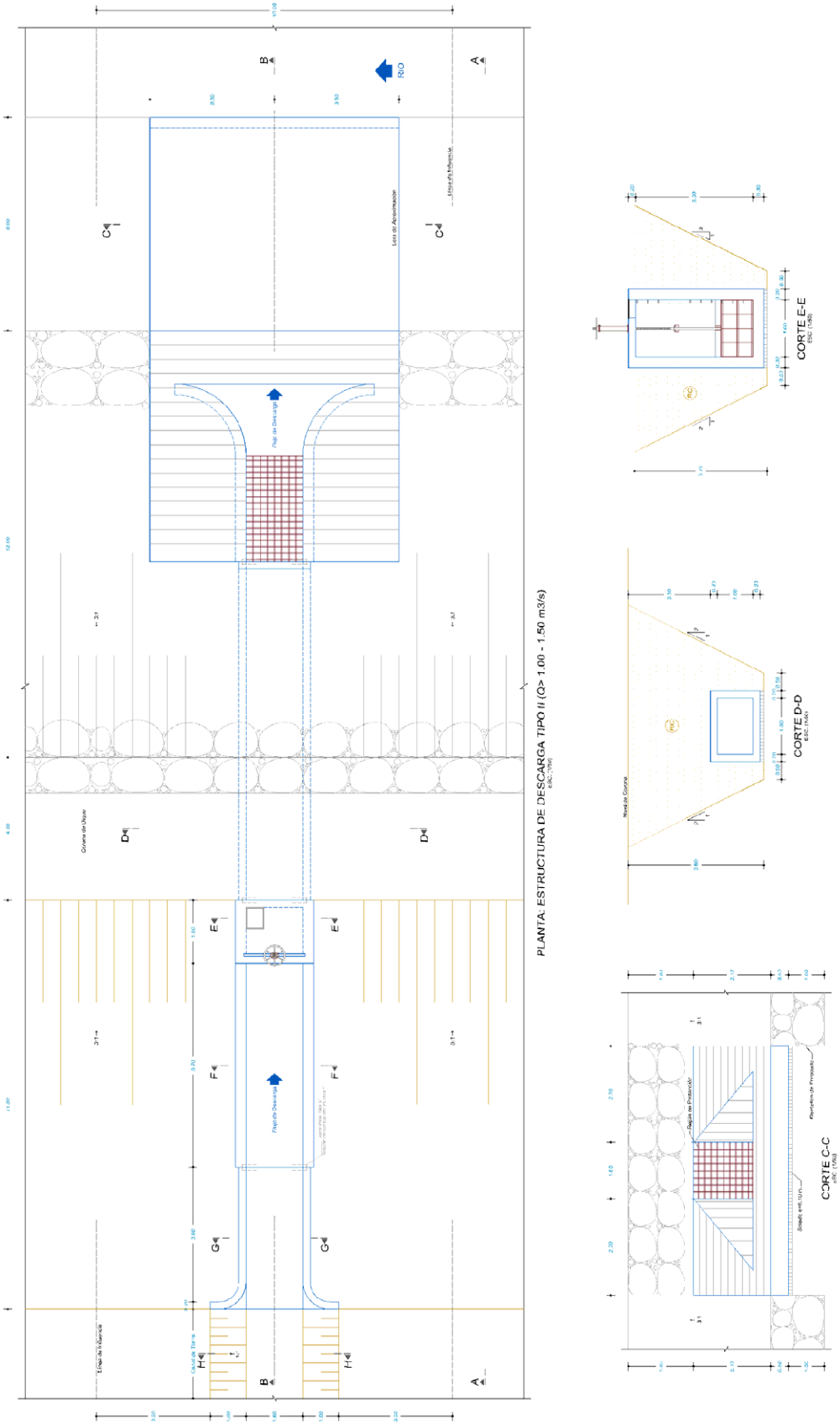

Figure 4.20 **Structure Drawing of Drainage Facility Type II (1/2)**

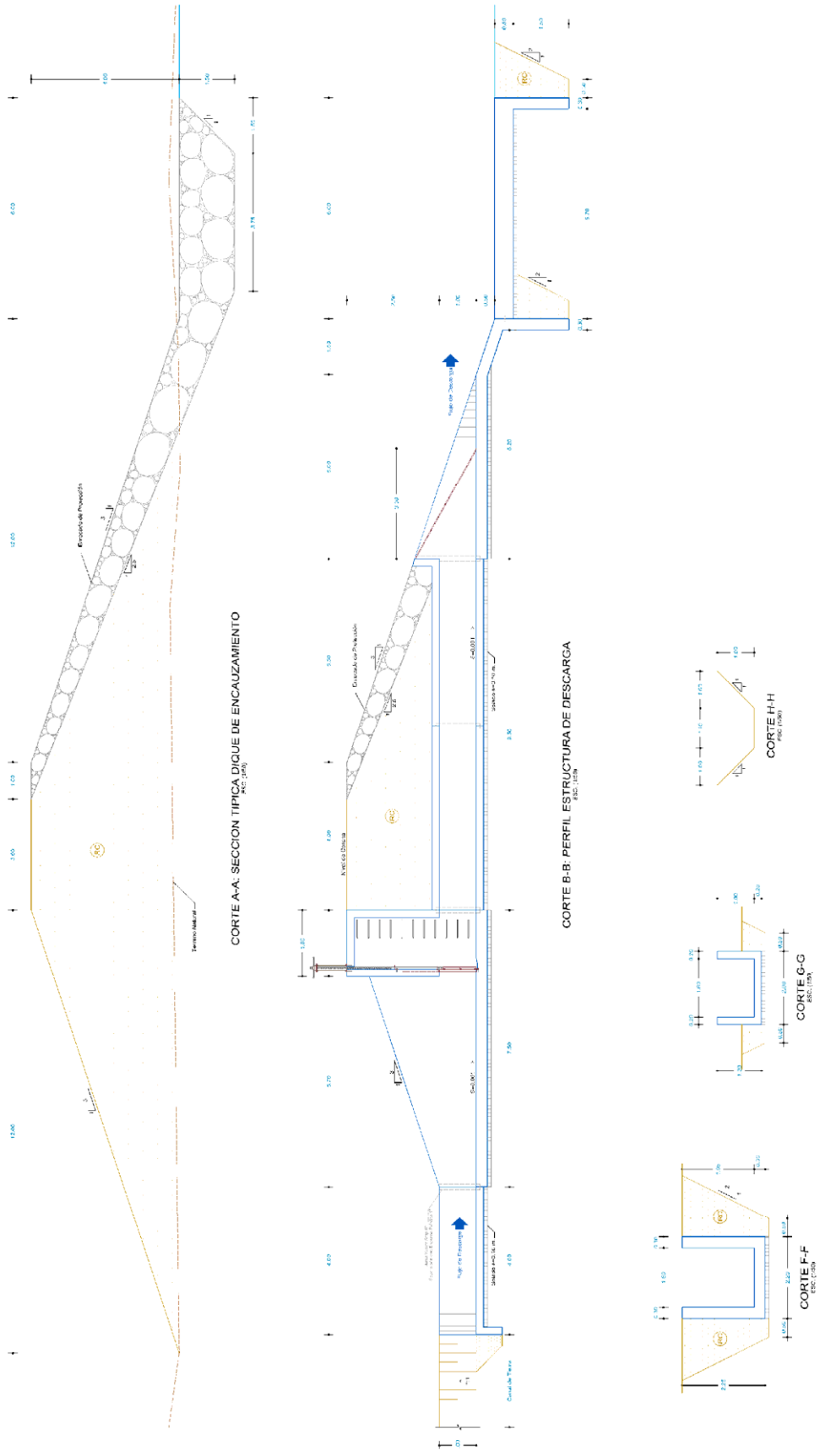

Figure 4.20 **Structure Drawing of Drainage Facility Type II (2/2)**

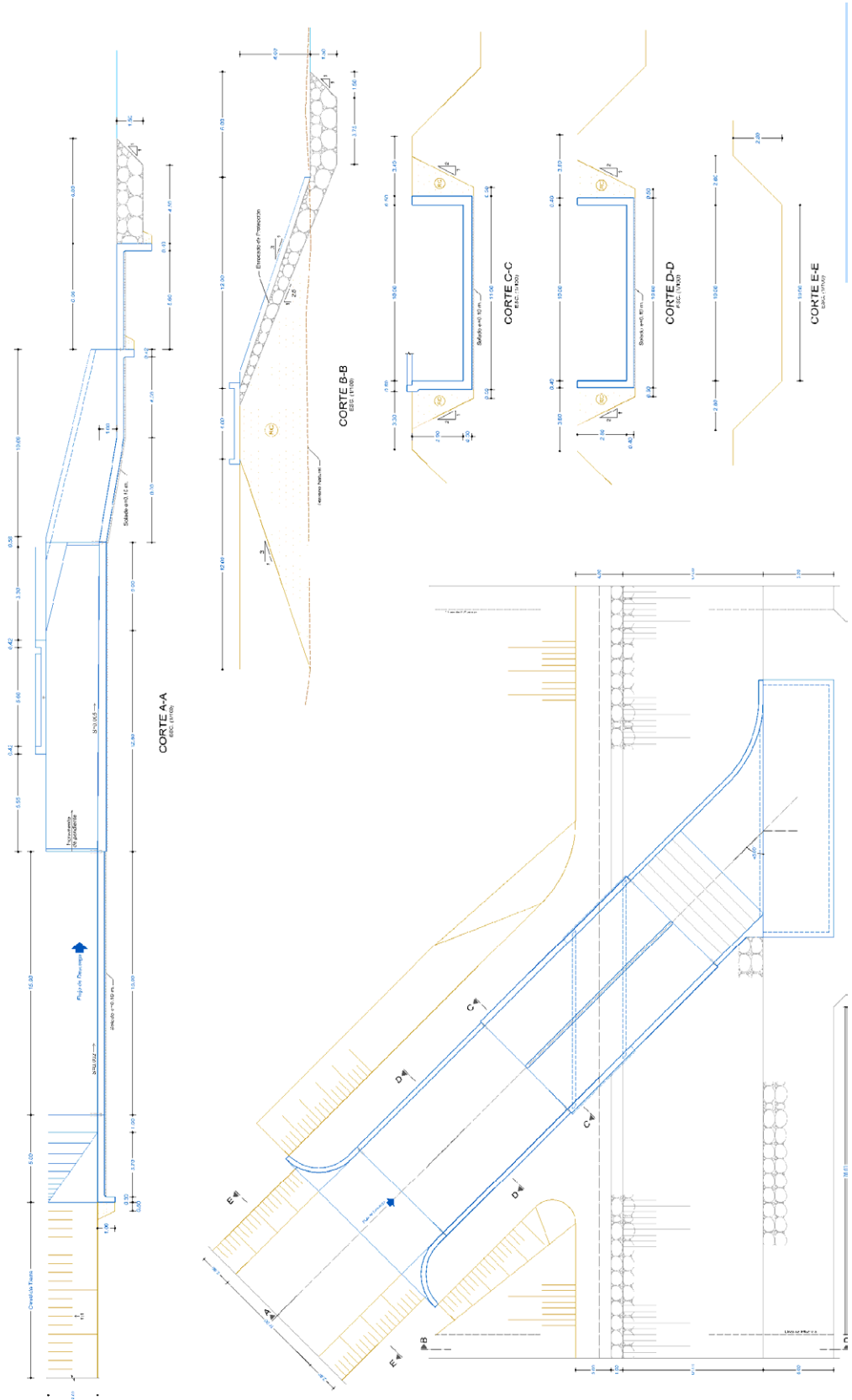

Figure 4.21 **Structure Drawing of Canal Facility**

Table 4.42 **Calculation of Compensation Cost for Intake Facility Type I**

QUANTITIES CALCULATION SUMMARY

PROJECT : ***ESTUDIO DE FACTIBILIDAD: PROTECCION DE VALLES Y POBLACIONES RURALES ANTE INUNDACIONES***

COMPONENT : ***Hydraulic Structure Compensation Cost*** **Date : January 2012**

INTAKE STRUCTURE

Item	Description	Unit	Quantity	Unit Price	Parcial	Total
01.00.00	**Water uptake Structure Type I (Q >0.00-1.00 m3/s)**					
01.01.00	**Preliminary works**					**572.85**
01.01.01	Layout survey	km	335.00	1.71	572.85	
01.02.00	**Earthwork**					**9,720.78**
01.02.01	Excavation of riverbed material with machinery	m^3	95.60	4.78	456.97	
01.02.02	Filling & Compaction with riverbed material	m^3	530.80	3.72	1,974.58	
01.02.03	Shaping & finishing slope of embankment	m^2	215.40	1.55	333.87	
01.02.04	Rock removal with explosives	m^3	60.72	27.56	1,673.44	
01.02.05	Accumulation of rocks	m^3	60.72	15.69	952.70	
01.02.06	Transportation of rocks	m^3	60.72	58.09	3,527.22	
01.02.07	Pilling rocks (for foundation)	m^3	19.12	9.44	180.49	
01.02.08	Revetment work	m^3	41.60	14.94	621.50	
01.03.00	**Concrete works**					**51,070.17**
01.03.01	Base concrete e=0.10 m.	m^2	85.73	20.01	1,715.36	
01.03.02	Concrete f´c=210 kg/cm2	m^3	76.90	276.56	21,266.63	
01.03.03	Formwork	m^2	217.88	55.59	12,112.06	
01.03.04	Re-bar f'y= 4200 kg/cm2	kg	4,306.23	3.71	15,976.12	
01.04.00	**Metal Structure**					**4,582.58**
01.04.01	Protection Grating (1.10 x 3.44 m.)	und	1.00	560.00	560.00	
01.03.02	Metal gate (1.10 x 1.00 m.)	und	1.00	3,800.00	3,800.00	
01.03.03	Steel gangway ladder	m	3.30	42.60	140.58	
01.03.04	Metal cover (0.60 x 0.50 m.)	und	1.00	82.00	82.00	
	Direct Cost					**65,946.38**
	Overhead Costs (15%)					**9,891.96**
	Utility (10%)					**6,594.64**
	SUBTOTAL					**82,432.97**
	Tax (18%)					**14,837.94**
	TOTAL COST					**97,270.91**

Table 4.43 **Calculation of Compensation Cost for Intake Facility Type II**

QUANTITIES CALCULATION SUMMARY

PROJECT : ***ESTUDIO DE FACTIBILIDAD: PROTECCION DE VALLES Y POBLACIONES RURALES ANTE INUNDACIONES***

COMPONENT : ***Hydraulic Structure Compensation Cost*** **Date : January 2012**

INTAKE STRUCTURE

Item	Description	Unit	Quantity	Unit Price	Parcial	Total
02.00.00	**Water uptake Structure Type II (Q >1.00-1.50 m3/s)**					
02.01.00	**Preliminary works**					**572.85**
02.01.01	Layout survey	km	335.00	1.71	572.85	
02.02.00	**Earthwork**					**9,523.32**
02.02.01	Excavation of riverbed material with machinery	m^3	95.60	4.78	456.97	
02.02.02	Filling & Compaction with riverbed material	m^3	477.72	3.72	1,777.12	
02.02.03	Shaping & finishing slope of embankment	m^2	215.40	1.55	333.87	
02.02.04	Rock removal with explosives	m^3	60.72	27.56	1,673.44	
02.02.05	Accumulation of rocks	m^3	60.72	15.69	952.70	
02.02.06	Transportation of rocks	m^3	60.72	58.09	3,527.22	
02.02.07	Pilling rocks (for foundation)	m^3	19.12	9.44	180.49	
02.02.08	Revetment work	m^3	41.60	14.94	621.50	
02.03.00	**Concrete works**					**53,972.99**
02.03.01	Base concrete e=0.10 m.	m^2	98.25	20.01	1,965.98	
02.03.02	Concrete f´c=210 kg/cm2	m^3	81.05	276.56	22,415.74	
02.03.03	Formwork	m^2	229.39	55.59	12,751.90	
02.03.04	Re-bar f'y= 4200 kg/cm2	kg	4,538.91	3.71	16,839.36	
02.04.00	**Metal Structure**					**5,882.58**
02.04.01	Protection Grating (1.10 x 3.44 m.)	und	1.00	860.00	860.00	
02.04.02	Metal gate (1.10 x 1.00 m.)	und	1.00	4,800.00	4,800.00	
02.04.03	Steel gangway ladder	m	3.30	42.60	140.58	
02.04.04	Metal cover (0.60 x 0.50 m.)	und	1.00	82.00	82.00	
	Direct Cost					**69,951.74**
	Overhead Costs (15%)					**10,492.76**
	Utility (10%)					**6,995.17**
	SUBTOTAL					**87,439.67**
	Tax (18%)					**15,739.14**
	TOTAL COST					**103,178.81**

Table 4.44 **Calculation of Compensation Cost for Drainage Facility Type I**

QUANTITIES CALCULATION SUMMARY

PROJECT : ***ESTUDIO DE FACTIBILIDAD: PROTECCION DE VALLES Y POBLACIONES RURALES ANTE INUNDACIONES***

COMPONENT : ***Hydraulic Structure Compensation Cost*** **FECHA :** **Enero 2012**

DRAINAGE STRUCTURE

Item	Description	Unit	Quantity	Unit Price	Parcial	Total
01.00.00	**Discharge Structure Type-I (Q >0.00-1.00 m3/s)**					
01.01.00	**Preliminary works**					**572.85**
01.01.01	Layout survey	km	335.00	1.71	572.85	
01.02.00	**Earthwork**					**11,337.98**
01.02.01	Excavation of riverbed material with machinery	m^3	95.60	4.78	456.97	
01.02.02	Filling & Compaction with riverbed material	m^3	530.80	3.72	1,974.58	
01.02.03	Shaping & finishing slope of embankment	m^2	215.40	1.55	333.87	
01.02.04	Rock removal with explosives	m^3	75.08	27.56	2,069.20	
01.02.05	Accumulation of rocks	m^3	75.08	15.69	1,178.01	
01.02.06	Transportation of rocks	m^3	75.08	58.09	4,361.40	
01.02.07	Pilling rocks (for foundation)	m^3	28.68	9.44	270.74	
01.02.08	Revetment work	m^3	46.40	14.94	693.22	
01.03.00	**Concrete works**					**47,818.15**
01.03.01	Base concrete e=0.10 m.	m^2	80.03	20.01	1,601.30	
01.03.02	Concrete f´c=210 kg/cm2	m^3	70.88	276.56	19,601.74	
01.03.03	Formwork	m^2	213.88	55.59	11,889.70	
01.03.04	Re-bar f'y= 4200 kg/cm2	kg	3,969.11	3.71	14,725.41	
01.04.00	**Metal Structure**					**4,582.58**
01.04.01	Protection Grating (1.10 x 3.44 m.)	und	1.00	560.00	560.00	
01.03.02	Metal gate (1.10 x 1.00 m.)	und	1.00	3,800.00	3,800.00	
01.03.03	Steel gangway ladder	m	3.30	42.60	140.58	
01.03.04	Metal cover (0.60 x 0.50 m.)	und	1.00	82.00	82.00	
	Direct Cost					**64,311.56**
	Overhead Costs (15%)					**9,646.73**
	Utility (10%)					**6,431.16**
	SUBTOTAL					**80,389.44**
	Tax (18%)					**14,470.10**
	TOTAL COST					**94,859.54**

Table 4.45 **Calculation of Compensation Cost for Drainage Facility Type II**

QUANTITIES CALCULATION SUMMARY

PROJECT : ***ESTUDIO DE FACTIBILIDAD: PROTECCION DE VALLES Y POBLACIONES RURALES ANTE INUNDACIONES***

COMPONENT : ***Hydraulic Structure Compensation Cost*** **FECHA :** **Enero 2012**

DRAINAGE STRUCTURE

Item	Description	Unit	Quantity	Unit Price	Parcial	Total
02.00.00	**Discharge Structure Type-II (Q >1.00-1.50 m3/s)**					
02.01.00	**Preliminary works**					**572.85**
02.01.01	Layout survey	km	335.00	1.71	572.85	
02.02.00	**Earthwork**					**9,098.64**
02.02.01	Excavation of riverbed material with machinery	m^3	95.60	4.78	456.97	
02.02.02	Filling & Compaction with riverbed material	m^3	477.72	3.72	1,777.12	
02.02.03	Shaping & finishing slope of embankment	m^2	215.40	1.55	333.87	
02.02.04	Rock removal with explosives	m^3	57.52	27.56	1,585.25	
02.02.05	Accumulation of rocks	m^3	57.52	15.69	902.49	
02.02.06	Transportation of rocks	m^3	57.52	58.09	3,341.34	
02.02.07	Pilling rocks (for foundation)	m^3	28.68	9.44	270.74	
02.02.08	Revetment work	m^3	28.84	14.94	430.87	
02.03.00	**Concrete works**					**50,720.97**
02.03.01	Base concrete e=0.10 m.	m^2	92.55	20.01	1,851.93	
02.03.02	Concrete f´c=210 kg/cm2	m^3	75.03	276.56	20,750.85	
02.03.03	Formwork	m^2	225.39	55.59	12,529.54	
02.03.04	Re-bar f'y= 4200 kg/cm2	kg	4,201.79	3.71	15,588.65	
02.04.00	**Metal Structure**					**5,882.58**
02.04.01	Protection Grating (1.10 x 3.44 m.)	und	1.00	860.00	860.00	
02.04.02	Metal gate (1.10 x 1.00 m.)	und	1.00	4,800.00	4,800.00	
02.04.03	Steel gangway ladder	m	3.30	42.60	140.58	
02.04.04	Metal cover (0.60 x 0.50 m.)	und	1.00	82.00	82.00	
	Direct Cost					**66,275.04**
	Overhead Costs (15%)					**9,941.26**
	Utility (10%)					**6,627.50**
	SUBTOTAL					**82,843.80**
	Tax (18%)					**14,911.88**
	TOTAL COST					**97,755.68**

Table 4.46 **Calculation of Compensation Cost for Canal Facility**

QUANTITIES CALCULATION SUMMARY

PROJECT : ***ESTUDIO DE FACTIBILIDAD: PROTECCION DE VALLES Y POBLACIONES RURALES ANTE INUNDACIONES***

COMPONENT : ***Hydraulic Structure Compensation Cost*** **FECHA : Enero 2012**

DISCHARGE STRUCTURE - QUEBRADA PEDREGAL

Item	Description	Unit	Quantity	Unit Price	Parcial	Total
01.00.00	**Discharge Structure (Q= 100 m3/s)**					
01.01.00	**Preliminary works**					**3,900.51**
01.01.01	Layout survey	km	2,281.00	1.71	3,900.51	
01.02.00	**Earthwork**					**119,729.61**
01.02.01	Excavation of riverbed material with machinery	m^3	1,824.80	4.78	8,722.54	
01.02.02	Filling & Compaction with riverbed material	m^3	2,654.00	3.72	9,872.88	
01.02.03	Shaping & finishing slope of embankment	m^2	1,077.00	1.55	1,669.35	
01.02.04	Rock removal with explosives	m^3	878.00	27.56	24,197.68	
01.02.05	Accumulation of rocks	m^3	878.00	15.69	13,775.82	
01.02.06	Transportation of rocks	m^3	878.00	58.09	51,003.02	
01.02.07	Pilling rocks (for foundation)	m^3	478.00	9.44	4,512.32	
01.02.08	Revetment work	m^3	400.00	14.94	5,976.00	
01.03.00	**Concrete works**					**240,840.91**
01.03.01	Base concrete e=0.10 m.	m^2	670.75	20.01	13,421.71	
01.03.02	Concrete f´c=210 kg/cm2	m^3	420.00	276.56	116,155.20	
01.03.03	Formwork	m^2	600.00	55.59	33,354.00	
01.03.04	Re-bar f'y= 4200 kg/cm2	kg	21,000.00	3.71	77,910.00	
	Direct Cost					**364,471.03**
	Overhead Costs (15%)					**54,670.65**
	Utility (10%)					**36,447.10**
	SUBTOTAL					**455,588.79**
	Tax (18%)					**82,005.98**
	TOTAL COST					**537,594.77**

4.5 Operation and Maintenance Cost

Operation and maintenance cost after completion of the Project is summarized in ***Table 4.47***. Operation and maintenance work for each facility or critical point consists of preparatory works, earth works and revetment maintenance works as follows.

Category	Work Item	Assumption for O&M Cost Estimate
Preparatory Works	Mob/Demob of Heavy Equipment	➢ Mobilization of bulldozer is assumed. It is confirmed that there are heavy equipment rental companies in each project site. Besides, water user associations aslo have bulldozer.
	Topographic Survey	➢ Topographic survey for whole dike lenghth.
Earth Works	Channel Normalization	➢ Target areas of channel normalization are the river sections where riverbed excavation is required. 30 cm depth excavation by bulldozer is assumed.
Revetment Maintenance Works	Cutting trees	➢ Reffering to past PERPEC projects, 667 trees/1km is need to be cut.
	Rearrangement of Boulders	➢ Reffering to past PERPEC projects, 1% of boulder riprap is assumed to be washed away.

Annual O&M costs are shown in ***Table 4.48*** to ***Table 4.52***. Annaual O&M cost is about 0.9% of construction cost in average.

Table 4.47 **Summary of Annual O&M Cost**

River Basin	O&M Cost (S./) (Market Price)	Ratio to Construction Cost (%)	O&M Cost (S./) (Social Price)	Ratio to Construction Cost (%)
Canete River	259,870	1.1	220,889	1.1
Chincha River	434,894	1.1	370,955	1.1
Pisco River	382,856	0.7	325,427	0.7
Majes-Camana River	709,880	1.0	603,398	1.0
Total	1,787,500	0.9	1,520,670	0.9

Table 4.48 **Annual O&M Cost**

River Basin	Critical Point	O&M Cost (S./)	
		Market Price	Social Price
Canete	Ca-1	31,310.71	26,614.10
	Ca-2	109,035.09	92,679.82
	Ca-3	45,212.69	38,430.78
	Ca-4	25,736.84	21,876.31
	Ca-5	48,574.62	41,288.43
	Total	**259,869.94**	**220,889.45**
Chincha	Chico-1	95,205.79	80,924.92
	Chico-2	25,826.59	21,952.60
	Chico-3	48,600.00	42,606.00
	Ma-1	141,354.25	120,151.11
	Ma-2	123,906.87	105,320.84
	Total	**434,893.49**	**370,955.46**
Pisco	Pi-1	63,085.67	53,622.82
	Pi-2	44,246.69	37,609.68
	Pi-3	71,833.72	61,058.66
	Pi-4	27,722.80	23,564.38
	Pi-5	27,722.80	23,564.38
	Pi-6	148,243.95	126,007.35
	Total	**382,855.61**	**325,427.27**
Majes-Camana	MC-1	111,543.70	94,812.14
	MC-2	54,926.62	46,687.63
	MC-3	164,851.70	140,123.94
	MC-4	52,793.34	44,874.34
	MC-5	107,337.57	91,236.94
	MC-6	150,701.06	128,095.90
	MC-7	67,726.03	57,567.13
	Total	**709,880.02**	**603,398.01**
Grand Total		**1,787,499.05**	**1,520,670.19**

Table 4.49 Details of Annual O&M Cost for Canete River

CAÑETE - 1

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					3,150.00	0.85	2,677.50
1.01	Mob & Demob of Heavy Equipment	一式	1	2,000.00	2,000.00			
1.02	Topographic Survey	m	1,000	1.15	1,150.00			
2.00	**Earth Works**					22,260.00	0.85	18,921.00
2.01	Channel Normalization	m3	6,000	3.71	22,260.00			
3.00	**Revetment Maintenance Works**					1,816.70	0.85	1,544.20
3.01	Cutting Trees	一式	667	2.50	1,667.50			
3.01	Rearragment of Boulders	m3	10	14.92	149.20			
Direct Cost						27,226.70		23,142.70
Indirect Cost (15%)						4,084.01		3,471.40
Total O&M Cost						31,310.71		26,614.10

CAÑETE - 2

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					8,140.00	0.85	6,919.00
1.01	Mob & Demob of Heavy Equipment	一式	2	2,000.00	4,000.00			
1.02	Topographic Survey	m	3,600	1.15	4,140.00			
2.00	**Earth Works**					80,136.00	0.85	68,115.60
2.01	Channel Normalization	m3	21,600	3.71	80,136.00			
3.00	**Revetment Maintenance Works**					6,537.12	0.85	5,556.55
3.01	Cutting Trees	一式	2,400	2.50	6,000.00			
3.01	Rearragment of Boulders	m3	36	14.92	537.12			
Direct Cost						94,813.12		80,591.15
Indirect Cost (15%)						14,221.97		12,088.67
Total O&M Cost						109,035.09		92,679.82

CAÑETE - 3

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					5,610.00	0.85	4,768.50
1.01	Mob & Demob of Heavy Equipment	一式	2	2,000.00	4,000.00			
1.02	Topographic Survey	m	1,400	1.15	1,610.00			
2.00	**Earth Works**					31,164.00	0.85	26,489.40
2.01	Channel Normalization	m3	8,400	3.71	31,164.00			
3.00	**Revetment Maintenance Works**					2,541.38	0.85	2,160.17
3.01	Cutting Trees	一式	933	2.50	2,332.50			
3.01	Rearragment of Boulders	m3	14	14.92	208.88			
Direct Cost						39,315.38		33,418.07
Indirect Cost (15%)						5,897.31		5,012.71
Total O&M Cost						45,212.69		38,430.78

CAÑETE - 4

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					3,120.00	0.85	2,652.00
1.01	Mob & Demob of Heavy Equipment	一式	1	2,200.00	2,200.00			
1.02	Topographic Survey	m	800	1.15	920.00			
2.00	**Earth Works**					17,808.00	0.85	15,136.80
2.01	Channel Normalization	m3	4,800	3.71	17,808.00			
3.00	**Revetment Maintenance Works**					1,451.86	0.85	1,234.08
3.01	Cutting Trees	一式	533	2.50	1,332.50			
3.01	Rearragment of Boulders	m3	8	14.92	119.36			
Direct Cost						22,379.86		19,022.88
Indirect Cost (15%)						3,356.98		2,853.43
Total O&M Cost						25,736.84		21,876.31

CAÑETE - 5

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					6,125.00	0.85	5,206.25
1.01	Mob & Demob of Heavy Equipment	一式	2	2,200.00	4,400.00			
1.02	Topographic Survey	m	1,500	1.15	1,725.00			
2.00	**Earth Works**					33,390.00	0.85	28,381.50
2.01	Channel Normalization	m3	9,000	3.71	33,390.00			
3.00	**Revetment Maintenance Works**					2,723.80	0.85	2,315.23
3.01	Cutting Trees	一式	1,000	2.50	2,500.00			
3.01	Rearragment of Boulders	m3	15	14.92	223.80			
Direct Cost						42,238.80		35,902.98
Indirect Cost (15%)						6,335.82		5,385.45
Total O&M Cost						48,574.62		41,288.43

TOTAL	259,869.94		220,889.45

Table 4.50 Details of Annual O&M Cost for Cincha River

Chico – 1

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					7,965.00	0.85	6,770.25
1.01	Mob & Demob of Heavy Equipment	一式	2	2,200.00	4,400.00			
1.02	Topographic Survey	m	3,100	1.15	3,565.00			
2.00	**Earth Works**					69,192.00	0.85	58,813.20
2.01	Channel Normalization	m3	18,600	3.72	69,192.00			
3.00	**Revetment Maintenance Works**					5,630.64	0.85	4,786.04
3.01	Cutting Trees	一式	2,067	2.50	5,167.50			
3.01	Rearragment of Boulders	m3	31	14.94	463.14			
Direct Cost						82,787.64		70,369.49
Indirect Cost (15%)						12,418.15		10,555.42
Total O&M Cost						95,205.79		80,924.92

Chico – 2

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					3,120.00	0.85	2,652.00
1.01	Mob & Demob of Heavy Equipment	一式	1	2,200.00	2,200.00			
1.02	Topographic Survey	m	800	1.15	920.00			
2.00	**Earth Works**					17,856.00	0.85	15,177.60
2.01	Channel Normalization	m3	4,800	3.72	17,856.00			
3.00	**Revetment Maintenance Works**					1,481.90	0.85	1,259.62
3.01	Cutting Trees	一式	533	2.50	1,332.50			
3.01	Rearragment of Boulders	m3	10	14.94	149.40			
Direct Cost						22,457.90		19,089.22
Indirect Cost (15%)						3,368.69		2,863.38
Total O&M Cost						25,826.59		21,952.60

Chico – 3

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Operation Cost**					21,600.00	0.91	19,656.00
1.01	Security	h	12	800.00	9,600.00			
1.02	Driver	h	12	1,000.00	12,000.00			
2.00	**Maintenance of Diversion Weir**					17,000.00	0.85	14,450.00
2.01	Dike	個	1	12,000.00	12,000.00			
2.02	Training Wall	個	1	5,000.00	5,000.00			
3.00	**Retaining Wall Maintenance**					10,000.00	0.85	8,500.00
3.01	Maintenance of Masonry Work	一式	1	10,000.00	10,000.00			
Total O&M Cost						48,600.00		42,606.00

Ma – 1

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					11,890.00	0.85	10,106.50
1.01	Mob & Demob of Heavy Equipment	一式	3	2,200.00	6,600.00			
1.02	Topographic Survey	m	4,600	1.15	5,290.00			
2.00	**Earth Works**					102,672.00	0.85	87,271.20
2.01	Channel Normalization	m3	27,600	3.72	102,672.00			
3.00	**Revetment Maintenance Works**					8,354.74	0.85	7,101.53
3.01	Cutting Trees	一式	3,067	2.50	7,667.50			
3.01	Rearragment of Boulders	m3	46	14.94	687.24			
Direct Cost						122,916.74		104,479.23
Indirect Cost (15%)						18,437.51		15,671.88
Total O&M Cost						141,354.25		120,151.11

Ma – 2

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					11,200.00	0.85	9,520.00
1.01	Mob & Demob of Heavy Equipment	一式	3	2,200.00	6,600.00			
1.02	Topographic Survey	m	4,000	1.15	4,600.00			
2.00	**Earth Works**					89,280.00	0.85	75,888.00
2.01	Channel Normalization	m3	24,000	3.72	89,280.00			
3.00	**Revetment Maintenance Works**					7,265.10	0.85	6,175.34
3.01	Cutting Trees	一式	2,667	2.50	6,667.50			
3.01	Rearragment of Boulders	m3	40	14.94	597.60			
Direct Cost						107,745.10		91,583.34
Indirect Cost (15%)						16,161.77		13,737.50
Total O&M Cost						123,906.87		105,320.84

TOTAL	434,893.49		370,955.46

Table 4.51 Details of Annual O&M Cost for Pisco River

PISCO – 1

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					10,892.00	0.85	9,258.20
1.01	Mob & Demob of Heavy Equipment	一式	3	2,200.00	6,600.00			
1.02	Topographic Survey	m	3,700	1.16	4,292.00			
2.00	**Earth Works**					37,200.00	0.85	31,620.00
2.01	Channel Normalization	m3	10,000	3.72	37,200.00			
3.00	**Revetment Maintenance Works**					6,765.10	0.85	5,750.34
3.01	Cutting Trees	一式	2,467	2.50	6,167.50			
3.01	Rearragment of Boulders	m3	40	14.94	597.60			
Direct Cost						54,857.10		46,628.54
Indirect Cost (15%)						8,228.57		6,994.28
Total O&M Cost						63,085.67		53,622.82

PISCO – 2

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					7,532.00	0.85	6,402.20
1.01	Mob & Demob of Heavy Equipment	一式	2	2,200.00	4,400.00			
1.02	Topographic Survey	m	2,700	1.16	3,132.00			
2.00	**Earth Works**					26,040.00	0.85	22,134.00
2.01	Channel Normalization	m3	7,000	3.72	26,040.00			
3.00	**Revetment Maintenance Works**					4,903.38	0.85	4,167.87
3.01	Cutting Trees	一式	1,800	2.50	4,500.00			
3.01	Rearragment of Boulders	m3	27	14.94	403.38			
Direct Cost						38,475.38		32,704.07
Indirect Cost (15%)						5,771.31		4,905.61
Total O&M Cost						44,246.69		37,609.68

PISCO – 3

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					3,940.00	0.85	3,349.00
1.01	Mob & Demob of Heavy Equipment	一式	1	2,200.00	2,200.00			
1.02	Topographic Survey	m	1,500	1.16	1,740.00			
2.00	**Earth Works**					55,800.00	0.85	47,430.00
2.01	Channel Normalization	m3	15,000	3.72	55,800.00			
3.00	**Revetment Maintenance Works**					2,724.10	0.85	2,315.49
3.01	Cutting Trees	一式	1,000	2.50	2,500.00			
3.01	Rearragment of Boulders	m3	15	14.94	224.10			
Direct Cost						62,464.10		53,094.49
Indirect Cost (15%)						9,369.62		7,964.17
Total O&M Cost						71,833.72		61,058.66

PISCO – 4

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					3,660.00	0.85	3,111.00
1.01	Mob & Demob of Heavy Equipment	一式	1	2,500.00	2,500.00			
1.02	Topographic Survey	m	1,000	1.16	1,160.00			
2.00	**Earth Works**					18,600.00	0.85	15,810.00
2.01	Channel Normalization	m3	5,000	3.72	18,600.00			
3.00	**Revetment Maintenance Works**					1,846.78	0.85	1,569.76
3.01	Cutting Trees	一式	667	2.50	1,667.50			
3.01	Rearragment of Boulders	m3	12	14.94	179.28			
Direct Cost						24,106.78		20,490.76
Indirect Cost (15%)						3,616.02		3,073.61
Total O&M Cost						27,722.80		23,564.38

PISCO – 5

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					3,660.00	0.85	3,111.00
1.01	Mob & Demob of Heavy Equipment	一式	1	2,500.00	2,500.00			
1.02	Topographic Survey	m	1,000	1.16	1,160.00			
2.00	**Earth Works**					18,600.00	0.85	15,810.00
2.01	Channel Normalization	m3	5,000	3.72	18,600.00			
3.00	**Revetment Maintenance Works**					1,846.78	0.85	1,569.76
3.01	Cutting Trees	一式	667	2.50	1,667.50			
3.01	Rearragment of Boulders	m3	12	14.94	179.28			
Direct Cost						24,106.78		20,490.76
Indirect Cost (15%)						3,616.02		3,073.61
Total O&M Cost						27,722.80		23,564.38

PISCO – 6

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					16,728.00	0.85	14,218.80
1.01	Mob & Demob of Heavy Equipment	一式	4	2,500.00	10,000.00			
1.02	Topographic Survey	m	5,800	1.16	6,728.00			
2.00	**Earth Works**					107,880.00	0.85	91,698.00
2.01	Channel Normalization	m3	29,000	3.72	107,880.00			
3.00	**Revetment Maintenance Works**					4,299.78	0.85	3,654.81
3.01	Cutting Trees	一式	1,200	2.50	3,000.00			
3.01	Rearragment of Boulders	m3	87	14.94	1,299.78			
Direct Cost						128,907.78		109,571.61
Indirect Cost (15%)						19,336.17		16,435.74
Total O&M Cost						148,243.95		126,007.35

TOTAL	382,855.61		325,427.27

Table 4.52 Details of Annual O&M Cost for Majes-Camana River

MC – 1

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					13,975.00	0.85	11,878.75
1.01	Mob & Demob of Heavy Equipment	一式	4	2,200.00	8,800.00			
1.02	Topographic Survey	m	4,500	1.15	5,175.00			
2.00	**Earth Works**					74,800.00	0.85	63,580.00
2.01	Channel Normalization	m3	20,000	3.74	74,800.00			
3.00	**Revetment Maintenance Works**					8,219.52	0.85	6,986.59
3.01	Cutting Trees	一式	3,000	2.50	7,500.00			
3.01	Rearragment of Boulders	m3	48	14.99	719.52			
Direct Cost						96,994.52		82,445.34
Indirect Cost (15%)						14,549.18		12,366.80
Total O&M Cost						111,543.70		94,812.14

MC – 2

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					6,700.00	0.85	5,695.00
1.01	Mob & Demob of Heavy Equipment	一式	2	2,200.00	4,400.00			
1.02	Topographic Survey	m	2,000	1.15	2,300.00			
2.00	**Earth Works**					37,400.00	0.85	31,790.00
2.01	Channel Normalization	m3	10,000	3.74	37,400.00			
3.00	**Revetment Maintenance Works**					3,662.28	0.85	3,112.94
3.01	Cutting Trees	一式	1,333	2.50	3,332.50			
3.01	Rearragment of Boulders	m3	22	14.99	329.78			
Direct Cost						47,762.28		40,597.94
Indirect Cost (15%)						7,164.34		6,089.69
Total O&M Cost						54,926.62		46,687.63

MC – 3

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					20,100.00	0.85	17,085.00
1.01	Mob & Demob of Heavy Equipment	一式	6	2,200.00	13,200.00			
1.02	Topographic Survey	m	6,000	1.15	6,900.00			
2.00	**Earth Works**					112,200.00	0.85	95,370.00
2.01	Channel Normalization	m3	30,000	3.74	112,200.00			
3.00	**Revetment Maintenance Works**					11,049.30	0.85	9,391.91
3.01	Cutting Trees	一式	4,000	2.50	10,000.00			
3.01	Rearragment of Boulders	m3	70	14.99	1,049.30			
Direct Cost						143,349.30		121,846.91
Indirect Cost (15%)						21,502.40		18,277.04
Total O&M Cost						164,851.70		140,123.94

MC – 4

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					4,800.00	0.85	4,080.00
1.01	Mob & Demob of Heavy Equipment	一式	1	2,500.00	2,500.00			
1.02	Topographic Survey	m	2,000	1.15	2,300.00			
2.00	**Earth Works**					37,400.00	0.85	31,790.00
2.01	Channel Normalization	m3	10,000	3.74	37,400.00			
3.00	**Revetment Maintenance Works**					3,707.25	0.85	3,151.16
3.01	Cutting Trees	一式	1,333	2.50	3,332.50			
3.01	Rearragment of Boulders	m3	25	14.99	374.75			
Direct Cost						45,907.25		39,021.16
Indirect Cost (15%)						6,886.09		5,853.17
Total O&M Cost						52,793.34		44,874.34

MC – 5

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					11,150.00	0.85	9,477.50
1.01	Mob & Demob of Heavy Equipment	一式	4	2,500.00	10,000.00			
1.02	Topographic Survey	m	1,000	1.15	1,150.00			
2.00	**Earth Works**					74,800.00	0.85	63,580.00
2.01	Channel Normalization	m3	20,000	3.74	74,800.00			
3.00	**Revetment Maintenance Works**					7,387.02	0.85	6,278.97
3.01	Cutting Trees	一式	2,667	2.50	6,667.50			
3.01	Rearragment of Boulders	m3	48	14.99	719.52			
Direct Cost						93,337.02		79,336.47
Indirect Cost (15%)						14,000.55		11,900.47
Total O&M Cost						107,337.57		91,236.94

MC – 6

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					14,055.00	0.85	11,946.75
1.01	Mob & Demob of Heavy Equipment	一式	3	2,500.00	7,500.00			
1.02	Topographic Survey	m	5,700	1.15	6,555.00			
2.00	**Earth Works**					106,590.00	0.85	90,601.50
2.01	Channel Normalization	m3	28,500	3.74	106,590.00			
3.00	**Revetment Maintenance Works**					10,399.40	0.85	8,839.49
3.01	Cutting Trees	一式	3,800	2.50	9,500.00			
3.01	Rearragment of Boulders	m3	60	14.99	899.40			
Direct Cost						131,044.40		111,387.74
Indirect Cost (15%)						19,656.66		16,708.16
Total O&M Cost						150,701.06		128,095.90

MC – 7

ITEM	Description	Unit	Q'ty	Market Price			Social Price	
				Unit Price	Sub-total	Total	CF	Total
1.00	**Preparatory Works**					5,490.00	0.85	4,666.50
1.01	Mob & Demob of Heavy Equipment	一式	1	2,500.00	2,500.00			
1.02	Topographic Survey	m	2,600	1.15	2,990.00			
2.00	**Earth Works**					48,620.00	0.85	41,327.00
2.01	Channel Normalization	m3	13,000	3.74	48,620.00			
3.00	**Revetment Maintenance Works**					4,782.20	0.85	4,064.87
3.01	Cutting Trees	一式	1,733	2.50	4,332.50			
3.01	Rearragment of Boulders	m3	30	14.99	449.70			
Direct Cost						58,892.20		50,058.37
Indirect Cost (15%)						8,833.83		7,508.76
Total O&M Cost						67,726.03		57,567.13

TOTAL	709,880.02		603,398.01

Ministry of Agriculture
Republic of Peru

THE PREPARATORY STUDY
ON
PROJECT OF THE PROTECTION OF FLOOD PLAIN AND VULNERABLE RURAL POPULATION AGAINST FLOOD IN THE REPUBLIC OF PERU

FINAL REPORT
I-6 SUPPORTING REPORT
ANNEX-10 ECONOMIC EVALUATION AND ANALYSIS

March 2013

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

YACHIYO ENGINEERING CO., LTD.
NIPPON KOEI CO., LTD.
NIPPON KOEI LATIN AMERICA –
CARIBBEAN Co., LTD.


COLOMBIA
ECUADOR
PERU
BRAZIL
BOLIVIA
CHILE
SOUTH PASIFIC OCEAN
Boundary representation is not necessarily authoritative
Quito
Manta
Guayaquil
Ambato
Cuenca
Tumbes
Loja
Talara
Sullana
Piura
Paita
Iquitos
Amazon
Leticia
Benjamin Constant
Rio Caquetá
Rio Napo
Rio Marañon
Rio Ucayali
Rio Yavari
Rio Javari
Rio Purus
Rio Juruá
Rio Branco
Cruzeiro do Sul
Pucallpa
Rio Madre de Dios
Rio Beni
Rio Apurimac
Rio Urubamba
Rio Mantaro
Rio Pachitea
Rio Alto Purus
Chachapoyas
Moyobamba
Tarapoto
Chiclayo
Cajamarca
Trujillo
Salaverry
Chimbote
Huaraz
Tingo Maria
Huanuco
Huancayo
Cerro de Pasco
Huacho
Lima
Callao
Ica
Nazca
Abancay
Quillabamba
Machu Picchu
Cusco
Puerto Maldonado
Ayacucho
Huancavelica
Puno
Juliaca
Desaguadero
Matarani
Moquegua
Tacna
Ilo
Arica
La Paz
Oruro
Lago Titicaca
Lago Poopo
PIURA
ピウラ州
TUMBES
LAMBAYEQUE
CAJAMARCA
AMAZONAS
SAN MARTIN
LA LIBERTAD
ANCASH
HUANUCO
PASCO
LORETO
UCAYALI
LIMA
リマ州
JUNIN
MADRE DE DIOS
CUSCO
HUANCAVELICA
APURIMAC
AYACUCHO
ICA
イカ州
PUNO
AREQUIPA
アレキパ州
MOQUEGUA
TACNA
Chira River
Canete River
Chincha River
Pisco River
Yauca River
Majes-Camana River
Legend
International boundary
Province boundary
Project Area (関連州)
Taget Rivers (対象河川)
National capital
Department capital
Railroad
Road
0 100 200 Km
0 100 200 Miles
78
72
0
6
12
18

Study Area

Abbreviation

Abbre.	Official Form or Meaning
ANA	Autoridad Nacional del Agua
ALA	Autoridad Loca del Agua
B/C	Cost-Benefit Ratio
GDP	Gross Domestic Product
GIS	Geographic Information System
DGAA	Dirección General de Asuntos Ambientales
DGFFS	Dirección General de Forestal y de Fauna Silvestre
DGIH	Dirección General de Infraestructura Hidráulica
DGPI(exDGPM)	Dirección General de Política de Inversiones
DNEP	Dirección Nacional de Endeudamiento Público
DRA	Dirección Regional de Aguricultura
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
F/S	Feasibility Study
GORE	Gobierno Regional
HEC-HMS	Hydrologic Engineering Centers Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Centers River Analysis System
IGN	Instituto Geográfico Nacional
IGV	Impuesto General a Ventas
INDECI	Instituto Nacional de Defensa Civil
INEI	Instituto Nacional de Estadística
INGEMMET	Instituto Nacional Geológico Minero Metalúrgico
INRENA	Instituto Nacional de Recursos Naturales
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
JNUDRP	Junta Nacional de Usuarios de Distritos del Perú
L/A	Loan Agreement
MEF	Ministerio de Economía y Finanzas
MINAG	Ministerio de Agricultura
M/M	Minutes of Meeting
NPV	NET PRESENT VALUE
O&M	Operation and maintenance

OGA	Oficina General de Administración
ONERRN	Oficina Nacional de Evaluación de Recursos Naturales
OPI (OPP)	Oficina de Programación e Inversiones (Oficina de Planificación e Prespuesto)
PE	Proyecto Especial Chira-Piura
PES	Payment for Enviromental Services, PSA(Pago por Servicos ambientales)
PERFIL	Perfil Study
Pre F/S	Pre Feasibility Study
PERPEC	Programa de Encauzamiento de Ríos y protección de Estructura de Captación
PRONAMACHIS	Programa Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos
PSI	Programa de Sub Sectorial de irrigaciones
SCF	Standard conversion factor
SENAMHI	Servicio Nacional de Meteorología y Hidrología
SNIP	Sistema Nacional de Inversión Pública
UF	Unidad formuladora (Formulation Unit)
VALLE	Basin, Catchment
VAT	Value added tax

THE PREPARATORY STUDY ON PROJECT OF THE PROTECTION OF FLOOD PLAIN AND VULNERABLE RURAL POPULATION AGAINST FLOOD IN THE REPUBLIC OF PERU SUPPORTING REPORT

Annex-10
Economic Evaluation and Analysis

Contents

Pages

LIST OF TABLES

Pages

CHAPTER 1 BENEFITS

1.1 Method of Calculating Benefits

The benefits of flood control projects are the reduction of flood damages by comparing with-the-project and without-the-project. Assuming that the life of flood control facility is 50 years, the amounts of damage are caluculated in every flood occurence probability (2-50 year), and then expected annual average of damage reduction (EAADRs) is estimated by interpolation method based on those flood damages and occurence probability, total of the EAADRs is assumed as the benefits turned by the construction of facilities.

The same way are specified in.Guidelines for flood control in Peru (GUIA METODOLOGICA PARA PROYECTOS DE PROTECCION Y / O CONTROL DE INUNDACIONES EN ÁREAS AGRICOLAS O URBANAS, 4.1.2p-105)

The calculating methods of specific benefits are as follows,

① Flood inudation analysis for each (2 years to 50) of the occurrence probability in case of without the projects is carried out and the amount of flood damage is calculated in the flood area.

② Then , flood inudation analysis in case of with-the-projects are carried out, and the amount of flood damage is calculated in the flood area.

③ The total benefits are estimated from the difference between ① and ②, and adding benefits of facilities other than levees (such as intake faicilities, road embankment on)

Damages are consists of direct damage by flood inunadation and indirect damages (such as inability of farming, intercption losses of traffic on) derived from the collpase of facilities.

1.2 Method of Calculating Amount of Damage

In this study, total amount of damage of direct and indirect cost is estimated by means of the items listed in the ***Table 1.1***. (See details in Appendix-1, 1 to 7)

Table 1.1 **Items of Calculating Amount of Flood Damage**

Classification of Damage	Items of Damage	Remarks
(1)Direct Damage	①Crop damage	・Field crops in the flood season Flood damage on crops is calculated by multiplying the inundation depth and the number of days depending on the damage rate ・Facilities of farming, such as agricultural farmland and irrigation channels ・the amount of crop damage by multiplying the damage ratio depending on the number of days flooded and inundation depth with sediment damage to farmland assets
	② Damage to irrigation structures	・Amount of damage due to breach of structures such as irrigation intake facilities and irrigation channels.

Classification of Damage	Items of Damage	Remarks
	③Road damage	· Flood damage on roads is estimated by calculating the damage on the distribution.
	④Damage to Houses	・Buildings for residential and business buildings Calculated by multiplying the damage ratio to assets depending on the depth of water. Houses:residential and business building Household goods: Such as automobiles, clothing, furniture and appliances. Flood damage against houses,shops,assets,and stocks is calculated by multiplying the coefficient of flood damage by valuation of property according to the inundation depth
	⑤ Damage of public facilities	・Roads, bridges, sewer and urban facilities ・the damage of public facilities such as schools, churches etc.. the amount of damage of public civil facilities,etc is estimagted by multiplying the ratio corresponding to facilities by the damage amount of the general assets.
	⑥ Damage of public services	・Facilities such as railways, telephone, gas, water, power
(2)Indirect Damage	①Damage to agriculture	· Assume the damage caused by the inability of agricultural water supply due to the breach of irrigation structures ・ reconstruction of irrigation structures and repair costs are estimated as direct damage.
	② Damage caused by blocking traffic	・Assumed the damage caused by blockage of the road which were destroyed by flood ・Cost of repair and reconstruction of roards is calculated as the direct damage.

(1) Direct Damage

Direct damage is calculated by multiplying the coefficient of damage corredponding to the flood water depth to the amount of assets valuation.

(2) Indirect Damage

For indirect damage, the effects of impact of the breach of intake facililies and road are taken into account. Method of calculating the amount of indirect damage is as follows.

a. Damage to the weir

For the breach of the weir, the sum of the direct damage for the reconstruction or rapair of the weir and indirect damage of crops due to the losses of harvesting by inability of water supply is calculated as the amount of damage.

1) Calculation of facility costs

Cost of intake facilities= facility construction costs per unit water intake × scale (amount of water intake, length of the facility)

Facility construction cost per unit water intake: collect documents of the amount of water intake and facility construction costs of existing facilities(new, repair) and estimate the cost per unit by

analyzing the correlation of those.
Facilities are assumpt to be complete loss at probabiliry 1/10 of river discharge.

2) Crop damage

Calculate the amount of revenue each year to crops that are irrigated cultivation in the area
Annual amount of revenue = (crop yield - costs) × number of annual harvest
High-yield crop = acreage under cultivation (ha) × unit frop yields (kg / ha) ×trading unit cost.
Cost = cost per unit area (S / .ha) ×acreaga under cultivation (ha)

b. Damage of road

Economic loss due to the blocking traffic is calculated as amount of damage cost.
amount of damage = Direct damage + indirect damage
amount of direct damage: road construction costs (new, repair)
amount of indirect damage : opportunity loss in case of impasable by the breach of the road (depreciation cost+ loss of labor costs)
period of impassable is assumed 5 days (In Peru.temporary road is constructed at about five days in general)

1.3 Calculation of Economic Evaluation

In cost-benefit survey for economic evaluation, two case of ①private price and ② social price which calculated by multiplying the (SCF) standard conversion factor to private price were considered.
The standard conversion factor (SCF) is the ratio of the private price in domestic and the social price calculated at the border with respect to all goods of the country's economy,
To convert economic price, the standard conversion factor SCF is applied for goods and services which were procured in the country.
In this study, economic evaluation is calculated based on the Guidelines which are available in Peru (Guideline of the National Public Investment System (Directorial Resolution No. 003-2011-EF/68.01, Annex SNIP 10-V3.1). Ministry of Economy and Finance is indicated SCF as shown in ***Table 1.2***.
At transformation from private costs to social costs, value-added tax the (18%) VAT does not considered. SCF of four river basin are shown in ***Table 1.3***. (See details in Appendix-2, 2.1)

In this project, it is necessary to consider the following components: at social evaluation.

- Infrastructure Costs
- Forestry and Vegetation Recovery Costs
- Training and Risk Prevention Costs
- Mitigation of Environmental Impact

- Detailled Design
- Supervision

Table 1.2 **Standard Conversion Factor (SCF) to Convert to Social Price**

(MEF: Ministry of Economy and Finance)

Correction Factors for Social Rates (Methodology MEF)	
DESCRIPCION	**VALOR**
·National Property Expenditures	0.85
·Imported Goods Expenditures	0.92
·Indirect Imported Goods Expenditures*	
Tasa Ad. Valorem	0.12
General Sales Tax Rate	0.18
·Currency correction factor	1.08
·Fuel costs	0.66
·Indirect costs (administrative and financial)	0.85
Legal entity	0.85
Natural Person	0.91
·Expenditures on skilled labor	0.91
·Expenditures on non skilled labor	0.68
Lima Metropolitana urbano	0,86
Urban Coast Region	0,68
Rural Coast Region	0,57
Urban Sierra Region	0,60
Urban Sierra Region	0,41
Urban Forest Region	0,63
Rural Forest Region	0,49
·Indirect taxes Manpower **	
Fourth Category Rate for Non-Personal Services (10%)	0.91

Table 1.3 **SCF of Direct Construction Cost to Social Price**

Basin	SCF
CAÑETE	0.832
CHINCHA	0.824
PISCO	0.824
MAJES - CAMANA	0.832

1.4 Disaster Scale

As the results of flood inundation simulation and river flow capacity on 50 year occurrence flood, disaster scale for each basin in before and after the flood control flood control measures taken is shown in ***Table 1.4***.

Table 1.4 **Flood Damage and Effect of Flood Control Measures in 50 Year Flood**

Basin	Inundation Area (ha)			Erosioned Area (ha)			Damage to water infrastructure (pcs)			Damage to roads (pcs)		
	Sin Proy.	Con Proy.	Efecto	Sin Proy.	Con Proy.	Efecto	Sin Proy.	Con Proy.	Efecto	Sin Proy.	Con Proy.	Efecto
CAÑETE	1,200	167	1,034	202	68	135	2	1	1	4	0	4
CHINCHA	2,352	1,020	1,332	132	35	97	2	0	2	4	4	0
PISCO	859	312	547	98	35	63	4	0	4	2	1	1
MAJES-CAMANA	3,098	545	2,552	1,318	399	919	13	7	6	5	2	3
TOTAL	7,509	2,044	5,465	1,750	537	1,213	21	8	13	15	7	8

*Some values differ due to the decimal consideration

By implementing the projects, the following damage mitigation can be expected.

(1) Throughout the 4 basins, flooding area is estimated as approximately 7,509 ha before the projects, however after the projects flooding area is expected to be reduced to approximately 2,044 ha, therefore there is a effect of protection against the flooding area of approximately 5,265 ha.

(2) Around 1,213 ha of farmland is protected from erosion or flow out caused by flood discharge.

(3) Breach risk of 13 intake weir is expected to be reduced, results in mitigating the damage possibility of farmland in irrigation area due to the inability of cultivating.

(4) Eigth locations of roads along the rivers are expected to be protected, results in avoiding the economic losses due to interruption of traffic.

1.5 Expected Amount of Damage in Each Return Period

Expected amount of damage in each river are shown in ***Table 1.5*** to ***Table 1.6*** in case of with-the-project and without-the project. Expected amount of damage in 50 years flood in case of without-the-project in each river are 158.2 million of Canete, 103.9 million of Chincha, 81.5 million of Pisco, 192.0 million of Mahes-Camana, expected damage is the highest in Mahes – Camana

Table 1.5 **Expected Flood Damage (Private Cost)**

Case	t					Total
		Cañete	Chincha	Pisco	Majes-Camana	
Without Project (1)	2	1,735	15,262	16,668	311	33,977
	5	6,420	39,210	23,343	48,616	117,590
	10	77,850	55,372	50,239	78,391	261,852
	25	104,090	77,797	59,936	111,072	352,895
	50	158,173	103,947	81,510	191,990	535,621
With Project (2)	2	167	449	221	0	837
	5	878	3,005	302	8,349	12,533
	10	9,260	4,309	2,756	18,278	34,603
	25	12,897	14,282	6,595	31,256	65,031
	50	17,886	29,945	9,108	50,734	107,674
Effect (1) - (2)	2	1,568	14,813	16,448	311	33,140
	5	5,542	36,205	23,041	40,268	105,057
	10	68,590	51,063	47,484	60,113	227,250
	25	91,193	63,514	53,341	79,816	287,864
	50	140,287	74,002	72,402	141,256	427,947

Table 1.6 **Expected Flood Damage (Social Price)**

Caso	t	Cañete	Chincha	Pisco	Majes-Camana	Total
Without Project (1)	2	2,711	16,758	17,099	317	36,885
	5	11,180	44,275	22,817	48,503	126,775
	10	110,910	74,539	54,702	78,738	318,889
	25	153,056	101,437	64,250	113,789	432,533
	50	225,586	133,108	87,899	201,622	648,216
With Project (2)	2	293	456	310	0	1,060
	5	1,077	4,859	433	8,540	14,909
	10	10,834	6,955	3,243	17,867	38,900
	25	15,524	18,932	8,543	31,916	74,915
	50	21,787	34,979	11,643	54,564	122,973
Effect (1) - (2)	2	2,418	16,302	16,788	317	35,826
	5	10,103	39,417	22,384	39,962	111,866
	10	100,076	67,583	51,459	60,871	279,990
	25	137,532	82,505	55,708	81,872	357,618
	50	203,799	98,129	76,257	147,058	525,243

Amount of direct damage and indirect in 50 year flood provability and 25 years is shown in ***Table 1.7***. As for Cañete, Chincha, Mahes-Camana River Basin, direct cost is larger than indirect cost, but indirect damage in Pisco river basin is larger than direct cost.

Table 1.7 Expected Amount of Damage in 50 and 25 Year Flood

Unit：S/000

Basin	Inundation for 25 years of return period			Inundation for 50 years of return period		
	Direct damages	Indirect damages	Total	Direct damages	Indirect damages	Total
Cañete	72,939	31,151	104,090	118,723	39,451	158,174
Chincha	54,552	23,245	77,797	77,609	26,338	103,947
Pisco	20,528	39,408	59,936	37,986	43,523	81,509
Majes-Camaná	93,980	17,092	111,072	159,200	32,790	191,990
Total	241,999	110,896	352,895	393,518	142,102	535,620

1.6 Expected Annual Average of Damage Reduction (EAADR)

(1) Method of calculation

Expected annual average of damage reduction (EAADR) can be calculated by accumulating total of annual average damage cost of each flood scale which is obtainde by multiplying flood coccurence probability of flood scale to the amount of flood damage of each dischare scale.

Amount of flood damage by each probability years,

As the flood occurs stochastically, annual flow of benefit should be presented in the form of expected annual average of damage resudtion, which is calculated as follows,

Table 1.8 **Expected Annual Average of Damage Reduction**

Occurrence Probability	Damage Value			Interval Average of Damage Reduction	Interval Provability	Annual Average Damage Reduction
	w/o Project	w/ Project	Damage Reduction			
1/1			D_0=0			
1/2	L_1	L_2	$D_1=L_1-L_2$	$(D_0+D_1)/2$	1-(1/2)=0.500	$d_1=(D_0+D_1)/2$ x 0.67
1/5	L_3	L_4	$D_2=L_3-L_4$	$(D_1+D_2)/2$	(1/2)-(1/5)= 0.300	$d_2=(D_1+D_2)/2$ x 0.300
1/10	L_5	L_6	$D_3=L_5-L_6$	$(D_2+D_3)/2$	(1/5)-(1/10)= 0.100	$d_3=(D_2+D_3)/2$ x 0.100
1/20	L_7	L_8	$D_4=L_7-L_8$	$(D_3+D_4)/2$	(1/10)-(1/20)= 0.050	$d_4=(D_3+D_4)/2$ x 0.050
1/30	L_9	L_{10}	$D_5=L_9-L_{10}$	$(D_4+D_5)/2$	(1/20)-(1/30)= 0.017	$d_5=(D_4+D_5)/2$ x 0.017
1/50	L_{11}	L_{12}	$D_6=L_{11}-L_{12}$	$(D_5+D_6)/2$	(1/30)-(1/50)= 0.013	$d_6=(D_5+D_6)/2$ x 0.013
1/100	L_{13}	L_{14}	$D_7=L_{13}-L_{14}$	$(D_6+D_7)/2$	(1/50)-(1/100) =0.010	$d_7=(D_6+D_7)/2$ x 0.010
Expected Annual Average of Damage Reduction			$d_1+d_2+d_3+d_4+d_5+d_6+d_7$			

(2) Calculation of Expected Annual Average of Damage Reduction

Calculating results of Expected Annual Average of Damage Reduction on each river basin are shown in ***Table 1.9*** and ***Table 1.10***.

Table 1.9 **Results of Expected Annual Avarage of Damage Reduction (Private Price)**

Basin	Return Period	Probability	Damages (Thousand Soles)			Interval Avarafe Damage ④	Probability incremental value ⑤	Anual Mean Damage ④×⑤	Accumulated Anual Mean Damage
			Without Project ①	With Project ②	Mitigated Damages ③=①－②				
CAÑETE	1	1.000	0	0	0			0	0
	2	0.500	1,735	167	1,568	784	0.500	392	392
	5	0.200	6,420	878	5,542	3,555	0.300	1,067	1,459
	10	0.100	77,850	9,260	68,590	37,066	0.100	3,707	5,165
	25	0.040	104,090	12,897	91,193	79,891	0.060	4,793	9,959
	50	0.020	158,173	17,886	140,287	115,740	0.020	2,315	12,274
CHINCHA	1	1.000	0	0	0			0	0
	2	0.500	15,262	449	14,813	7,406	0.500	3,703	3,703
	5	0.200	39,210	3,005	36,205	25,509	0.300	7,653	11,356
	10	0.100	55,372	4,309	51,063	43,634	0.100	4,363	15,719
	25	0.040	77,797	14,282	63,514	57,289	0.060	3,437	19,157
	50	0.020	103,947	29,945	74,002	68,758	0.020	1,375	20,532
PISCO	1	1.000	0	0	0			0	0
	2	0.500	16,668	221	16,448	8,224	0.500	4,112	4,112
	5	0.200	23,343	302	23,041	19,745	0.300	5,923	10,035
	10	0.100	50,239	2,756	47,484	35,263	0.100	3,526	13,562
	25	0.040	59,936	6,595	53,341	50,412	0.060	3,025	16,586
	50	0.020	81,510	9,108	72,402	62,872	0.020	1,257	17,844
MAJES-CAMANA	1	1.000	0	0	0			0	0
	2	0.500	311	0	311	155	0.500	78	78
	5	0.200	48,616	8,349	40,268	20,289	0.300	6,087	6,165
	10	0.100	78,391	18,278	60,113	50,191	0.100	5,019	11,184
	25	0.040	111,072	31,256	79,816	69,965	0.060	4,198	15,381
	50	0.020	191,990	50,734	141,256	110,536	0.020	2,211	17,592

Table 1.10 **Calculating Results of Annual Average of Damage Reduction (Social Price)**

Basin	Return Period	Probability	Damages (Thousand Soles)			Interval Avarafe Damage ④	Probability incremental value ⑤	Anual Mean Damage ④×⑤	Accumulated Anual Mean Damage
			Without Project ①	With Project ②	Mitigated Damages ③=①－②				
CAÑETE	1	1.000	0	0	0			0	0
	2	0.500	2,711	293	2,418	1,209	0.500	605	605
	5	0.200	11,180	1,077	10,103	6,261	0.300	1,878	2,483
	10	0.100	110,910	10,834	100,076	55,090	0.100	5,509	7,992
	25	0.040	153,056	15,524	137,532	118,804	0.060	7,128	15,120
	50	0.020	225,586	21,787	203,799	170,665	0.020	3,413	18,533
CHINCHA	1	1.000	0	0	0			0	0
	2	0.500	16,758	456	16,302	8,151	0.500	4,075	4,075
	5	0.200	44,275	4,859	39,417	27,859	0.300	8,358	12,433
	10	0.100	74,539	6,955	67,583	53,500	0.100	5,350	17,783
	25	0.040	101,437	18,932	82,505	75,044	0.060	4,503	22,286
	50	0.020	133,108	34,979	98,129	90,317	0.020	1,806	24,092
PISCO	1	1.000	0	0	0			0	0
	2	0.500	17,099	310	16,788	8,394	0.500	4,197	4,197
	5	0.200	22,817	433	22,384	19,586	0.300	5,876	10,073
	10	0.100	54,702	3,243	51,459	36,922	0.100	3,692	13,765
	25	0.040	64,250	8,543	55,708	53,583	0.060	3,215	16,980
	50	0.020	87,899	11,643	76,257	65,982	0.020	1,320	18,300
MAJES-CAMANA	1	1.000	0	0	0			0	0
	2	0.500	317	0	317	159	0.500	79	79
	5	0.200	48,503	8,540	39,962	20,140	0.300	6,042	6,121
	10	0.100	78,738	17,867	60,871	50,417	0.100	5,042	11,163
	25	0.040	113,789	31,916	81,872	71,372	0.060	4,282	15,445
	50	0.020	201,622	54,564	147,058	114,465	0.020	2,289	17,735

1.7 Benefits in Project Evaluation Period

Benefits are calculated for 15 years as the project evaluation period from the commencement of project operations.

The benefits of 15-year evaluation period by implementing the project is shown in ***Table 1.11***.

Table 1.11 **Benefits by Implementing the Projects**

Basin	Economic Loss without -the-project		Economic Loss with-the-project		Expected Annual Average of Damage Reduction ①-③	Benefits for Evaluation period. ②-④
	Annual Average of Damage ①	Total Amount of Damage for Evaluation Period ②	Annual Average of Damage ③	Total Amount of Damage for Evaluation Peirod④		
Canete	13,952	209,273	1,678	25,169	12,274	184,104
Chincha	22,528	337,919	1,996	29,942	20,532	307,977
Pisco	18,568	278,516	724	10,860	17,844	267,656
Mahes-Camana	22,482	337,226	4,890	73,343	17,592	263,883
Whole 4 Basin	77,530	1,162,934	9,288	139,314	68,242	1,023,620

(i) Throughout the entire 4 river basin, in the annual average amount of damage is s/o 77,530 thousand in case of without-the-project, however it will be reduced by s/o 9,288 thousand in case of with-the-project.

The difference between with-the-project and without-the-project is reached by s/o 68,242 thousand, this means that 88.0% of Expected Annual Average of Damage reduction will be expected. As the results, total benefits of s/o 1,023,620 will be expected in 15 year evaluation period.

(ii) At the individual riverbasin, benefit in 15-year evaluation period, Chincha, Pisco, Mahesu –Camana and Caniete is generated high in the order. The difference between the maximum benefit and minimum benefit is about 1.6 times, and also similar levels of benefit in each river basin are generated by carrying out the project.

1.8 Summary of Benefits

By implementing this project, the following benefits can be expected.

(1) Approximately 5,500 ha of land will be protected from flooding.
(2) Approximately 1,215 ha per year of farmland will be protected from soil erosion and flow out across 4 river basin by river improvement.
(3) By protecting 13 intake weir, stable farming becomes possible.
(4) 8 location of road place will be avoided from failures, and contribute to the stability of the regional distribution and daily life.
(5) Througout the 4 river basins, benefits can be expected s/o 68,242 thousand on annual average, and s/o 1,023,620 thousand in 15 year evalution period

CHAPTER 2 SOCIAL EVALUATION

2.1 Purpose and Evaluation Index

The purpose of the social evaluation in this study is to examine the efficiency of investment in structural and non-structual measures using the technique of cost-benefit analysis from the view point of the national economy. As the method of social evaluation, cost-benefit ratio (B/C), net present value (NPV) and economic internal rate of return. (EIRR) is adopted. EIRR is as an indicator of the efficiency of investment.

EIRR is defined as the discount rate which even out the present value of costs incurred by the projects and the present value of the benefits, and it makes net present value(NPV)= 0 and B/C=1, indicating what percentage of profits being expected by investment.

Internal rate of return used in the economic evaluation is called as the economic internal rate of return (EIRR). Private price is converted to a economic price (so-called social price) to remove the effects of market distortions.

Internal rate of return (IRR), net present value(NPV) and B / C is calculated by a formula in the table below. In case of B/C=1 or NPV >0, the projects is judged as efficient from the view point of the national economy growth.

Table 2.1 **Evaluation index and Feature of Cost-Benefit Analysis**

Evaluation Index	Formula	Feature
(NPV:Net Present Value)	$NPV = \sum_{i=1}^{n} \frac{B_i}{(1+r)^i} - \sum_{i=1}^{n} \frac{C_i}{(1+r)^i}$	•The magnitude of net benefit by the implementation of the project can be compaired. ・Value changes by the social discount rate.
(B/C: Cost Benefit Ratio)	$B/C = \sum_{i=1}^{n} \frac{B_i}{(1+r)^i} \Big/ \sum_{i=1}^{n} \frac{C_i}{(1+r)^i}$	• The efficiency of investment can be cpmpaired by the size of the benefit per unit investment . ・Value changes by the social discount rate.
(IRR: Economic Internal Rate of Return)	$\sum_{i=1}^{n} \frac{B_i}{(1+r)^i} = \sum_{i=1}^{n} \frac{C_i}{(1+r)^i}$	・The efficiency of investment can be determined by comparison with the social discount rate. ・Not affected by the social discount rate.
Here, Bi: The benefits of the i-th year, Ci: The costs of the i-th year, r: Social discount rate (11%) n: Evaluation years		

2.2 Preconditions

Preconditions for each indicator to conduct the economic evaluation is as follows.

i) Evaluation Period

Evaluation period is the year 2013 - 2027 (15 years after construction started). The project schedule is assumed as below. In this study, evalution period is set as 15 years from implementing the costruction of the projects, however there is a possiblity to change evaluation years after in service 15 years under the guidance of the OPI.

- Detailed design year: 2012
- Construction period: 2013 to 2014
- The evaluation period: 2013 to 2027

Project evaluation period is set for 15 years as well as the period which has been adopted in perfil program report of this project. In provision of the SNIP, evaluation period is 10 years as a rule, however in case that the agency of project formation (DGIH in this project) permits the necessity, period can be changed. In Program Perfill Report, DGIH have adopted 15 years and obtained the approval from OPI and DGPM (March 19, 2010). And also 15 years has adopted in this study under the guidance of DGIH and OPI. In general, development study of JICA has been adopted 50 years. Economic evaluation in case of adopting 50 years as evaluation period is attached in Annex-14 project implementation plan of loan assisatance.

ii) Other preconditions

Price Level: 2011

Social discount rate: 11% (Pursuant to the provisions of the SNIP)

Project Cost: Separately estimated (Refer to ***Table 2.3*** - ***2.4***)
Annual Maintenance Costs: Separately estimated (see ***Table 2.5***)

2.3 Locations of Flood Control Facilities

In this project, the locations of flood control facilities were decided as the results of flood inunation simulation, which carried out reffering to field survey results and the accumulation of assets situation and, interview with irrigaition associations.

Construction items planed in this porject are repair of exixiting dike, embankment, river excavation, revetment, improvement or repair of diversin weir and intake weir and widening of river course.

Locations of flood control facilities on each river basin are shown in ***Table 2.2***.

Total project cost are shown in ***Table 2.3*** (Private Cost) and ***Table 2.4*** (Social Cost) and Annual maintenance cost is shown in ***Table 2.5***. (See details in ***Appendix-2***, ***2.2*** and ***2.3***)

Table 2.2 **Location of Construction Site**

River	Locatio		Critical Point	Main Protection Objects	Measure	Feature of Work	
Rio Canete	Ca-1	4..2-5.2 km	Narrow Section	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	1,100 m 5,430 m3
	Ca-2	6.7～8.3 km	Innnuded Point		Dike with bank Protection	Length Dike with bank Large Boulder Riplap	3,200 m 113,700 m3 28,200 m3
	Ca-3	10.1-11.2 km	Narrow Section		Riverbed excavation, Dike with bank Protection	Riverbed excavation Dike with bank Large Boulder Riplap	L=700 m, V=80,270m3 1,630 m 16,730 m3
	Ca-4	24.6-25.0 k	Existing Intake weir (w:150m, i: 1:2, crest w:2.0m)	Existing Intake weir、Agricultural lands	Riverbed excavation、Dike with bank Protection	Riverbed excavation Dike with bank Protection Large Boulder Riplap	L=370 m, V=34,400 m3 L=710m, V=20,150 m3 7,300 m3
	Ca-5	25.1-26.6 k	Narrow Section	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	1,520 m 95,125 m3 14,000 m3
Rio Chincha	Chico-1	2.9-5.0 km	Innnuded Point	Agricultural lands、Existing Intake weir	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	3,150 m 60,160 m3 23,700 m3
	Chico-2	14.7-15.3 km	Existing Intake weir (w:100m, H:3.0m, crest w:2.0m)		Riverbed excavation、Dike with bank Protection	Riverbed excavation Dike with bank Protection Large Boulder Riplap	L=540 m, V=20,000 m3 L=850 m, V=5,500 m3 23,700 m3
	Chico-3	24.0-24.4 km	Existing Intake weir (w:70m, H: 3.0m, crest w:2.0m)		Existing Intake Weir, Dike with bank Protection	Groundsill and Diversion Weir Dike with bank Protection Large Boulder Riplap	Groundsill 1 set, V=5,200 m3, Diversion weir 1 set V=4,300 m3 L=730 m, V=20,350 m3 7,400 m3
	Ma-1	2.5-5.0 km	Innnuded Point		Dike with bank Protection	Length Dike with bank Large Boulder Riplap	4,630 m 49,900 m3 37,000 m3
	Ma-2	8.0-10.5km	Narrow Section		Riverbed excavation、Dike with bank Protection	Riverbed excavation Dike with bank Protection Large Boulder Riplap	L=2,500 m, V=123,500 m3 L=4,080 m, V=37,700 m3 32,200 m3
Rio Pisco	Pi-1	3.0-5.0 km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	4,120 m 92,900 m3 32,200 m3
	Pi-2	6.5-7.9 km	Narrow Section		Riverbed excavation、Dike with bank Protection	Riverbed excavation Dike with bank Protection Large Boulder Riplap	L=1,200 m, V=74,900 m3 L=2,950 m, V=42,520 m3 25,000 m3
	Pi-3	12.4-13.9 km	Innnuded Point		Dike with bank Protection	Length Dike with bank Large Boulder Riplap	1,500 m 33,900 m3 12,600 m3
	Pi-4	19.5-20.5 km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	1,010 m 17,400 m3 8,060 m3
	Pi-5	25.8-26.4 km	Narrow Section		Riverbed excavation、Dike with bank Protection	Riverbed excavation Dike with bank Protection Large Boulder Riplap	L=600 m, V=67,600 m3 L=1,250 m, V=29,900 m3 10,600 m3
	Pi-6	34.5-36.4 km	Existing Intake weir (Sediment Retuding Basin 1,800 x 700m)		Riverbed excavation・Dike with bank Protection	Riverbed excavation Outer Dike with bank protection Large Boulder Riplap Inner Dike with bank protection Large Boulder Riplap	L=1,900 m, V=496,000 m3 L=2,050 m, V=103,600 m3 19,900 m3 L=3,750 m, V=114,000 m3 63,100 m3
Rio Camana	MC-1	0.0-4.5km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	4,500 m 155,700 m3 44,300 m3
	MC-2	7.5-9.5 km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	2,000 m 43,100 m3 18,300 m3
	MC-3	11.0-17.0 km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	6.000 m 169,000 m3 59,000 m3
Rio Majes	MC-4	48.0-50.5 km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	2,500 m 75,200 m3 17,700 m3
	MC-5	52.0-56.0 km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	4,300 m 179,000 m3 39,400 m3
	MC-6	59.6-62.8 km	Innnuded Point, local erosion	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	6,200 m 235,000 m3 51,400 m3
	MC-7	65.0-66.7 km	Innnuded Point	Agricultural lands	Dike with bank Protection	Length Dike with bank Large Boulder Riplap	2,900 m 32,300 m3 27,500 m3

Source: Jica Strudy Team

Table 2.3 **Total Project Cost (Private Price)**

BASIN NAME	DIRECT COST						COSTO INDIRECTO					CONSULTANT COST			HYDROLIC INFRASTRUCTURE COST	LAND ACQUISITION COST	TOTAL COST FOR EACH PROJECT	PROGRAM ADMINISTRATION COST	PROGRAM GRAND COST
	COMPONENT A				COMPONENT B	TOTAL DIRECT COST	Gastos Generales	Profits	Costo de Obras	Tax	TOTAL CONSTRUCTION COST	Detail Design	Supervision cost	TOTAL CONSULTANT COST					
	INFRASTRUCTURE COST		Afforestation and Plant Recovery	Environmental Impact Mitigation	Capacitation and risk prevention														
	Infrastructure	Rehabilitation of existing infrastructure																	
	(1)-1	(1)-2	(2)	(3)	(4)	(5)=(1)+(2)+(3)+(4)	(6) = 0.15 x (5)	(7) = 0.1 x (5)	(8) = (5)+(6)+(7)	(9) = 0.18 x (8)	(10) = (8)+(9)	(11)	(12)	(13)=(11)+(12)	(14)=(10)+(13)	(15)	(17)=(14)+(15)+(16)	(18)	(19)=(17)+(18)
CAÑETE	15,867,305	505,660	26,746	585,576	144,050	17,129,336	2,569,400	1,712,934	21,411,671	3,854,101	25,265,771	1,236,604	1,829,962	3,066,566	28,332,338	1,263,432	29,595,770		
CHINCHA	26,547,476	487,440	76,593	798,096	144,050	28,053,654	4,208,048	2,805,365	35,067,068	6,312,072	41,379,140	2,025,254	2,997,030	5,022,284	46,401,424	622,981	47,024,405		
PISCO	39,047,316	4,168	50,051	772,915	144,050	40,018,500	6,002,775	4,001,850	50,023,125	9,004,163	59,027,288	2,889,022	4,275,259	7,164,281	66,191,569	352,567	66,544,136		
MAJES-CAMANA	47,466,607	1,164,852	268,196	1,043,414	144,050	50,087,119	7,513,068	5,008,712	62,608,899	11,269,602	73,878,501	3,615,898	5,350,910	8,966,808	82,845,309	4,946,510	87,791,820		
TOTAL	**128,928,703**	**2,162,119**	**421,586**	**3,200,002**	**576,200**	**135,288,610**	**20,293,292**	**13,528,861**	**169,110,763**	**30,439,937**	**199,550,700**	**9,766,778**	**14,453,162**	**24,219,940**	**223,770,640**	**7,185,491**	**230,956,130**	**8,518,170**	**239,474,300**

Table 2.4 **Total Project Cost (Private Price)**

BASIN NAME	TOTAL COST OF COMPONENTS (A + B) PRIVATE PRICE	CORRECTION FACTOR (FC)	TOTAL COST OF COMPONENTS (A + B) SOCILA PRICE	CONSULTANT COST			HYDROLIC INFRASTRUCTURE COST	LAND ACQUISITION COST	TOTAL COST FOR EACH PROJECT	PROGRAM ADMINISTRATION COST	PROGRAM GRAND COST
				Detail Design	Supervision	TOTAL CONSULTANT COST					
	(10) = (8)+(9)			(11)	(12)	(13)=(11)+(12)	(14) = (10)+(13)	(15)	(17) = (14)+(15)+(16)	(18)	(19) = (17)+(18)
CAÑETE	25,265,771	0.832	21,025,353	1,108,551	1,652,295	2,760,846	23,786,198	1,077,688	24,863,886		
CHINCHA	41,379,140	0.825	34,143,142	1,800,180	2,683,167	4,483,347	38,626,489	537,590	39,164,079		
PISCO	59,027,288	0.825	48,694,156	2,567,375	3,826,671	6,394,045	55,088,201	341,990	55,430,191		
MAJES-CAMANA	73,878,501	0.832	61,465,314	3,240,727	4,830,303	8,071,030	69,536,344	4,304,833	73,841,176		
TOTAL	**199,550,700**		**165,327,964**	**8,716,833**	**12,992,435**	**21,709,268**	**187,037,232**	**6,262,101**	**193,299,333**	**7,512,038**	**200,811,371**

Table 2.5 **Annual Maintenance Cost**

(s/o)

River Name	Provate Cost	Social Cost	SFC	Ratio against Construction Cost (%)
Cañete	259,870	220,889	0.85	1.1
Chincha	434,894	378,955	0.85	1.1
Pisco	382,856	325,427	0.85	0.7
Majes-Camaná	709,880	603,398	0.85	0.9
Total	1,787,500	1,519,375	0.85	0.9

SFC=0.85 of Maintenance Cost is determined by excluding 18% of sales tax (0.85=1/1.18)

2.4 Cost-Effective Analysis

Cost-Effective analysis is conducted by comparing total cost of construction and maintenance with total benefits (amount of damage reduction) brought out by construction flood control facilities, those costs is transferd to net present value with the use of social discount rate before comparing.

Therefore, at the time of evaluation being as the basis for estimating present value and 15 years from commencement of the project setting as evaluation period, total cost of the project is estimated by sum of present value required to complete flood control facility and maintenance, and total benefits is estimated by the sum of present value of expected annual average of damage reduction.

Table 2.6 shows the results of calculation of B / C, NPV, IRR at private cost. And ***Table 2.7*** shows those figures at social price. (See details in Appendix-2, 2.4 to 2.6)

Table 2.6 **Social Evaluation (B/C, NPV, IRR) (Private Price)**

	Basin		Anual Average Acummulated Benefit	Anual Average Acummulated Benefit (15 years)	Proyect Cost	O&M Cost	B/C	Net Present Value (NPV)	Internal Rate of Return (IRR)
Private Prices	Basin Level	Cañete	159,556,431	72,052,521	29,595,770	3,378,309	2.63	44,681,147	33%
		Chincha	266,913,530	120,532,859	47,024,405	5,653,615	2.76	76,905,695	35%
		Pisco	231,968,634	104,752,437	66,544,136	4,977,123	1.74	44,377,936	21%
		Majes-Camana	228,698,340	103,275,637	87,791,820	9,228,440	1.28	22,447,137	15%
	All Basin		887,136,935	400,613,455	239,474,300	23,237,488	1.89	188,411,915	23%

Table 2.7 **Social Evaluation (B/C, NPV, IRR) (Social Price)**

	Basin		Anual Average Acummulated Benefit	Anual Average Acummulated Benefit (15 years)	Proyect Cost	O&M Cost	B/C	Net Present Value (NPV)	Internal Rate of Return (IRR)
Social Prices	Basin Level	Cañete	240,931,523	108,799,900	24,863,886	2,871,563	4.73	85,780,474	55%
		Chincha	313,198,474	141,434,223	39,164,079	4,822,421	3.89	105,033,115	47%
		Pisco	237,897,809	107,429,935	55,430,191	4,230,554	2.13	57,079,434	27%
		Majes-Camana	230,549,756	104,111,700	73,841,176	7,844,174	1.53	36,063,846	19%
	All Basin		1,022,577,561	461,775,757	200,811,371	19,768,712	2.60	283,956,869	32%

2.5 Summary of Social Evaluation

Economic effects of the project has been confirmed for all basin in private cost and social cost. As the results of cost-effective analysis. Social evaluation in this project are as follows.

(1) Throughout the Entire 4 River Basin

1) B/C shows 1.89 in private price,and 2.60 in social price. Therefore, this project is considered to be relatively high cost effectiveness.
2) Even IRR shows 23% in the private price, and 32% in the social price, compared to 10% social discount rate, which is the projects with high return on investment, there is a profitable enough .

(2) Througout the River Individually

1) Cañete River Basin has the highest economic benefits, B/C is 4.73, and 55% internal rate of return (IRR) in the social price,indicating a very high economic efficiency.
2) Similarly, in Chincha river basin, B/C is 3.89 and the internal rate of return is 47% in the social price, a very high economic effect can be expected as well as Caniete river basin.
3) In Pisco River Basin, campared with Cañete and Chincha river, the economic effect is not so

high, however B/C is 2.13, IRR has shown a 27% in the social price, a healthy economic effect can be expected.

4) Majes–Camana river basin shows the lowest economic indicators such as B/C=1.53 and IRR=19% in the 4 river river basin, however both B/C and IRR has exceeded standard figure, so that the projects in both rivers can be expected required economic effectiveness as public works projects.

Others, as a positive effect with difficult mesurement by the project in monetary terms, below items can be mentioned.

1) To contribute to future economic development of the region by mitigating the stagnation of economic activities and the concern to flood damage.
2) Contribute to the increase of employment in the region for the construction of the projects.
3) Awareness of flood or other disaster of people living in the flooding area can be improved.
4) For reducing flood damage, stable farming becomes possible, to contribute to higher incomes.
5) Contribute to raise farmland prices

(3) From economic valuation mentioned above, by implementing this project, make a significant contribution to local economic development and poverty reduction can be expected.

CHAPTER 3 SENSITIVITY ANALYSIS

3.1 The Purpose

To cope with the uncertainty of the future due to changes in socio-economic conditions, sensitivity analysis is conducted.

However, in public works projects, there is a characteristic that it takes for a long time from planning to operation and also for service life after beginning of operation, so that a lot of uncertainties which make major impact on the costs or benefits in the future are existed, which can not be predicted deterministically.

Thus, the results of cost-benefit analysis with uncertainty, originally, is desirable to show with some width not rather than absolute and unique calculated from the scenario of one.

As the measure to settle those issues, sensitivity analysis is considered to be one of the idea.

By performing sensitivity analysis and showing the width of the results of cost-benefit analysis to play a proper execution of management of the project and accountability to the public, so that improve the accuracy and reliability of project evaluation.

3.2 Implementation of the Sensitivity Analysis

1) Outline of sensitivity analysis

There are three methods on sensitivity analysis as shown in ***Table 3.1***.

Table 3.1 **Method of Sensitibity Analysis**

Method of Sensitivity Analysis	Outline of Each Method	Outcome
Sensitivity Analysis by Each Factor	To understand the impact of the analysis results in case that only one factor in preconditions and assumptions that set at analysis was veried.	Range of possible values for an analysis of precondition and assumption when one is varied
Upper and Lower Case	Method is that, in the case of preconditions and assumptions set in the analysis, all the main ones were made to change, and set the case to become better or deteriorate, to know the width of the analysis results.	The range of values that can be taken in the results of the analysis, in case that all major preconditions and assumptions were changed
Monte Carlo Sensitivity Analysis	Gives the probability distribution in all the main variables of preconditions and assumptions set in the analysis, and by Monte Carlo simulation, the probability distribution of the analysis results is to know.	The probability distribution of the results of the analysis when all the main precondtions and assumptions has fluctuated

2) Contents of the Sensitivity Analysis in this Study

In this project, sensitivity analysis by a different factor has been employed in public works investment in general, and performed. Economic indicators and case study performed for sensitivity analysis are as follows.

Table 3.2 **Study Case and Economic Indicator in Sensitivity Analysis**

Indicator	Width of flctuation by different factor	Economic indicator evaluated
Construction cost	In case of 5% and 10% increase of construction costs.	IRR、NPV、B/C
Benefit	In case of 5% and 10% decline of benefits	IRR、NPV、B/C
Social discount rate	In case of 5% increase and 5% decline of social discount rate.	NPV、B/C

3) Sensitivity Analysis Results

The results of sensitivity analysis for each case study in private price and social price is shown in ***Table 3.3***.

Table 3.3 **Results of Sensitivity of IRR, B/C, NPV**

	Basin		Item	Basic Case	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
					Cost increase 5%	Cost increase 10%	Benefit decrease 5%	Benefit decrease 10%	Disc.rate increase 5%	Disc. rate decrease 5%
PRIVATE PRICE	ALL BASINS		IRR (%)	23%	22%	21%	22%	20%	23%	23%
			B/C	1.89	1.80	1.72	1.79	1.70	1.46	2.52
			NPV(s)	188,411,915	178,326,517	168,241,120	168,381,242	148,350,570	90,983,920	350,795,189
	EACH BASIN SEPARATELY	CAÑETE	IRR (%)	33%	32%	30%	32%	30%	33%	33%
			B/C	2.63	2.51	2.41	2.50	2.37	2.04	3.51
			NPV(s)	44,681,147	43,388,857	42,096,567	41,078,521	37,475,894	26,429,301	74,757,445
		CHINCHA	IRR (%)	35%	33%	32%	33%	32%	35%	35%
			B/C	2.76	2.64	2.53	2.62	2.49	2.14	3.68
			NPV(s)	76,905,695	74,851,989	72,798,284	70,879,052	64,852,409	46,239,359	127,369,505
		PISCO	IRR (%)	21%	20%	19%	20%	19%	21%	21%
			B/C	1.74	1.66	1.58	1.65	1.56	1.34	2.33
			NPV(s)	44,377,936	41,471,590	38,565,243	39,140,315	33,902,693	19,082,579	86,701,555
		MAJES - CAMANA	IRR (%)	15%	14%	13%	14%	13%	15%	15%
			B/C	1.28	1.22	1.17	1.21	1.15	0.99	1.70
			NPV(s)	22,447,137	18,614,081	14,781,025	17,283,356	12,119,574	-767,319	61,966,685
SOCIAL PRICE	ALL BASINS		IRR (%)	32%	30%	29%	30%	28%	32%	32%
			B/C	2.60	2.48	2.37	2.47	2.34	2.01	3.47
			NPV(s)	283,956,869	275,512,283	267,067,696	260,868,082	237,779,294	166,899,787	476,920,446
	EACH BASIN SEPARATELY	CAÑETE	IRR (%)	55%	53%	51%	53%	51%	55%	55%
			B/C	4.73	4.51	4.32	4.49	4.25	3.66	6.30
			NPV(s)	85,780,474	84,694,340	83,608,206	80,340,479	74,900,484	56,890,166	132,831,360
		CHINCHA	IRR (%)	47%	45%	43%	45%	43%	47%	47%
			B/C	3.89	3.71	3.55	3.69	3.50	3.01	5.17
			NPV(s)	105,033,115	103,321,945	101,610,775	97,961,404	90,889,692	67,971,426	165,573,203
		PISCO	IRR (%)	27%	25%	24%	25%	24%	27%	27%
			B/C	2.13	2.04	1.95	2.03	1.92	1.65	2.86
			NPV(s)	57,079,434	54,657,431	52,235,427	51,707,937	46,336,440	30,344,695	101,432,164
		MAJES - CAMANA	IRR (%)	19%	18%	17%	18%	16%	19%	19%
			B/C	1.53	1.46	1.40	1.45	1.38	1.19	2.04
			NPV(s)	36,063,846	32,838,567	29,613,288	30,858,261	25,652,676	11,693,501	77,083,721

4) Evaluation of Sensitivity Analysis

Impact on the project due to changes in socio-economic situation in this study is as follows.

1) Throughout 4 basins

Despite 5% to 10% changes in expense and cost, both internal rate of return (IRR) and B/C is not seen large fluctuations. Since the fluctuation of NPV is also small, it can be said to be a project with high efficiency even if the economic and social situation changes more or less.

2) Individual river basin

As for Cañete river, Chincha river and Pisco river, the projects were indicated a highly efficient from the base case, even if small changes are occurred in costs and benefits, the value of IRR, B / C, and NPV indicate a small change, so that it can be said this projects have high efficiency.

In Majes-Camana river, when social dicount rate become 15% (5% increase), economic effciency

become lower than standard value in case of private price, however, in case of social price, indicate highly efficient in all cases.

CHAPTER 4 RISK ANALYSIS

Risk analysis for 4 river basins which make up the components of this projects was performed.

4.1 Definition of Risk

Increase of costs (%) and decrease of benefits (5) that make NPV=0 in social price calculated in the previous section, and define the risk of each river basin are as follows,

- Large Risk: NPV become 0 at 0% to less than 15% of increase of costs and 0% to less than 15% of decrease of benefits.
- Medium Risk: NPV become 0 at more than 15% to less than 30% and more than 15% to 30% of decrease of benefits.
- Small Risk: NPV become 0 at more than 30% of increase of costs and more than 30% of decrease of benefits.

Twenty-eight percent decrease in the cost and benefits to be 0% increase in the NPV of each basin in social price was calculated in the previous section, is defined as follows: the magnitude of the risk of each basin.

Basin becomes zero NPV by less than 0-15% reduction in benefits or increase in the cost of less than 0-15%: large risk

Basin becomes zero NPV by less than 30% to less than or more than 15 reduction of 30% to more than 15 benefit cost increases: During the risk

Basin becomes zero NPV by 30% or more reduction of more than 30 percent increase in the cost or benefit: risk small

4.2 The Magnitude of the Risk of each Basin

Calculation results of increase (%) of costs and decrease (%) of benefits which NPV becomes 0 in the case of social price at each river baisn are shown in ***Table 4.1***.

Benefits of Mahes-Camana indicates moderate risk in this table, however, risk increase of other river basin is very small.

For the basin that have large risk is required to conduct monitoring for the amount of cost reduction under construction and maintenance after completion of the construction.

Table 4.1 **Increase Amount of Costs (%) and Decrease (%) of Beneftis that Makes NPV=0**

	VAN = 0			
Basin	Cost increase (%)	Risk	Benefit decrease (%)	Riesgo
CAÑETE	471%	Low	79%	Low
CHINCHA	355%	Low	74%	Low
PISCO	136%	Low	53%	Low
MAJES-CAMANA	66%	Low	35%	Medium

CHAPTER 5 SUSTAINABILITY ANALYSIS

This project is carried out in collaboration with central government (DGIH) and water user associations of each river basin and local govenments.

Apportionment of costs of construction is shared among central government and water user associations associations of each river basin and local governments, respectively.

Sharing rate will be determined by consultations among relevant agencies, in this study it is assumed that 80% of the central government (DGIH), 15% of local government, and 5% of water users associations as a percentage of the general division.

On the other hand, after the construction of facilities, maintenance and management will be responsible for water user associations. Therefore, the sustainability of the project will be judged by the profitability of the projects and the maintenance ability by the water user associations.

(1) The Profitability of the Projects

As the result of social evaluation, the profitability of the projects of the whole basin and each basin indicates enough high, so that there are no problems with the sustainability of the the projects.

(2) Operation and Maintenance

Budget in recent water user associations of each basin is shown in ***Table 5.1***.

Table 5.1 **Budget of water users associations**

(unit:s/o)

River	Annual budget			
	2007	2008	2009	2010
Canete	2,355,539.91	2,389,561.65	2,331339.69	2,608,187.18
Chincha	1,562,928.56	1,763,741.29	1,483,108.19	
Pisco	1,648,019.62	1,669,237.35	1,725,290.00	1,425,961.39
Mahes-Camana		1,867,880.10	1,959,302.60	1,864,113.30
Total	5,755,792.18	9,526,298.10	15,536,928.01	5,898,261.84

*）Budget of Mahes-Camana water user asscociation on 2008 is assumed budget of Camana on 2008（1,122,078.40）+ budget of Mahes on 2009（745,810.70）due to the lack of data of water user association budget of Mahes

On the other hand, annual maintenance costs that are required after construction of facilities is shown in ***Table 5.2***.

Ratio of maintenance cost agaistr budget of water user associations on 2009 and Annual average of dumage reduction are shown in ***Table 5.2***.

Ratio of annual maintenance cost against anuual budget of water user associations in 2009, Majes-Camana river indicates the highest value of 36.2% and next 22.2% of Pisco and then 11.1% of Canete and 2.9% of Chincha.

On the other hand, the ratio of maintenance costs for annual average amount of damage reduction

is very low values, which have made 2% to 4%.

Therefore, maintenance costs can be thought to be absorbed sufficiently by water user associations. Furthermore, as for the ability of maintenance, it is thought to be possible for water users associations to conduct maintenance with the technical assistance of the Ministry of Agriculture and local govenments, due to the flood control facilities such as dike and weir in this project is familiar to associations.

Table 5.2 **The Ratio of Maintenance Costs for the Budget of Water Users Associations and for the Annual Average Amount of Damage Reduction**

Basin	Operation Cost (thousand soles) (1)	Anual OyM Cost (thousand soles) (2)	Anual OyM cost percentage (%) (3) = (2)/(1)	Mean anual damages (thousand soles) (4)	Percentage of OyM anual cost (%) (5) = (2)/(4)
Cañete	2,331	260	11.1	12,274	2.1
Chincha	14,831	435	2.9	20,532	2.1
Pisco	1,725	383	22.2	17,844	2.1
Majes-Camaná	1,959	710	36.2	17,704	4
Total	**7,499**	**1,788**	**23.8**	**68,242**	**2.6**

Appendix

Appendix-1 Damage Calculation

1. Damage to Agriculture
2. Damage to water infrastructure
3. Damage to road infrastructure
4. Damage to Houses
5. Damage to public facilities
6. Damage to Public Services
7. Summary of Damage

Appendix-2 Social Evaluation

1. Conversion of Project direct project costs from private to social prices
2. Operation and maintenance costs
3. Total Project Cost
4. Calculation of economic variables (private prices)
5. Calculation of economic variables (social prices)
6. Social evaluation results

Appendix-1 Damage Calculation

1. Damage to Agriculture

1.1 Crop Production Costs

1.1.1 Cañete River Basin

COSTO DE PRODUCCION POR HECTAREA DE MAIZ AMARILLO DURO

DEPARTAMENTO	LIMA	TIPO DE SUELO		FRANCO		
PROVINCIA	Cañete	RENDIMIENTO (kg/ha)		8500		
NIVEL TECNOLOGICO	MEDIO	FECHA		Enero 2012		
CONCEPTO	Unidad	Cantidad	Precio (S/.)	Total (S/.) PP	FC	Total (S/.) PS
COSTOS DIRECTOS				3,121.64		2,381.14
a.- Preparación del Terreno						
Mano de obra	j/h	6.00	20.00	120.00	0.57	68.40
Hora máquina	h/m	4.00	45.00	180.00	0.85	152.46
b.- Siembra						
Semilla	Kg	30.00	7.33	219.87	0.85	186.23
Mano de obra	j/h	5.00	20.00	100.00	0.57	57.00
c.- Abonamiento						
Urea	Kg	250.00	1.28	319.34	0.85	270.48
Superfosfato triple	Kg	180.00	1.53	275.15	0.85	233.05
Sulfato de potasio	Kg	80.00	2.69	215.26	0.85	182.33
Mano de obra	j/h	4.00	20.00	80.00	0.57	45.60
d.- Labores Culturales						
Mano de obra	j/h	10.00	20.00	200.00	0.57	114.00
e.- Control Fitosanitario				0.00		
Servin 85%	Kg	3.00	59.99	179.98	0.85	152.44
Dipterex granulado	Kg	6.00	70.99	425.92	0.85	360.75
Mano de obra	j/h	4.00	20.00	80.00	0.57	45.60
f.- Cosecha						
Mano de obra	j/h	20.00	20.00	400.00	0.57	228.00
Trilla	Kg	6600.00	0.03	207.31	0.85	175.59
g.- Transporte						
Transporte de Insumos	Sacos	12.00	5.24	62.82	0.85	53.21
Agua	m3	7000	0.0080	56.00	1.00	56.00
COSTOS INDIRECTOS				468.25		405.03
- Asistencia Técnica	%	5	31.22	156.08	0.90	140.63
- Gastos administrativos	%	10	31.22	312.16	0.85	264.40
TOTAL GENERAL				3,589.89		2,786.17

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE ALGODÓN

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**		3000		
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.) PP**	**FC**	**Total (S/.) PS**
COSTOS DIRECTOS				**4,229.85**		**3,273.61**
a.- Mano de Obra						
Limpia canales	j/h	2	20.00	40.00	0.57	22.80
Riego machaco	j/h	2	20.00	40.00	0.57	22.80
Resiembra	j/h	2	20.00	40.00	0.57	22.80
Riegos	j/h	8	20.00	160.00	0.57	91.20
Abonamiento	j/h	6	20.00	120.00	0.57	68.40
Deshierbos	j/h	6	20.00	120.00	0.57	68.40
Tratamiento fitosanitario	j/h	5	20.00	100.00	0.57	57.00
Cosecha	j/h	18	30.00	540.00	0.57	307.80
b.- Tracción Mec. y Animal						
Matada y junta	hora-maq	3	45.00	135.00	0.85	114.35
Arado y surcado	hora-maq	4	45.00	180.00	0.85	152.46
Siembra	hora-maq	3	45.00	135.00	0.85	114.35
Rayado y cultivo	hora-maq	3	45.00	135.00	0.85	114.35
Desgrane	hora-maq	0	45.00	0.00	0.85	0.00
c.- Insumos diversos						
Semilla	kg	300	2.09	628.20	0.85	532.09
Urea	kg	280	1.22	343.00	0.85	290.52
Fosfato Diamónico	kg	150	1.92	287.40	0.85	243.43
Sulfato de Potasio	kg	100	2.69	269.08	0.85	227.91
Mantas	Unidad	20	1.05	20.94	0.85	17.74
Insecticidas Líquidos	L	2.4	173.80	417.12	0.85	353.30
Insecticidas Sólidos	kg	2.4	130.88	314.10	0.85	266.04
Envases/materiales diversos	unidades	6	5.24	31.41	0.85	26.60
Envases especiales y otros	unidades	6	15.60	93.60	0.85	79.28
Agua	m3	10000	0.0080	80.00		80.00
COSTOS INDIRECTOS				**465.28**		**400.95**
- Asistencia Técnica	%	3	42.30	126.90	0.90	114.33
- Gastos administrativos	%	8	42.30	338.39	0.85	286.61
TOTAL GENERAL				**4,695.14**		**3,674.55**

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE MAIZ CHALA

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**		50000		
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.) PP**	**FC**	**Total (S/.) PS**
COSTOS DIRECTOS				**1,866.07**		**1,360.12**
a.- Mano de Obra						
Preparación de Terreno						
Pica, Junta y Quema	j/h	2	20.00	40.00	0.57	22.80
Limpieza de Canales y acequias	j/h	2	20.00	40.00	0.57	22.80
Tomeo	j/h	2	20.00	40.00	0.57	22.80
Riego de Machado	j/h	2	20.00	40.00	0.57	22.80
Siembra						
Desinfección y Siembra	j/h	8	20.00	160.00	0.57	91.20
Labores Culturales						
Abonamiento	j/h	3	20.00	60.00	0.57	34.20
Deshierbos	j/h	2	20.00	40.00	0.57	22.80
Aplicación de pesticidas	j/h	3	20.00	60.00	0.57	34.20
Aporque	j/h	2	20.00	40.00	0.57	22.80
Riegos	j/h	6	20.00	120.00	0.57	68.40
Cosecha						
Cortadores	j/h	6	20.00	120.00	0.57	68.40
Cargadores	j/h	4	20.00	80.00	0.57	45.60
b.- Tracción Mec. y Animal						
Arado y Surcado	hora-maq	2	45.00	90.00	0.85	76.23
Rastrillo y Gradeo	hora-maq	2	45.00	90.00	0.85	76.23
Cultivadora y Aporque	hora-maq	1	45.00	45.00	0.85	38.12
c.- Insumos diversos						
Semilla	kg	50	2.09	104.70	0.85	88.68
Urea	kg	90	1.28	114.96	0.85	97.37
Fosfato Diamónico	kg	120	1.92	229.92	0.85	194.74
Sevín (85%)	lts	2	75.38	150.77	0.85	127.70
Dipterex Granulado	kg	10	4.40	43.97	0.85	37.25
Metasystox	lts	1	61.04	61.04	0.85	51.70
Flete	kg	250	0.06	15.71	0.85	13.30
Agua	m3	10000	0.0080	80.00		80.00
COSTOS INDIRECTOS				**242.59**		**208.50**
- Asistencia Técnica	%	3	18.66	55.98	0.90	50.44
- Gastos administrativos	%	10	18.66	186.61	0.85	158.06
TOTAL GENERAL				**2,108.66**		**1,568.62**

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE CAMOTE

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**		22000		
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.) PP**	**FC**	**Total (S/.) PS**
COSTOS DIRECTOS				**4,452.15**		**3,340.01**
a.- Mano de Obra						
Preparación de Terreno						
A. Pica, Junta y Quema	Jornal	3.00	20.00	60.00	0.57	34.20
B. Limpieza de Canales y acequias	Jornal	2.00	20.00	40.00	0.57	22.80
C. Tomeo	Jornal	3.00	20.00	60.00	0.57	34.20
D. Riego de Machaco	Jornal	3.00	20.00	60.00	0.57	34.20
Siembra						
A. Desinfección y Siembra	Jornal	6.00	20.00	120.00	0.57	68.40
B. Resiembra a mano	Jornal	3.00	20.00	60.00	0.57	34.20
Labores Culturales						
A. Abonamiento	Jornal	3.00	20.00	60.00	0.57	34.20
B. Deshierbos	Jornal	5.00	20.00	100.00	0.57	57.00
C. Aplicación de Pesticidas	Jornal	3.00	20.00	60.00	0.57	34.20
D. Aporque	Jornal	5.00	20.00	100.00	0.57	57.00
D. Riegos	Jornal	8.00	20.00	160.00	0.57	91.20
Cosecha						
A. Corte	Jornal	8.00	20.00	160.00	0.57	91.20
B. Saca	Jornal	10.00	20.00	200.00	0.57	114.00
C. Ensacado	Jornal	10.00	20.00	200.00	0.57	114.00
E. Guardiania	Jornal	8.00	20.00	160.00	0.57	91.20
b.- Tracción Mec. y Animal						
A. Arado en humedo	H-M	3.00	45.00	135.00	0.85	114.35
B. Surcado	H-M	2.00	45.00	90.00	0.85	76.23
C. Siembra	H-M	2.00	45.00	90.00	0.85	76.23
D. Cultivos	H-M	2.00	45.00	90.00	0.85	76.23
E. Saca	H-M	2.00	45.00	90.00	0.85	76.23
c.- Insumos diversos						
Semilla	Esqueje	50,000.00	0.016	785.25	0.85	665.11
Fertilizantes : A. Urea	Kg.	250.00	1.28	319.34	0.85	270.48
B. Sulfato de Potasio	Kg.	150.00	2.69	403.62	0.85	341.86
C. Fosfato Diamónico	Kg.	180.00	1.92	344.88	0.85	292.11
Pesticidas						
A. Vencetho	gr	150.00	0.12	17.28	0.85	14.63
B. Dipterex Granulado	Kg.	8.00	3.98	31.83	0.85	26.96
C. Piretroide	Lt.	1.00	60.86	60.86	0.85	51.55
Otros						
A. Sacos Vacios	Unidad	120.00	1.05	125.64	0.85	106.42
B. Flete Traslado de insumos	Kg.	3,000.00	0.06	188.46	0.85	159.63
Agua	m3	10,000.00	0.008	80.00		80.00
COSTOS INDIRECTOS				**667.82**		**577.67**
- Asistencia Técnica	%	5.00	44.52	222.61	0.90	200.57
- Gastos administrativos	%	10.00	44.52	445.22	0.85	377.10
TOTAL GENERAL				**5,119.97**		**3,917.68**

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE MANZANO - MANTENIMIENTO

DEPARTAMENTO	LIMA	TIPO DE SUELO		FRANCO		
PROVINCIA	Cañete	RENDIMIENTO (kg/ha)		23000		
NIVEL TECNOLOGICO	MEDIO	FECHA		Enero 2012		
CONCEPTO	Unidad	Cantidad	Precio (S/.)	Total (S/.) PP	FC	Total (S/.) PS
COSTOS DIRECTOS				4,445.05		3,412.78
a.- Mano de Obra						
Labores Culturales						
Aplicaciones	j/h	5	20.00	100.00	0.57	57.00
Deshierbos	j/h	7	20.00	140.00	0.57	79.80
Mezcla de Fertilizantes	j/h	2	20.00	40.00	0.57	22.80
Riegos						
Tomeo, riego	j/h	10	20.00	200.00	0.57	114.00
Cosecha						
Cosechadores	j/h	24	25.00	600.00	0.57	342.00
Guardianía	j/h	12	20.00	240.00	0.57	136.80
b.- Tracción Mec. y Animal						
Poda, Deshierbo, ayudante	hora-maq	4	45.00	180.00	0.85	152.46
Abonamiento	hora-maq	4	45.00	180.00	0.85	152.46
Aplicaciones	hora-maq	6	45.00	270.00	0.85	228.69
c.- Insumos diversos						
Semilla	kg	0	0.00	0.00	0.85	0.00
Urea	kg	350	1.28	447.07	0.85	378.67
Superfosfato triple	Kg	250	1.92	479.00	0.85	405.72
Sulfato de Potasio	kg	250	2.69	672.70	0.85	569.77
Multifruit	kg	4	12.56	50.26	0.85	42.57
B. brake throw	lts.	2	159.14	318.29	0.85	269.59
Perfektion	lts.	4	50.26	201.02	0.85	170.27
Tamaron	lts.	4	43.97	175.90	0.85	148.98
Flete productos	kg	1000	0.06	62.82	0.85	53.21
Agua	m3	11000	0.0080	88.00	1.00	88.00
COSTOS INDIRECTOS				666.76		576.75
- Asistencia Técnica	%	5	44.45	222.25	0.90	200.25
- Gastos administrativos	%	10	44.45	444.51	0.85	376.50
TOTAL GENERAL				5,111.81		3,989.53

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE VID - MANTENIMIENTO

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**		17000		
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.) PP**	**FC**	**Total (S/.) PS**
COSTOS DIRECTOS				**6,450.62**		**3,983.72**
a.- Producción						
- Costo de Siembra						
ARADO SECO	j/h	12	20.00	240.00	0.57	136.80
PAJEO Y QUEMA	j/h	12	20.00	240.00	0.57	136.80
RASPADO DE MALEZAS	j/h	12	20.00	240.00	0.57	136.80
POSTES DE CEMENTO	j/h	13	20.00	260.00	0.57	148.20
PODAS DE SARMIENTO	j/h	12	20.00	240.00	0.57	136.80
PALOS	Und	6	6.28	37.69	0.85	31.93
ALAMBRE N° 12	Kg.	10	5.24	52.35	0.85	44.34
EMPALE Y TEMPLADO DE ALAMBRE	j/h	8	20.00	160.00	0.57	91.20
AMARRE DE PARRA	j/h	10	20.00	200.00	0.57	114.00
TIJERA DE PODAR	Und	3	41.62	124.85	0.85	105.75
LAMPA RECTA	Und	3	52.04	156.11	0.85	132.22
- Riego						
+ 1 º riego M.O.	j/h	12	20.00	240.00	0.57	136.80
- Manejo del cultivo						
+ Fertilizantes GUANO	Kg.	200	1.05	209.40	0.85	177.36
BORAC ABONO	Kg.	2	54.13	81.19	0.85	68.77
ESTIBA Y DESESTIBA	j/h	6	20.00	120.00	0.57	68.40
PREPERAR ABOMO MEZCLA	j/h	2	20.00	40.00	0.57	22.80
HOLLADO PARA ABONAMIENTO	j/h	3	20.00	60.00	0.57	34.20
ABOMAMIENTO M. O.	j/h	6	20.00	120.00	0.57	68.40
AZUFRE	Kg.	10	5.65	56.54	0.85	47.89
PODA EN VERDE	j/h	5	20.00	100.00	0.57	57.00
LIMPIEZA DE CAUCE	j/h	8	20.00	160.00	0.57	91.20
RASPADO DE MALEZAS	j/h	4	20.00	80.00	0.57	45.60
PAJEO Y QUEMA	j/h	8	20.00	160.00	0.57	91.20
FUMIGACION CON ASUFRE	j/h	3	20.00	60.00	0.57	34.20
FUMIGACION MANO DE OBRA	j/h	3	20.00	60.00	0.57	34.20
DESPARRAMAR GUANO	j/h	5	20.00	100.00	0.57	57.00
FAENA CULTIVO A CABALLO	j/h	5	20.00	100.00	0.57	57.00
DESPIQUE- RASPADO DE CAMPO	j/h	5	20.00	100.00	0.57	57.00
GASOLINA	Gln	5	12.35	61.77	0.85	52.32
ACEITE	Gln	5	10.94	54.71	0.85	46.34
ARADO	j/h	5	20.00	100.00	0.57	57.00
CULTIVO	j/h	3	20.00	60.00	0.57	34.20
b- Cosecha						
COSECHA PESADA						
+ Paleo M.O.	j/h	26	20.00	520.00	0.57	296.40
+ Recojo M.O.	j/h	26	20.00	520.00	0.57	296.40
c- Post cosecha						
- Limpieza	j/h	12	20.00	240.00	0.57	136.80
- Selección Escogida	j/h	22	20.00	440.00	0.57	250.80
- Secado	j/h	12	20.00	240.00	0.57	136.80
- Acondicionamiento	j/h	12	20.00	240.00	0.57	136.80
Agua	m3	22000	0.0080	176.00	1.00	176.00
COSTOS INDIRECTOS				**1032.10**		**895.09**
- Asistencia Técnica	%	6	64.51	387.04	0.90	348.72
- Gastos administrativos	%	10	64.51	645.06	0.85	546.37
TOTAL GENERAL				**7,482.71**		**4,878.81**

PP: Precios Privados, PS: Precios Sociales
Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE VID - INSTALACION

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**				
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Set. 2010		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.) PP**	FC	**Total (S/.) PS**
COSTOS DIRECTOS				**33,818.58**		**28,035.52**
a.- Mano de Obra						
Preparación del terreno						
Junta y Quema de broza	j/h	2	20.00	40.00	0.57	22.80
Limpia de Acequias y Bordos	j/h	1	20.00	20.00	0.57	11.40
Distribución Materia Orgánica	j/h	3	20.00	60.00	0.57	34.20
Riego Machaco	j/h	1	20.00	20.00	0.57	11.40
Tomeo	j/h	1	20.00	20.00	0.57	11.40
Plantación						
Selección y Desinfección estacas	j/h	2	20.00	40.00	0.57	22.80
Diseño/ Trazo de Campo	j/h	3	20.00	60.00	0.57	34.20
Apertura de hoyos para Transplante	j/h	20	20.00	400.00	0.57	228.00
Distribución de Plantas	j/h	1	20.00	20.00	0.57	11.40
Plantación	j/h	8	20.00	160.00	0.57	91.20
Recalce	j/h	1	20.00	20.00	0.57	11.40
Hoyado para postes	j/h	20	20.00	400.00	0.57	228.00
Colocación de postes y cabezales	j/h	20	20.00	400.00	0.57	228.00
Alambrado	j/h	15	20.00	300.00	0.57	171.00
Atada	j/h	3	20.00	60.00	0.57	34.20
Labores Culturales						
Mezcla y Abonamiento	j/h	4	20.00	80.00	0.57	45.60
Aplicación de pesticidas	j/h	6	20.00	120.00	0.57	68.40
b.- Tracción Mec. y Animal						
Arado en Seco	hora-maq	3	45.00	135.00	0.57	114.35
Nivelación	hora-maq	3	45.00	135.00	0.57	114.35
Subsolado	hora-maq	4	45.00	180.00	0.57	152.45
Rayado para riego	hora-maq	2	45.00	90.00	0.57	76.23
Rayado en húmedo	hora-maq	3	45.00	135.00	0.57	114.35
Surcado	hora-maq	2	45.00	90.00	0.57	76.23
Cultivos y rayados	hora-maq	8	45.00	360.00	0.57	304.92
c.- Insumos diversos						
Postes						
Postes Cabeceros	und	66	15.71	1036.53	0.57	877.94
Postes Centrales	und	470	8.38	3936.72	0.57	3334.40
Anclajes	und	66	4.19	276.41	0.57	234.12
Alambre 2.6	kg	510	4.19	2135.88	0.57	1809.09
Totora	tercios	3	5.24	15.71	0.57	13.30
Plantones enraizados, injertos	und	1670	12.56	20981.88	0.57	17771.65
Abonamiemto						
Nitrato de Amonio	kg	100	1.28	127.73	0.57	108.19
Sulfato de Amonio	kg	70	1.03	71.82	0.57	60.84
Sulfato de Potasio	kg	133	2.69	357.88	0.57	303.12
Sulfato de Magnesio	kg	100	1.80	180.08	0.57	152.53
Fosfato Diamónico	kg	100	1.92	191.60	0.57	162.29
Guano de Invema	tm	7	50.26	351.79	0.57	297.97
humus	tm	3	141.35	424.04	0.57	359.16
Flete productos	kg	5500	0.06	345.51	0.57	292.65
Agua	m3	5000	0.0080	40.00	0.57	40.00
COSTOS INDIRECTOS				**5072.79**		**4387.95**
- Asistencia Técnica	%	5	338.19	1690.93	0.57	1523.53
- Gastos administrativos	%	10	338.19	3381.86	0.57	2864.43
TOTAL GENERAL				**38891.37**		**32423.48**

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE MANDARINA MANTENIMIENTO

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**		38000		
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.) PP**	**FC**	**Total (S/.) PS**
COSTOS DIRECTOS				**5,649.20**		**4,425.29**
a.- Preparación del terreno						
Subsolado, Arado, Gradeo, Surcado	Hr.Máquina	5.00	45.00	225.00	0.85	190.58
Transporte de Abono	Hr.Máquina	2.00	45.00	90.00	0.85	76.23
Distribución Materia Orgánica	Hr.Máquina	1.00	45.00	45.00	0.85	38.12
Despaje, Quema, Incorp. M. Orgánica	Jornal	12.00	20.00	240.00	0.57	136.80
Trazado de Campo	Jornal	5.00	20.00	100.00	0.57	57.00
Hoyado	Jornal	10.00	20.00	200.00	0.57	114.00
Incorporación de Abono	Jornal	8.00	20.00	160.00	0.57	91.20
b.- Semilla						
Plantones injertados	Unidad	4.00	9.37	37.48	0.85	31.75
Transporte de plantones	Hr.Máquina	4.00	44.70	178.80	0.85	151.44
Plantación y tapado	Jornal	4.00	20.00	80.00	0.57	45.60
c.- Abonamiento						
Urea	Kg.	450.00	1.28	574.80	0.85	486.86
Superfosfato triple	Kg.	350.00	1.92	670.60	0.85	568.00
Sulfato de potasio	Kg.	300.00	2.69	807.24	0.85	683.73
Guano de corral	T.M.	5.00	83.76	418.80	0.85	354.72
d.- Cultivos-Deshierbos						
Deshierbo	Jornal	5.00	20.00	100.00	0.57	57.00
Desbrote	Jornal	4.00	20.00	80.00	0.57	45.60
Aplicaciones	Jornal	8.00	20.00	160.00	0.57	91.20
e.- Riegos						
Tomeo, riego	Jornal	12.00	20.00	240.00	0.57	136.80
f.- Control Fitosanitario						
Triona	Lt.	2.50	8.32	20.81	0.85	17.63
Citowett	Lt.	2.50	36.44	91.09	0.85	77.15
Dithane	Kg.	3.50	37.48	131.19	0.85	111.12
Lorsban	Kg.	3.00	66.59	199.77	0.85	169.20
Fetrilon Combi	Kg.	6.00	114.44	686.62	0.85	581.57
Agua	m3	14000	0.0080	112.00	1.00	112.00
COSTOS INDIRECTOS				**847.38**		**732.98**
- Asistencia Técnica	%	5	56.49	282.46	0.90	254.50
- Gastos administrativos	%	10	56.49	564.92	0.85	478.49
TOTAL GENERAL				**6,496.58**		**5,158.28**

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE PAPA

DEPARTAMENTO	LIMA	TIPO DE SUELO		FRANCO		
PROVINCIA	Cañete	RENDIMIENTO (kg/ha)		25000		
NIVEL TECNOLOGICO	MEDIO	FECHA		Enero 2012		
CONCEPTO	Unidad	Cantidad	Precio (S/.)	Total (S/.) PP	FC	Total (S/.) PS
COSTOS DIRECTOS				6,673.35		5,210.29
a.- Mano de Obra						
Despaje y riego machaco	j/h	3	20.00	60.00	0.57	34.20
Limpia canales	j/h	2	20.00	40.00	0.57	22.80
Desinfección semilla	j/h	1	20.00	20.00	0.57	11.40
Riegos	j/h	14	20.00	280.00	0.57	159.60
Abonamiento	j/h	4	20.00	80.00	0.57	45.60
Deshierbos	j/h	4	20.00	80.00	0.57	45.60
Tratamiento fitosanitario	j/h	10	20.00	200.00	0.57	114.00
Cosecha y carguío interno	j/h	4	20.00	80.00	0.57	45.60
Selección y envasado	j/h	10	20.00	200.00	0.57	114.00
Guardiania	j/h	30	20.00	600.00	0.57	342.00
b.- Tracción Mec. y Animal						
Aradura, gradeo,nivelación y surcado	Días	6	24.85	149.10	0.85	126.29
Siembra y Cultivo	hora-maq	4	79.50	318.00	0.85	269.35
Desbroze , cosecha y carguio	hora-maq	2	79.50	159.00	0.85	134.67
c.- Insumos diversos						
Semilla	kg	1200	1.05	1,256.40	0.85	1,064.17
Urea	kg	450	1.28	574.80	0.85	486.86
Fosfato Diamónico	kg	300	1.92	574.80	0.85	486.86
Sulfato de Potasio	kg	200	2.39	477.43	0.85	404.38
Guano de corral	Tm	2	83.76	167.52	0.85	141.89
Insecticidas Líquidos	L	4	174.74	698.98	0.85	592.03
Insecticidas Sólidos	kg	3	130.04	390.11	0.85	330.43
Envases/materiales diversos	unidades	2	15.60	31.20	0.85	26.43
Envases especiales y otros	unidades	10	15.60	156.00	0.85	132.13
Agua	m3	10000	0.008	80.00	1.00	80.00
COSTOS INDIRECTOS				734.07		632.57
- Asistencia Técnica	%	3	66.73	200.20	0.90	180.38
- Gastos administrativos	%	8	66.73	533.87	0.85	452.19
TOTAL GENERAL				7,407.42		5,842.86

PP: Precios Privados, PS: Precios Sociales
Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE YUCA MANTENIMIENTO

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**		35000		
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Tctal (S/.) PP**	FC	**Total (S/.) PS**
COSTOS DIRECTOS				**4,900.32**		**3,905.53**
a.- Mano de Obra						
Preparación de Terreno						
Despaje, junta y quema	Jornal	2.00	20.00	40.00	0.57	22.80
Tomeo, riego machaco	Jornal	2.00	20.00	40.00	0.57	22.80
Siembra						
Plantado de Estacas	Jornal	6.00	20.00	120.00	0.57	68.40
Abonamiento	Jornal	2.00	20.00	40.00	0.57	22.80
Labores Culturales						
Control fitosanitario	Jornal	2.00	20.00	40.00	0.57	22.80
Cosecha						
Recojo raíces	Jornal	16.00	20.00	320.00	0.57	182.40
Llenado de sacos	Jornal	4.00	20.00	80.00	0.57	45.60
Ensacado y carguío	Jornal	2.00	20.00	40.00	0.57	22.80
Guardianía	Jornal	10.00	20.00	200.00	0.57	114.00
b.- Tracción Mec. y Animal						
Preparación de Terreno						
Aradura en seco	Hora/máq	3.00	45.00	135.00	0.85	114.35
Aradura en húmedo	Hora/máq	2.00	45.00	90.00	0.85	76.23
Gradeo	Hora/máq	1.00	45.00	45.00	0.85	38.12
Rastrilleo	Hora/máq	1.00	45.00	45.00	0.85	38.12
Nivelación	Hora/máq	1.00	45.00	45.00	0.85	38.12
Rayado y surcado	Hora/máq	2.00	45.00	90.00	0.85	76.23
Labores Culturales						
Cultivos	Hora/máq	2.00	45.00	90.00	0.85	76.23
Cosecha						
Cosecha	Hora/máq	2.00	45.00	90.00	0.85	76.23
c.- Insumos diversos						
Semilla	Kg.	12500.00	0.10	1308.75	0.85	1108.51
Urea	Kg.	200.00	1.28	255.47	0.85	216.38
Fosfato Diamónico	Kg.	250.00	1.92	479.00	0.85	405.72
Sulfato de Potasio	Kg.	30.00	2.69	80.72	0.85	68.37
Guano de corral	T.M.	10.00	83.76	837.60	0.85	709.45
Pesticidas						
Insecticidas (Tamaron)	Lt.	1.00	42.09	42.09	0.85	35.65
Adherente	Lt.	1.00	20.94	20.94	0.85	17.74
Flete Traslado de insumos	Kg.	1000	0.05	52.35	0.85	44.34
Envases	und	200	1.05	209.40	0.85	177.36
Agua	m3	8000	0.0080	64.00	1.00	64.00
COSTOS INDIRECTOS				**735.05**		**635.82**
- Asistencia Técnica	%	5	49.00	245.02	0.90	220.76
- Gastos administrativos	%	10	49.00	490.03	0.85	415.06
TOTAL GENERAL				**5,635.37**		**4,541.34**

PP: Precios Privados, PS: Precios Sociales
Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE PALTO - MANTENIMIENTO

DEPARTAMENTO	LIMA	**TIFO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**		11000		
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.)**	FC	Total (S/.)
COSTOS DIRECTOS				**3,840.25**		**2,894.33**
a.- Mano de Obra						
Preparación del Tereno						
Despaje	j/h	3	20.00	60.00	0.57	34.20
Machaco	j/h	3	20.00	60.00	0.57	34.20
Trazado de estacas	j/h	3	20.00	60.00	0.57	34.20
Apertura de Hoyos	j/h	4	20.00	80.00	0.57	45.60
Distribución materia orgánica	j/h	8	20.00	160.00	0.57	91.20
Plantación						
Plantación, ayudante para revisión de plantone	j/h	5	20.00	100.00	0.57	57.00
Incorporación abono de fondo, mezcla	j/h	5	20.00	100.00	0.57	57.00
Labores Culturales						
Deshierbo	j/h	18	20.00	360.00	0.57	205.20
Riegos y Abonos						
Regador	j/h	7	20.00	140.00	0.57	79.80
Abonamiento	j/h	6	20.00	120.00	0.57	68.40
Aplicadores Control Fitosanitario	j/h	6	20.00	120.00	0.57	68.40
b.- Tracción Mec. y Animal						
Preparación del terreno						
Subsolado, arado en seco	hr./máq.	3	45.00	135.00	0.85	114.35
Rastra	hr./máq.	3	45.00	135.00	0.85	114.35
Rayada	hr./máq.	3	45.00	135.00	0.85	114.35
Arado en húmedo	hr./máq.	3	45.00	135.00	0.85	114.35
Planchado	hr./máq.	2	45.00	90.00	0.85	76.23
Plantación						
Transporte, colocar en campo	hr./máq.	2	45.00	90.00	0.85	76.23
Labores Culturales						
Cultivada	hr./máq.	3	45.00	135.00	0.85	114.35
Rayada	hr./máq.	3	45.00	135.00	0.85	114.35
c.- Insumos diversos						
Semilla (Plantones injertados)	unidades	2.00	3.25	6.49	0.85	5.50
NITRATO DE AMONIO	kg.	60.00	1.27	76.01	0.85	64.38
UREA	kg.	50.00	1.28	63.87	0.85	54.10
FOSFATO DE AMONICO	kg.	40.00	1.92	76.64	0.85	64.91
SULFATO DE POTASIO	kg.	50.00	2.39	119.36	0.85	101.10
GUANO DE CORRAL	t	2.00	83.76	167.52	0.85	141.89
HUMUS	t	1.00	280.60	280.60	0.85	237.66
Azufre Diluido	Lt	2.00	52.04	104.07	0.85	88.15
Abono Foliar Rico en BORO	Lt	1.50	62.40	93.60	0.85	79.28
Acidificante	Lt	1.75	26.02	45.53	0.85	38.57
Abono Folear Rico en NITROGENO	kg.	2.00	15.60	31.20	0.85	26.43
Abono Folear Rico en Microelementos	kg.	0.5	108.16	54.08	0.85	45.80
Flete Traslado de insumos	kg.	4000	0.06	251.28	0.85	212.83
Agua	m3	15000	0.0080	120.00	1.00	120.00
COSTOS INDIRECTOS				**576.04**		**498.27**
- Asistencia Técnica	%	5	38.40	192.01	0.90	173.00
- Gastos administrativos	%	10	38.40	384.02	0.85	325.27
TOTAL GENERAL				**4,416.29**		**3,392.60**

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA

COSTO DE PRODUCCION POR HECTAREA DE PALTO - INSTALACION

DEPARTAMENTO	LIMA	**TIPO DE SUELO**		FRANCO		
PROVINCIA	Cañete	**RENDIMIENTO (kg/ha)**				
NIVEL TECNOLOGICO	MEDIO	**FECHA**		Enero 2012		
CONCEPTO	**Unidad**	**Cantidad**	**Precio (S/.)**	**Total (S/.)**	**FC**	**Total (S/.)**
COSTOS DIRECTOS				**5,797.34**		**4,523.13**
a.- Mano de Obra						
Preparación del terreno						
Despaje, Quema, Incorporación de Mat Org.	j/h	2.00	20.00	40.00	0.57	22.80
Machaco	j/h	2.00	20.00	40.00	0.57	22.80
Trazado de Estacas	j/h	4.00	20.00	80.00	0.57	45.60
Apertura de hoyos	j/h	8.00	20.00	160.00	0.57	91.20
Distribución Materia Orgánica	j/h	6.00	20.00	120.00	0.57	68.40
Plantación						
Plantación ayudante	j/h	4.00	20.00	80.00	0.57	45.60
Incorporación abono de fondo	j/h	4.00	20.00	80.00	0.57	45.60
Labores Culturales						
Deshierbo	j/h	16.00	20.00	320.00	0.57	182.40
Tomeo, riego	j/h	15.00	20.00	300.00	0.57	171.00
Abonamiento y aplicaciones	j/h	10.00	20.00	200.00	0.57	114.00
b.- Tracción Mec. y Animal						
Subsolado y Arado en seco	hora-maq	5.00	45.00	225.00	0.57	190.58
Rastra	hora-maq	2.00	45.00	90.00	0.57	76.23
Rayada	hora-maq	1.00	45.00	45.00	0.57	38.12
Arado en Húmedo	hora-maq	3.00	45.00	135.00	0.57	114.35
Transporte de plantaciones	hora-maq	2.00	45.00	90.00	0.57	76.23
Cultivado y Rayado	hora-maq	3.00	45.00	135.00	0.57	114.35
c.- Insumos diversos						
Plantas Injertadas	kg	208.00	10.47	2177.76	0.57	1844.56
Urea	kg	64.00	1.28	81.75	0.57	69.24
Nitrato de Amonio	kg	139.00	1.28	177.55	0.57	150.39
Sulfato de Potasio	kg	120.00	2.69	322.89	0.57	273.49
Fosfato Diamónico	kg	130.00	1.92	249.08	0.57	210.97
Guano de corral	tm	1.50	50.26	75.38	0.57	63.85
Humus	tm	1.00	141.35	141.35	0.57	119.72
Control fitosanitario						
Dithane	Lt	2.00	24.08	48.16	0.57	40.79
Boroplus	Lt	1.00	31.41	31.41	0.57	26.60
BB5	Lt	1.25	37.69	47.12	0.57	39.91
Nitrofoska foliar	kg	2.00	12.56	25.13	0.57	21.28
Fertrilon Combi	kg	0.50	102.61	51.30	0.57	43.45
Flete productos	kg	3000	0.06	188.46	0.57	159.63
Agua	m3	5000.00	0.0080	40.00	0.57	40.00
COSTOS INDIRECTOS				**869.60**		**752.21**
- Asistencia Técnica	%	5.00	57.97	289.87	0.57	261.17
- Gastos administrativos	%	10.00	57.97	579.73	0.57	491.03
TOTAL GENERAL				**6666.94**		**5275.33**

PP: Precios Privados, PS: Precios Sociales

Fuente: Equipo estudio JICA