FINAL REPORT

VOLUME III SUPPORTING REPORT

J. SOCIO-ECONOMY AND FINANCE

STUDY
ON
INTEGRATED WATER RESOURCES DEVELOPMENT
IN THE CAÑETE RIVER BASIN
IN
THE REPUBLIC OF PERU

FINAL REPORT
VOLUME III
SUPPORTING REPORT

J: Socio-Economy and Finance

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Chapter 1 National and Regional Socio-Economic Background

1.1 General Features of the Republic of Peru

The Republic of Peru, which lies between latitudes of 0°01'48"- 18°21'0"S and longitudes of 12°30'11"- 18°21'03"W, covers a land area of 1,285,216 km^2, the third largest country in South America, next to Brazil and Argentine. The country is administratively divided into 25 departments (including a Constitutional Province of Callao), which are further divided into 194 provinces consist of 1,818 districts, as of 1998.

According to the Population Census conducted in 1993, the country had a population of 22,639,443 that had been growing at a rate of 2.0% per annum since 1981. It is estimated that the country's population has amounted to 24,801 thousand in 1998. And, the proportion of the urban population in the same year was estimated to touch 72%, which was remarkably increased from 60% in 1972, implying a continuos trend of rural-urban migration.

In conformity with the topographic and climatic condition, the country is categorized into three large regions: a narrow coastal strip between the Pacific Ocean and the foothills of the Andes ("Costa "), mountain area ("Sierra"), made up of the valleys and western plateaus of the Andes and the Amazon watershed ("Selva"), consists of the valleys and eastern plateaus of the Andes and the Amazon jungle. The distribution of territorial extension and population among these three regions as well as the population density for respective region is as resumed herreinafter.

Territorial Extension and Population by Large Regions in Peru

Regions	Territorial Extension		Population (1998)		Population Density (Person/km^2)
	Km^2	%	In thousand Persons	%	
Costa	136,768	10.6	12,901.8	52.0	94.3
Sierra	404,929	31.5	8,656.6	34.9	21.4
Selva	743,518	57.9	3,242.4	13.1	4.4
Total	1,285,216	100.0	24,800.8	100.0	19.3

Source: INEI, Compendio Estadístico 1998-99

More than half of the nation's population is concentrated in the "Costa" region, which represents no more than 10% of the territorial extension of the country.

Judging from UNDP's human development index (HDI) in 1997, Peru is categorized as nation of medium human development being ranked at 80th (HDI: 68.3) among 174 nations of the world. HDI is calculated on the basis of four indicators and Peru's value for respective indicator is as follows: life expectancy

at birth (68.3 years), adult literacy rate (88.7%), gross school enrollment rate (‘78%) and real GDP per capita (US$ 4,680 in PPP).

1.2 Structural Reform Program and Recent Economic Performance

Starting in 1990, the Peruvian government has launched a bold economic and social structure reform agenda to restore long-term and sustainable economic growth of the country, aiming at: (a) improving incentive policies to reflect prices their opportunity costs, (b) reducing government subsidies so as to control budget deficit and inflation, (c) deregulating to promote private investment; and (d) defeating terrorism and fighting drug trafficking. To materialize these agenda, the government has liberalized an interest rate, an exchange rate and an international capital flows; it has established the independence of the central bank and eliminated credit from the central bank to the government; it has increased the competition by opening the economy to trade with the rest of the world and eliminating public monopolies and price controls; and it promoted private ownership of land and promoted a vast privatization program.

As a consequence of the said actions, the government has succeeded to achieve high economic growth (GDP’s average growth of 6.2% per annum for the period 1993-98), to subdue an intractable hiper-inflation (an annual inflation was plummeted from 7,650% in 1990 to 6.0% in 1998) and to alleviate poverty (poor population has decreased from 55.3% in 1991 to 37.6% in 1997). In 1998, the macro-economic performance of Peru was severely affected by the phenomenon of “El Niño” together with the financial crisis taken place in Asian countries and the GDP’s growth rate was thereby declined remarkably to 0.7%/year - the lowest for the last six years. Nevertheless, the Peruvian economy was able to muddle through this diversity, and is anticipated to restore around 2%/year of GDP’s growth for the year of 1999.

Major macroeconomic indicators of Peru in recent years is as summarized hereinafter.

Major Economic Indicators in Peru 1994-98

Items	1994	1995	1996	1997	1998*
GDP Growth (%/year)	13.1	7.3	2.5	7.2	0.7
Current account balance (US$ x 10^6)	- 2,648	- 4,306	- 3,626	- 3,408	- 3,789
Trade balance (US$ x 10^6)	- 997	- 2,165	- 1,988	- 1,738	- 2,477
- Exports in FOB (US$ x 10^6)	4,598	5,589	5,898	6,814	5,723
- Imports in FOB (US$ x 10^6)	5,596	7,754	7,886	8,552	8,200
Net international reserves (US$ x 10^6)	6,025	6,693	8,862	7,982	7,114
External public debt (US$ x 10^6)	23,980	25,652	15,196	18,787	19,562
Inflation (%/year)	15.4	10.2	11.8	6.5	6.0
Exchange rate (Annual average)	2.20	2.25	2.45	2.66	2.93

* Preliminary estimation

Source: Banco Central de Reserva del Perú, “Memoria, 1997”

1.3 Government's Development Policies and Strategies

The national development plan to cover the period of (1995-2000), has not been forged, and it is thus not easy without such plan to pinpoint the government's central policies and strategies on development. Albeit such constraint, there would not wide of the mark to mention that a sustainable socio-economic development and an alleviation of poverty are the major concerns to be tackled with by the present government.

In 1998, the budget for the public sector amounted to about US$ 10,076 millions, which was distributed by type of services in the following manner: Economic services (12.8%), social services (42.3%), debt and subscription of share of stocks (19.8%) and general services (25.1%). And, 18.8% of this public finance, equivalent to US$ 1,897 million, was earmarked to investment of public works; this finance to public works was distributed by ministry as follows: 47.6% for Ministry of Presidency (In charge of development of water supply and sewerage systems, water resources, etc.), 26.1% for Ministry of Transportation, Communication, Housing and Construction, 6.4% for Ministry of Education, 5.2% for Ministry of Agriculture, 3.1% for Ministry of Energy and Mining, 11.6% for the rest of ministries. On the other hand, to materialize their concern on poverty alleviation, the government had allocated close to 9% of the public finance to the relevant program.

Within the context of the structural reform program, the Peruvian government is proceeding with privatization for the purpose of consolidating bases for development of competitive economy and re-composition of the role of State and the private sector. Until February 1997, the national revenue stemmed from privatization efforts reached US$ 7,022 million, which is broken down by sector as follows: Telecommunications (37.7%), Electricity (22.4%), Petroleum (11.2%), Mining (11.1%) and Other sectors (17.6%). In line with the policies for privatization, the government has created the Commission for Promotion of Private Concessions (PROMCEPRI) with functions of planning, design, implementation and regulation of concession process. PROMCEPRI had made promotion for concession of public infrastructure in eight specific fields (highways, electric infrastructure, port facilities, communications, airports, hydraulic structures, railways and tourism), so that public finance may be focused on development of infrastructures with less financial returns but high social returns (The percentage of the public finance for social development against GDP had increased from 4.0% in 1994 to 6.4% in 1998, while that for economic development had declined from 2.2% to 1.9%) until May 1998, and then its functions have been transferred to the Commission for Promotion of the Private Investment (COPRI).

Chapter 2 Socioeconomic Condition of the Study Area

2.1 Administrative Division and Demographic Feature

The Study area consists of three sectors: the Cañete River Basin, the Corridor Lurin-Cañete (Proposed route for installation of the water conveyance facilities from the Cañete River to Lima Metropolitan Area) which comprises the Axis Chilca-Cañete and Lima South Zone and the Pampas Concón-Topará and Chincha Alta. The Cañete River Basin is located within the provinces of Cañete, Yauyos and Huarochiri (very small portion only) and the Corridor Lurin-Cañete pass through the province of Cañete and encompasses 10 districts of 12 districts located in the south zone of the province of Lima. In addition, the proposed benefitable area of irrigation system to be contemplated in the Master Plan is prolonged to the District of Grosio Prado, Province de Chincha, Department of Ica. In sum, the Study area is extended over four provinces of the Department of Lima and one district of the Department of Ica, comprising 51 districts in total. The table below indicates the evolution of population in the Study area from 1981 to date.

Evolution of Population in the Study area

Provinces	No. of Related Districts	Population			Annual Growth (%/1981-98)
		1981[1/]	1993[1/]	1998[2/]	
Cañete	15	122,520	152,964	169,187	1.9
Yauyos	24	27,822	23,190	21,567	- 1.5
Huarochiri	1	1,854	1,771	1,786	- 0.2
Lima	10	539,154	881,314	1,023,520	3.8
Chincha (Depto. de Ica)	1	12,011	14,912	16,108	1.7
Total	51	703,361	1,074,151	1,232,168	3.4

Source: 1/: INEI, Censos Nacionales de Población y Vivienda, 1918 y 1993

2/: Estimated by the Study Team based on projection of INEI

Due to suburban sprawling of the population in Lima Metropolitan Area, the population in its south zone has been burgeoning at a rate of 3.8% for the period of 1981-98, outstripping remarkably an average rate of Lima Metropolitan Area (2.3%).

By contrast, the exodus of inhabitants in the Province of Yauyos is of significance reducing its population by more than 30% for the last 17 years (1981-1998). Owing to geographical advantage to be easily accessible to Lima Metropolitan Area as well as being endowed with favorable conditions for agricultural development, the population in the Province of Cañete showed a sound growth to catch up with the national average. Because the great majority of its population is represented by the province of Lima, the growth of the

population in the Study area in general has attained such higher rate as 3.1%, in comparison with the national average (2.0%).

2.1.1 Social Conditions and Coverage of Social Services

Similar to other rural-predominant provinces in Peru, the provinces of Yauyos and Cañete are less developed socially in comparison with the Province of Lima. The table below indicates an evidence of this disparity.

Some Social Indicators

Items	Provinces		
	Lima	Cañete	Yauyos
Adult illiteracy rate (%)	3.7	7.5	10.2
Primary school enrollment rate (%)	92.3	92.3	90.2
Average years of school attendance (years)	11.1	8.8	7.4
Population without any school education (%)	3.6	7.2	9.8
Population who has learned language(s) other than Spanish as mother language (%)	10.7	7.6	7.7
Rural population (%)	0.4	26.9	39.8
Share of the primary sector within EAP (%)	2.2	45.7	76.6

Source: INEI, Perfil socio-Demográfico del Departamento de Lima, 1999

It is worth while to point out that the proportion of population who has learned language(s) other than Spanish as mother language is higher in Lima than other two provinces. This phenomenon may be attributable to the fact that Lima has received many immigrants from departments or provinces in which such dialects as quechua, aimara, jíbaro, etc are predominantly spoken.

As for distribution of electricity, 7 of 33 districts (21%) in Yauyos had no access to this service in 1997, meanwhile none of district in Lima and Cañete was reported to be without any electric services. Districts with coverage rate of electric service more than 75% are: 70% in Lima, 33% in Yauyos and 25% in Cañete.

Except for one district (Tupe) in Yauyos, all districts in three provinces in question had some coverage rate of water supply. Nevertheless, as of 1997, there were a number of districts with coverage rate of water supply inferior to 50%: 7 of 16 districts (43%) in Cañete, 8 of 33 districts (24%) in Yauyos and 10 of 43 districts (23%) in Lima. Water resources to be available for domestic water supply are not abundant in these provinces, so rationing of water supply is carried out in many districts, standing at 54% of districts in three provinces on average.

Sewerage system is far under-developed in Yauyos and in Cañete; in case of the former, close to 40% of its districts had not been provided this system as of 1997,

meanwhile in the case of the latter, even though all of its districts had any coverage of the service, the coverage rate remained low (districts with coverage rate more than 50% were less than half – 7 of 16 districts). By contrast, the situation had been improved in Lima with the coverage rate of sewerage services almost equal to that of the water supply.

An outstanding imbalance is observed among provinces with respect to development of road network; almost 80% of roads (total length: 4,839 km) in Lima are paved with asphalt, meanwhile only 1 km of road in Yauyos (1,311 km in total) has such improvement. Development of roads also lags behind in Cañete, with as low portion as 45% in total length.

2.1.2 Economic Activities

The Province of Lima together with the Constitutional Province of Callao makes up Lima Metropolitan Area – the capital city in Peru, so is the center of the economic activities of the country with contribution of the Gross Regional Product (GRP) of the Department representing 47% to the GDP in Peru in 1997; in particular, the region's contribution to the GDP becomes higher in such sectors as manufacturing (59%) and services (57%). In Lima Metropolitan Area, the primary sector represents as small portion as 5.2% of its total GRP.

On the other hand, the agricultural and livestock sector constitutes the mainstay in the provinces of Cañete and Yauyos. In the Province of Cañete, owing to endowment with fertile soil and consistent availability of surface water from the Cañete River, crop production represented mainly by cotton, yellow corn, sweet potato, potato and grapevine has been prosperous under irrigation system. Recently, the production of asparagus has expanded as a consequence of inauguration of related canning factory. Agricultural products of the province play an important role in the wholesale market of Lima Metropolitan Area; sweet potato occupies more than three-fourth of the supply in this market and apple, grape, pumpkin, cassava and potato also make a significant contribution in supply of foodstuff there. According to the Population Census in 1993, the economically active population (EAP) of the province is distributed by sector as follows: primary (45.7%), secondary (11.4%) and terciary (42.9%).

Economic activities of the Province of Yauyos are extremely concentrated in the primary sector, which accounted for 76.6% of the EAP in 1993. Nevertheless, unlike the Province of Cañete, the the agriculture (crop production) sector is less important and, by contrast, livestock and mining sectors contribute more dynamically to the regional economy. In value terms, the relation between livestock and crop production is 57:43; about 65% of the livestock production is represented by cattle, which is followed by sheep (16%), mean while nearly half of crop production is represented by two traditional crops (potato and yellow

corn). In the Province of Yaunos, ango-industry is limited to processing milk to produce cheese, butter, etc.

Chapter 3 Tourism Development

3.1 Tourism-oriented Resources in the Cañete River Basin

Frankly, speaking, tourism attraction is very scarce in the Cañete River Basin. The city of Lunauaná may be the only spot which may call attention of tourists from Lima Metropolitan Area, other departments of the country and foreign countries owing to its geographical position within the basin to give tourists opportunities for enjoying river adventures by canoe, boat, raft, etc. Lunahuaná has also some prestigious hotels and good restaurants, and the road from Lima to the town is completely paved including the stretch of the Pan American Highway which occupies mayor portion to the destination.

Although the basin has other tourism-oriented resources such archaeological ruins (Ñaupahuasi, Huashuaao, Tupina Chaca, Turpa, etc.), hot spring at Ocro (District of Yaunos), natural lakes and lagoons, water fall, panoramic view of the valley and so on, poor transportation means combined with an absence of adequate lodging facilities and other infrastructure has constrained the basin from development of tourism.

Some zones belonging to five districts (Alis, Huancaya, Miraflores, Tanta and Vitis) of the Province of Yauyos located upper basin of the Cañete River together with three districts of the Province of Jauja, Department of Junin have been included in “Tourism-oriented Reserve Zone” denominated as “Cañete y Conchas-Pachacayo”, which by general law for tourism are required to forge action plans for preservation, control and use of their tourism-oriented resources.

3.2 Tourism Development Prospects

At national level, there are fourteen tourism-oriented reserve zones which are designated as such provisionally. This means that these zones are eligible zones to be upgraded to the national park (8 in total nationwide) or the national reserve (8 in total nationwide) within the context of the natural protected areas in Peru , provided that an adequate measures and actions on preservation, control and use of their fauna and flora should be taken. In this regard, it is critical that local governments should formulate action programs aiming at proper management and preservation of natural resources (implementation of measures to conserve soil, water and vegetation, establishment of ecological monitoring system, undertaking of training for responsible persons and enlightenment of rural inhabitants, etc.) with participation of local population.

Tourism development is one of few proposals which attribute to decelerating exodus of population in the upper basin of the Cañete River as well as to vitalization of the basin’s regional economic activities. For attaining this development it is prerequisite that, apart from measures mentioned above, to

improve related infrastructures such as transportation, lodging facilities, restaurants and water and sewage treatment systems and, at the same time, to incorporate tourism information and promotion center of the basin in Lima Metropolitan Area.

Finally, the construction of dam proposed in the Cañete River Basin is anticipated to contribute to an expansion of tourism related with river water to have been developed at Lunahuana and its surrounding area, because river flow will be maintained at such level as to make it possible to navigate boats, canoes and other means. even at dry season.

Chapter 4 Economic and Financial Evaluation of The Master Plan

4.1 Introduction

SEDAPAL has conducted a master plan study on Lima & Callao Water Supply and Sewerage Systems with time horizon up to 2030. In this SEDAPAL's M/P, four alternative plans comprising Cañete river scheme have been forged with respect to capturing and conveyance of raw water to Lima & Callao; in these alternative plans, Cañete river scheme is competing with Mantaro - Carispacha scheme within long-term implementation schedule of water supply system. In this context, as a precondition in proceeding with economic evaluation on different scenarios for development of water resources of the Cañete river, it is worthy while to review economic evaluation of these two schemes exposed in SEDAPAL's M/P with input of updated information on capital and recurrent cost as well as with more sophisticated engineering consideration.

4.2 Comparison of Cañete Scheme with Mantaro-Carispacha Scheme

For the sake of present comparison, engineering works and cost for both schemes cover no more than regulation, intake and conveyance of raw water to specified water treatment plants as briefly described hereinafter:

4.2.1 Cañete scheme

River water is to be regulated by raising a new dam at Paucarcocha and construction of a new dam at Morro de Arica, withdrawn at Zuniga with construction of an intake to covey to Lima through a system of open channel and pipe line.

4.2.2 Mantaro-Carispacha scheme

Rive water is to be traversed from the Mantaro river and to be pumped from Carispacha lake and conveyed to Lima through Marcapomacocha-Marca III System to the Rimac river.

On the other hand, the comparison between Cañete and Mantaro – Carispacha schemes from economic viewpoint have been made at first on the following assumptions:

(1) Cañete S/P (single purpose) the water resources in the former scheme should be newly developed for exclusive use of D/I water supply to Lima.
(2) Cañete D/P (dual purpose) – the same comparison is to be made on condition that water resources of the Cañete River should be developed for dual, Case 1.1.
(3) Cañete M/P-1 (multipurpose) - D/I water supply to Lima, hydroelectric

power generation and irrigation to Concon-Topara – full scale with minimum maintenance flow 1.0 m^3/s and development of groundwater, Case 3.3.

(4) Cañete M/P-2 (multipurpose) - D/I water supply to Lima, hydroelectric power generation and irrigation to Concon-Topara – full scale with minimum maintenance flow 4.3 m3/s, Case 3.1.

See Table 1.3 of the Supporting Report G of the main report for definition of Case 1.1, Case 3.1 and Case 3.3

The economic evaluation on the two schemes is be made on the basis of the following conditions, namely:

1) Design production amount for respective scheme:

- Design raw water production : 5 m^3/s for both Cañete and Mantaro schemes
- Electric power generation: 270 MW (Assumed for simplification)
- Irrigation for Concon-topara: 10 m^3/s for the Case 3.1 and Case 3.3
- Minimum maintenance flow: Cañete – 4.3 m^3/s for the Case 3.1 and 1.0 m^3/s for the Case 3.3; Mantaro – Carispacha (Rimac) – Not considered

2) Scope of cost estimation

Capital cost for water intake, regulation, conveyance works and groundwater development including temporary and related facilities and recurrent cost for their operation and maintenance. Cost for administrative and engineering services and physical and price contingencies are also taken into account.

3) Cost allocation of dam construction to D/I water supply

In so far as the cases of dual purpose and multi-purpose are concerned, cost to be allocated to the sector of the D/I water supply to Lima has been determined in line with the methodology named as "Separable Cost – Remaining Benefits (SCRB) Method", which is the method recommended for general use in allocating costs of multi-purpose river basin projects in the United State of America and is world-widely used by a number of development agencies (See Attachment of the Sector Report on Socio Economy and Finance for its reference). Consequently, cost allocation to D/I water supply has been determined as given below:

- Dual purpose: 50%
- Multi-purpose: 26% (Case 3.1) and 22% (Case 3.3)

4) Parameter for evaluation

Net present value (NPV) of capital and recurrent costs expressed in market price is employed. Discount rate used for calculating NPV is at 12%, referring to other similar projects of SEDAPAL. Construction period is assumed to be 5 years including study and design stage and the project life is assumed to be 30 years after commencement of operation.

The result of cost comparison at NPV is as resumed in the tables below and detailed one in Table 4.1.

Cañete Scheme (Single Purpose) vs. Mantaro-Carispacha Scheme

Unit: Million US$

Schemes		Cañete (S/P)	Mantaro-Carispacha
Water Conveyance System	Total Capital Cost	294.97	217.95
	Annual Recurrent Cost	0.84	6.18
	Total Cost at NPV	204.32	176.30
Dam	Capital Cost	142.91	n.a.
	Annual Recurrent Cost	0.53	n.a.
	Total Cost at NPV	99.54	n.a.
Integrated Engineering Works	Cost Summary at NPV	303.86	176.30

Cañete Scheme (Dual and Multiple Purposes) vs. Mantaro-Carispacha Scheme

Unit: Million US$

Schemes		Cañete			Mantaro-Carispacha
		D/P (Case 1.1)	M/P-1 (Case 3.3)	M/P-2 (Case 3.1)	
Water Conveyance System	Total Capital Cost	294.97	294.97	294.97	217.95
	Annual Recurrent Cost	0.84	0.84	0.84	6.18
	Total Cost at NPV	204.32	204.32	204.32	176.30
Dam	Capital Cost	71.46	46.60	184.36	n.a.
	Annual Recurrent Cost	0.27	0.17	0.69	n.a.
	Total Cost at NPV	49.77	32.42	128.45	n.a.
Ground Water	Capital Cost	n.a.	2.66	n.a.	n.a.
	Annual Recurrent Cost	n.a.	0.13	n.a.	n.a.
	Total Cost at NPV	n.a.	2.42	n.a.	n.a.
Integrated Engineering Works	Cost Summary at NPV	254.09	239.16	332.77	176.30

As above comparison indicates, it is judged that any case of the Cañete scheme is economically disadvantageous than the Mantaro-Carispacha scheme. Therefore, it is advised that the priority for implementation of water supply project to Lima should be given to the Mantaro-Caprispacha Scheme in ahead of the Cañete Scheme.

4.3 Economic and Financial Evaluation of Water Development Scenarios of the Cañete River Basin

4.3.1 Components of Development Scenarios

Seven alternatives consist of three different scenarios have been presented in relation with development of water resources of the Cañete River, as candidate scenarios subject to economic and financial evaluation with an input of capital investment for development of infrastructure and recurrent cost for their operation and maintenance as well as anticipated benefits stemmed from respective development scheme. These scenarios and alternatives are as briefly summarized hereinafter.

Components of Development Scenarios and Alternatives

Development Scenarios	Alternatives	Development Components
Scenario-1 (First priority on the D/I water supply, in particular, high weight on the water conveyance to the south of Lima Metropolitan Area)	Case 1.1	Development scheme: D/I water supply to the Cañete River Basin (Water demand: 34.22 MCM), D/I water supply to Lima – 5 m^3/s (Water demand: 157.68 MCM), Irrigation to Cañete Valley (Water demand: 340.2 MCM), maintenance flow (Water demand: 135.60 MCM) and hydroelectric power generation (46 MW at Morro de Arica and 200 MW at El Platanal) Total water demand: 667.7 MCM Major engineering works: Morro de Arica dam (205 MCM), Capillucas dam (2.8 MCM), improvement of irrigation system at Cañete Valley (27,390 ha) and water conveyance system from Cañete to Lima with amount of 5m^3/s (206 km)
	Case 1.2	Development scheme: D/I water supply to the Cañete River Basin, D/I water supply to Lima – 10 m^3/s (Water demand: 315.36 MCM), Irrigation to Cañete Valley, Irrigation to pampas Altas de Imperial (Water requirement: 30.17 MCM), maintenance flow and hydroelectric power generation (46 MW at Morro de Arica and 200 MW at El Platanal) Total water demand: 855.55 MCM Major engineering works: Morro de Arica dam, Paucarcocha dam (55 MCM), Capillucas dam, improvement of irrigation system at Cañete Valley , provision of new irrigation system to Pampas Altas de Imperial (3,075 ha) and water conveyance system from Cañete to Lima with amount of 10 m^3/s (206 km)

Development Scenarios	Alternatives	Development Components
Scenario-2 (High weight on the irrigation development)	Case 2.1	Development scheme: D/I water supply to the Cañete River Basin, Irrigation to Cañete Valley , Irrigation to Concon-Topara & Chincha Alta on full scalle (Water demand: 351.41 MCM), maintenance flow and hydroelectric power generation (46 MW at Morro de Arica and 200 MW at El Platanal) Total water demand: 861.4 MCM Major engineering works: Morro de Arica dam , Paucarcocha dam, Capillucas dam, improvement of irrigation system at Cañete Valley and provision of new irrigation system at Concon-Topara & Chincha Alta on full scale (35,010 ha).
	Case 2.2	Development scheme: D/I water supply to the Cañete River Basin, D/I, Irrigation to Cañete Valley on half scale (Water demand: 175.71 MCM), maintenance flow and hydroelectric power generation (46 MW at Morro de Arica and 200 MW at El Platanal) Total water demand: 685.73 MCM Major engineering works: Morro de Arica dam, Capillucas dam, improvement of irrigation system at Cañete Valley and provision of new irrigation system at Concon-Topara & Chincha Alta on half scale (17,505 ha).

Components of Development Scenarios and Alternatives

Development Scenarios	Alternatives	Development Components
Scenerios-3 (Equal weight on the D/I water supply and irrigation development)	Case 3.1	Development scheme: D/I water supply to the Cañete River Basin, D/I water supply to Lima – 5 m^3/s, Irrigation to Cañete Valley, Irrigation to Pampas Altas de Imperial, Irrigation to Concon-Topara & Chincha Alta on full scale, maintenance flow and hydroelectric power generation (50 MW at Morro de Arica and 200 MW at El Platanal) Total water demand: 1,049.28 MCM Major engineering works: Morro de Arica dam, Capillucas dam , San Jeronimo dam (250 MCM), water conveyance system from Cañete to Lima with an amount of 5 m^3/s, improvement of irrigation system at Cañete Valley, provision of new irrigation system to Pampas Altas de Imperial and at Cancon-Topara & Chincha Alta on full scale.
	Case 3.2	Development scheme: D/I water supply to the Cañete River Basin, D/I water supply to Lima – 5 m^3/s, Irrigation to Cañete Valley, Irrigation to Concon-Topara & Chincha Alta on half scale, maintenance flow and hydroelectric power generation (50 MW at Morro de Arica and 200 MW at El Platanal) Total water demand: 843.41 MCM Major engineering works: Morro de Arica dam, Paucarcocha dam, Capillucas dam , water conveyance system from Cañete to Lima with an amount of 5 m^3/s, improvement of irrigation system at Cañete Valley and provision of new irrigation system at Concon-Topara & Chincha Alta on half scale.
	Case 3.3	Development scheme: D/I water supply to the Cañete River Basin, D/I water supply to Lima – 5 m^3/s, Irrigation to Cañete Valley, Irrigation to Concon-Topara & Chincha Alta on full scale, maintenance flow – 1 $m^{3/}s$ (31.54 MCM) and hydroelectric power generation (50 MW at Morro de Arica and 200 MW at El Platanal) Total water demand: 915.05 MCM Major engineering works: Morro de Arica dam, Paucarcocha dam, Capillucas dam, improvement of irrigation system at Cañete Valley, provision of new irrigation system to Concon-Topara & Chincha Alta on full scale and water conveyance system from Cañete to Lima with an amount of 5 m^3/s.

4.3.2 Evaluation Methodology

The economic evaluation, which is intended to sound the project implementation from the standpoint of the national economy, is carried out pursuant to the conventional methodology that is commonly applied for evaluation of similar projects in Peru under finance of the World Bank, Inter-American Development Bank (IDB), etc. This methodology is, in sum, to identify and value the project costs and benefits that will arise "with" the project and to compare them with the situation as it would be "without" the project; at first, these costs and benefits are valued at market price and then they are converted to into economic costs and benefits with adjustment of three components: 1) elimination of direct transfer items (tariffs and duties, interest on credit transaction, subsidies, water charge, etc.), 2) adjustment for price distortions as for traded commodities by valuing at border price, and adjustment for non-traded commodities, services, exchange rate, etc. by valuing them at shadow price. Once economic pricing has been made for both project costs and benefits, cash flow build up with these economic costs and benefits will be prepares to cover the whole project life, which for the present project is set as 30 years from starting operation and maintenance of completed infrastructure, in view of calculating internal rate of return (IRR).

The IRR is defined as "the rate of discount at which the total present value of cost incurred during the life of the project is equal to the total present value of benefits accruing during the same period". On the basis of thus calculated IRR, the feasibility of the project is generally judged against such indicator as the opportunity cost of capital (to be presumed at 12% in Peru). Apart from this IRR, the net present value (NPV) is also calculated so as to present the magnitude of project's incremental benefits.

4.3.3 Components of Project Costs and Benefits

(1) Benefits

The water resources development scenarios of the Cañete river foster to produce quatifiable benefits stemmed from water supply to southern part of Lima Metropolitan Area, provision of irrigation system to unexploited lands (Concon-Topara & Chincha Alta and Pampas Altas de Imperial) as well as an improvement of existing irrigation district (Cañete Valley) and electric power generation to connect with National Interconnection System (Sistema de Interconectado Nacional – SIN) of the country. More detailed description of these benefits are as given hereinafter.

Sectors	Anticipated Tangible Benefits
• D/I water supply to Lima:	The direct benefits of D/I water supply to Lima stem from sale of newly served water to population. For the present master plan, only supply of raw water from the Cañete river to southern district of Lima with amount of 5 m^3/s is considered.
• Hydroelectric power generation:	For the purpose of economic evaluation, two alternatives for expansion of National Interconnected System are prepared; one is what is called "With Project" situation, which envisages development of hydroelectric power generation at El Platanal and at Morro de Arica and the other is "Without Project" situation, in which electric demand to satisfy an expansion of the National Interconnected System is proposed with installation of one additional gas turbine (300 MW) to substitute for hydroelectric power generation. The benefits stem from electric power generation are thus expressed as an alternative energy cost consisting of the capital and running cost for installation as well as for operation and maintenance of this additional gas turbine, which is obtained as the balance of investment and running costs for thermal power generation to connect with the National Inter connected System between "Without Project" and "With Project".
• Irrigation :	The quantifiable benefits derived from development of new irrigation system are expressed as net surplus of crop production (production value minus production cost) to cover the whole beneficial area by an irrigation system and those from improvement of existing irrigation districts are the balance of net surplus of crop production between "Without" project situation and "With" project situation.

(2) Costs

The cost for different scenarios consist of direct costs (capital cost and recurrent cost for construction, operation and maintenance of engineering works) and

indirect costs (administration cost, engineering services and physical and price contingencies). Direct costs, in turn, are represented by development of dam (Paucarcocha, Morro de Arica, Auco & San Jeronimo) and installation of facilities required for utmost production of anticipated benefits mentioned above. Meanwhile, indirect costs are composed of: administration cost and engineering services (10% of direct costs), physical contingency (10% of direct cost) and price contingency (3 % of the sum of the costs for direct costs, administration and engineering services and physical contingency).

4.3.4 Valuation of Costs and Benefits

(1) Benefits

1) D/I water supply to Lima

SEDAPAL's water tariffs are based on marginal cost expressed at net present value of capital and recurrent cost and according to SEDAPAL's Master Plan capital and recurrent costs expressed at market price were converted to economic price with a conversion factor of 0.64 on average. Thus economic and financial values of raw water to be used for estimating project's benefit are determined as follows.

Unit Value of Raw Water (US$/m^3)

Year	Unit value of raw water (US$/m^3)	
	Market Price	Economic Price
2005	0.288	0.184
2006 – 2019	0.321	0.205
2020 - 2035	0.953	0.610

Raw water to be produced under the present master plan is 157.68 MCM/year (5 m^3/s), which are to be conveyed to Lima with an efficiency of 95%, equivalent to 149.78 MCM/year. Then, an annual amount of project's benefits are obtained as given in the table below.

D/I Water Supply Benefits

Year	Anticipated Benefits (US$/year)	
	Market Price	Economic Price
2005	43,136,640	27,559,520
2006 – 2019	48,079,380	30,704,900
2020 – 2035	142,740,340	91,365,800

2) Hydroelectric power generation

As mentioned before, benefits accrued to hydroelectric power generation of the present master plan are represented by the balance of investment between "Without Project" (Without hydroelectric power development) and "With Project" (With hydroelectric power development) in relation with thermal power generation to be connected with the National Interconnected System. Equipment required for thermal power generation are gas turbine with capacity of 300 MW and 150 MW. In order to satisfy an expansion plan of the National Interconnected System it is proposed to install these equipment for both "Without Project" and "With Project" situations as scheduled hereinafter:

Installation Schedule of Equipment for Thermal Power Development for Expansion of National Interconnected System

Year	Without Project	With Project
2003	Camisea St.: 300 MW	Camisea St.: 300 MW
2004	Camisea St.: 300 MW	
2008		Camisea St.: 150 MW
2010	Camisea St.: 300 MW	
2011	Camisea St.: 150 MW	Camisea St.: 300 MW
2012	Camisea St.: 150 MW	Camisea St.: 150 MW
2013	Camisea St.: 300 MW	Camisea St.: 300 MW
2014	Camisea St.: 150 MW	Camisea St.: 150 MW

Note: The above equipment are have durable life of 15 years, thus are replaced every 15 years.

Investment cost for installation of equipment is estimated to be 150 million US$ for 300 MW gas turbine and US$ 75 million US$ for 150 MW gas turbine. Meanwhile, fixed operation and maintenance cost for 300 MW gas turbine is set to be 2.6 million US$ per year and variable cost – cost of fuel consumption – for the same equipment is 31.9 million US$ per year.

3) Irrigation

The conversion of market price of agricultural commodities and farm inputs (seeds, plants, fertilizers, agro-chemicals, farm machinery and labor force, etc.) into economic price has been made in pursuance to the guideline ("Actualización de los Precios de Eficiencia para los Estudios de Factibilidad de Subproyectos de Riego y Drenaje") prepared by Ministry of Agriculture for Irrigation Subsector Program. To be more concrete, the following conversion factors have been employed.

Conversion Factors for Agricultural Commodities and Inputs

Categories	Items	Conversion Factor
Agricultural products	Exportable commodities	1.06
	Importable commodities	0.70
	Non-tradable commodities	1.00
Farm inputs	Labor force	0.86
	Agricultural machinery	0.84
	Seeds and plants	0.80
	Fertilizers	0.50
	Agro-chemicals	0.81
	Transportation	0.82
	General administration	0.86

(For calculating above conversion factors the following parameters have been applied: Shadow exchange rate: 1.17; Standard conversion factor: 0.86, Conversion factor for capital and consumable products: 0.83)

Using above conversion factors, farm gate price and crop budget calculated have been expressed in economic price to obtain net agricultural benefits at economic price (efficiency price). Net agricultural benefits calculated both market and economic prices at maturation stage of agricultural production for respective irrigation project is as given hereinafter .

Net Agricultural Benefits at Project's Maturation Stage

	Net Agricultural Benefits (US$/year)	
Irrigation Projects	Market Price	Economic Price
Valle de Cañete	4,512,000	7,580,000
Concon-Topara & Chincha Alta	66,384,000	78,333,000
Pampas Altas de Imperial	3,027,000	3,663,000

(2) Costs

Following similar procedure employed in estimating economic price of benefits, capital and recurrent costs for construction, operation and maintenance of infrastructure have been converted from market price to economic price with use of the different conversion factor to be given in the table below.

Conversion factors for different cost components

Categories	Conversion Factor	Categories	Conversion Factor
Skilled laborer	0.92	Construction equipment	0.85
Unskilled laborer	0.86	Materials	0.83
Fuels	0.51	General Expenses	0.82
Transportation	0.82	Supervision and administration	0.92

As a consequence of conversion of market price to economic price with employment of above conversion factors, the total sum of capital and recurrent costs for development of infrastructure for each alternatives of infrastructure have been expressed in both market and economic prices in the following manner:

Summary of capital and recurrent costs

Unit: In million of US$

Alternatives	Capital Cost (Total)		Recurrent Cost (Yearly)	
	Market Price	Economic Price	Market Price	Economic Price
Case 1.1	655.53	544.09	2.17	1.69
Case 1.2	889.30	738.12	2.85	2.20
Case 2.1	595.40	494.18	4.84	3.78
Case 2.2	475.49	394.66	3.63	2.83
Case 3.1	1,392.49	1,155.77	7.64	5.96
Case 3.2	841.11	698.12	4.70	3.67
Case 3.3	902.48	749.06	6.29	4.91

(3) Build-up of Costs and Benefits for Respective Development Scenarios

As precondition to obtain IRR and NPV an annual inflow (benefits) and outflow (costs) to cover whole project life (5 years for infrastructures development stage and 30 years for operation and maintenance stage) should be prepares for respective development alternatives. This cash flow is forged in accordance with the following principles.

1) Benefits

- D/I water supply to Lima: Taking into consideration of projection for supply and demand of D/I water supply to Lima Metropolitan Area, it is presumed that raw water to be derived from the Cañete would be conveyed to south of Lima starting in 2010 until 2039. Hence, to be complied with 4.3.4.(1) 1) above, anticipated benefits are estimated at constant value of US$ 48,079,300 at market price and US$ 30,704,900 at economic price for the period 2010 – 2019 and

US$ 142,740,340 at market price and US$ 91,365,800 at economic price for the period 2020 – 2039.

- Hydroelectric power generation: Installation of one additional gas turbine is required in the fourth year (year 2003) from start of the project, and running cost for operation and maintenance of the equipment is scheduled from the fifth year (year 2004) onward. Durable life of gas turbine is set as 15 years, so replacement of the equipment is required in the 20th year (year 2019) and in the 35th year (year 2034). Hence, benefits attributable hydroelectric power generation are estimated as shown in the Table 4.1 and for each scenario and case are shown in Table 4.1a.

- Irrigation development: Benefits attributable to new installation and improvement of irrigation system are generally produced shortly after being put into operation of completed systems. Nevertheless, it should be noted that non-traditional and permanent crops proposed in new agricultural development projects would undergo transitional period until attaining projected target yield. In line with this methodology, agricultural benefits are subject to being depressed for some years from commencement of projects as follows (Figures in parentheses represent percentage against maximum benefits):

  Cañete Valley: 1st year (20%), 2nd year (40%), 3rd year (60%) 4th year (80%) and 5th year on (100%)
  Pampas Altas de Imperial: 1st year (17%), 2nd year (34%), 3rd year (54%), 4th year (74%), 5th year (94%), 6th year (97%) and 7th year on (100%)
  Concon-Topara: 1st year (18%), 2nd year (36%), 3rd year (56%), 4th year (76%), 5th year (96%), 6th year (98%) and 7th year on (100%)

  In line with above conditions, annual flow of net agricultural benefits for respective project is resumed in the Table 4.3.

2) Costs

Capital cost for development of infrastructure is allocated during the five years, in which initial two years are assigned for design and preparation of development works, meanwhile major construction works are scheduled to be executed during the latter three years. Operation and maintenance costs are accounted for time horizon of 30 years after being put into operation of completed infrastructures. In this cash flow, residual values for civil works and equipment whose useful life still remains at the expiration of the project life.

The cash flows of project costs and benefits thus prepared for each alternative are given in the Table 4.4.

4.3.5 Evaluation Results

The economic and financial IRRs and NPVs for respective development scenario are as summarized in the following table. For calculating the NPV, a discount rate of 12% was applied referring to prevailing practice in Peru.

Scenarios/ Alternatives	IRR (%)		NPV at 12% (US$ x 10^3)	
	Financial	Economic	Financial	Economic
Case 1.1	17.1	14.2	156,149	56,427
Case 1.2	17.2	11.2	260,023	- 24,763
Case 2.1	15.6	16.9	117,986	148,583
Case 2.2	15.8	15.9	87,789	81,538
Case 3.1	12.6	13.0	36,707	46,453
Case 3.2	15.0	14.3	137,269	83,782
Case 3.3	16.1	16.4	208,299	184,672

The above indicators show that all alternatives except for the Case 1.2 have been assessed to be both economically and financially feasible for their implementation bearing in mind that their IRRs outstrip the opportunity cost of capital in Peru, which is considered to be around 12%.

It should be noted herewith that above IRRs and NPVs are underestimated actually because benefits accrued to maintenance flow (4.3 m^3/s or 1.0 m^3/s) do not make up part of tangible benefits due to their being intractable in quantification. It is thus considered that benefits stem from an integrated water resources development of the Cañete River Basin are considerably larger than quantified ones, even though intangible socio-economic secondary benefits such as public health effect owing to supply of piped domestic water, generation of job opportunity, development of agriculture-based industry, increase in trading of commodities and services, etc. should not taken into account.

TABLES

Table 1.1 Population in Peru

(1) By Area of Residence

Year of National Census	Urban Population			Rural Population			Total Population		Population in Lima-Callao		
	Number	%	Growth Rate (%)	Number	%	Growth Rate (%)	Number	Growth Rate (%)	Number	%	Growth Rate (%)
1961	4,698,746	47.4	-	5,208,000	52.6	-	9,906,746	-			
1972	8,058,495	59.5	5.0	5,479,713	40.5	0.5	13,538,208	2.9	3,412,677	25.2	
1981	11,091,923	65.2	3.6	5,913,287	34.8	0.8	17,005,210	2.6	4,835,793	28.4	3.9
1993	15,458,599	70.1	2.8	6,589,757	29.9	0.9	22,048,356	2.2	6,434,323	29.2	2.4
Projection											
1998	17,827,691	71.9	2.9	6,973,077	28.1	1.1	24,800,768	2.4	7,200,936	29.0	2.3
2000	18,555,235	72.3	2.0	7,106,455	27.7	1.0	25,661,690	1.7	7,469,831	29.1	1.8

Source: INEI, Peru: Compendio Estadistico Economico financiero 1997-98

(2) By Large Regions

Year of	Distribution of Population (%)		
National Census	Costa	Sierra	Selva
1961	39.0	52.3	8.7
1972	46.1	44.0	9.9
1981	49.8	39.7	10.5
1993	52.2	35.7	12.1
Annual Growth Rate			
1961-72	4.4	1.3	4.1
1972-81	3.5	1.4	3.3
1981-93	2.8	1.5	3.6
1961-93	3.6	1.4	3.7

Source: INEI, Peru: Compendio Estadistico Economico financiero 1997-98

Tables 1.2 Gross Domestic Product by Sector (At constant price of 1986)

Unit: Nuevos Soles ar Constant Price of 1986

Year	Agriculture		Fishery		Mining		Manufacturing		Construction		Services		Total
	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%	Value
1989	41,746	12.6	3,798	1.1	9,309	2.8	78,748	23.7	26,451	8.0	172,583	51.9	332,635
1990	38,848	12.3	3,773	1.2	8,500	2.7	74,180	23.5	27,286	8.6	163,658	51.8	316,245
1991	40,004	12.3	3,370	1.0	8,681	2.7	78,758	24.2	27,756	8.5	167,081	51.3	325,650
1992	36,924	11.5	3,804	1.2	8,455	2.6	76,893	24.0	28,972	9.0	165,983	51.7	321,031
1993	40,347	11.8	4,603	1.3	9,144	2.7	80,589	23.6	33,127	9.7	173,732	50.9	341,542
1994	45,721	11.8	5,934	1.5	9,463	2.5	94,834	24.6	43,429	11.2	186,743	48.4	386,124
1995	49,539	12.0	4,810	1.2	9,664	2.3	99,769	24.1	50,898	12.3	199,699	48.2	414,379
1996	52,249	12.3	4,777	1.1	9,887	2.3	102,124	24.0	48,607	11.4	207,208	48.8	424,852
1997	54,876	12.1	4,312	0.9	10,378	2.3	108,234	23.8	57,794	12.7	219,661	48.3	455,255
1998	56,302	12.3	2,423	0.5	10,762	2.3	101,302	22.1	59,932	13.1	227,721	49.7	458,442
Annual Growth Rate (%)	3.0		-4.6		1.5		2.6		8.5		2.8		3.3

Source: INEI, National Directorate of National Accounts

Table 1.3 Balance of Payment in Peru

Unit: In Million of US$

Year	Current Account	Trade			Services			Factors	Transf.
		Export	Import	Balance	Export	Import	Balance		
1989	-570	3,533	2,287	1,246	836	1,143	-307	-1,685	176
1990	-1,383	3,321	2,922	399	799	1,164	-365	-1,733	316
1991	-1,509	3,406	3,595	-189	826	1,238	-412	-1,367	459
1992	-2,102	3,661	4,002	-341	836	1,411	-575	-1,632	446
1993	-2,302	3,516	4,123	-607	837	1,412	-575	-1,615	495
1994	-2,649	4,598	5,596	-998	1,063	1,565	-502	-1,799	650
1995	-4,306	5,589	7,754	-2,165	1,131	1,894	-763	-1,999	621
1996	-3,626	5,898	7,886	-1,988	1,414	2,099	-685	-1,642	689
1997	-3,408	6,814	8,552	-1,738	1,540	2,288	-748	-1,603	681
1998	-3,789	5,723	8,200	-2,477	1,808	2,331	-523	-1,454	665

Source: Banco Central de Reserva de Peru, Memoria 1997

Table 1.4 Public Sector's Budget in Peru

(1) By Sector

Unit: In million of nuevo soles

Sectors	1997 Amount	1997 %	1998 Amount	1998 %
Economic Sectors	**3,152**	**12.7**	**3,786**	**12.8**
Transport	1,866	7.5	1,843	6.2
Agriculture	702	2.8	1,269	4.3
Fishery	110	0.4	127	0.4
Energy and Mineral Resources	278	1.1	302	1.0
Industry, Commerce and Services	114	0.5	131	0.4
Communications	31	0.1	42	0.1
Housing and Urban Development	51	0.2	72	0.2
Social Sector	**10,942**	**44.2**	**12,484**	**42.3**
Education	3,858	15.6	4,434	15.0
Health	2,308	9.3	2,775	9.4
Assistance and Social Prevention	4,776	19.3	5,275	17.9
Debt and Subscription of Stocks	**4,685**	**18.9**	**5,858**	**19.8**
General Services	**5,986**	**24.2**	**7,396**	**25.1**
Defense and National Security	3,785	15.3	4,063	13.8
Administration and Planning	1,301	5.3	2,269	7.7
Justice	522	2.1	613	2.1
Foreign Affairs	210	0.8	239	0.8
Legislative	147	0.6	180	0.6
Labor	21	0.1	32	0.1
Total	**24,765**	**100.0**	**29,524**	**100.0**

(2) By Type of Expese

Unit: In million of nuevo soles

Expense	1997 Amount	1997 %	1998 Amount	1998 %
Current Expense	**15,767**	**63.7**	**17,693**	**59.9**
Personnel and Social Obligations	6,288	25.4	7,477	25.3
Welfare Obligations	3,016	12.2	3,820	12.9
Goods and Services	3,993	16.1	4,382	14.8
Other Current Expenses	1,167	4.7	1,056	3.6
Contingency Reserve	1,303	5.3	959	3.2
Capital Expense	**4,379**	**17.7**	**5,973**	**20.2**
Investment	3,835	15.5	5,557	18.8
Financial Investment	162	0.7	163	0.6
Other Capital Expenses	382	1.5	253	0.9
Debt Services	**4,619**	**18.7**	**5,857**	**19.8**
Domestic Debt	3,972	16.0	1,064	3.6
Externl Debt	647	2.6	4,794	16.2
Total	**24,765**	**100.0**	**29,524**	**100.0**

(3) Breakdown of Investment by Ministry (Fiscal Year of 1998)

Unit: Nuevo Soles x 10^6

Ministries	Amount	%
Presidency	2,643.3	47.6
Transport, Com. Housing and Const.	1,450.3	26.1
Education	355.5	6.4
Agriculture	287.8	5.2
Energy and Mining	173.0	3.1
Health	140.9	2.5
Others	506.1	9.1
Total	5,556.9	100.0

Source: INEI, Peru: Comprendio de Estadisticas Economicas y Financieras: 1997-98

Table 1.5 Approved Projects, According to Fields of Investment 1996-1997

Unit: In milllion of nuevo soles

Fields	1996 Amount	1996 %	1997 Amount	1997 %
I. Social Assistance	**172,749**	**62.6**	**246,364**	**57.8**
Public Health	8,506	3.1	15,178	3.6
Education	50,476	18.3	44,682	10.5
Water Supply	77,610	28.1	123,328	28.9
Sewerage	36,157	13.1	63,176	14.8
II. Production Activities	**103,423**	**37.4**	**180,182**	**42.2**
Agriculture	66,328	24.0	59,006	13.8
Transport	18,399	6.7	52,011	12.2
Energy	18,094	6.6	26,318	6.2
Tourism	402	0.1	0	0.0
Others	200	0.1	42,847	10.0
Total	**276,172**	**100.0**	**426,546**	**100.0**

Source: INEI, Peru: Compendio de Estadistics Economicas
y Financieras 1997-98

Table 2.1 Evolution of Population in the Study Area

(1) Cañete River Basin

Provinces	Districts	Population 1981[1/]	1993[1/]	1998[2/]	Annual Growth Rate (%) 1981-98
Cañete	Cerro Azul	3,659	5,215	5,781	2.7
	Imperial	25,097	31,196	34,541	1.9
	Lunahuaná	5,011	4,308	4,746	-0.3
	Nuevo Imperial	12,016	13,368	14,415	1.1
	Pacarán	1,922	1,524	1,679	-0.8
	Quilmana	9,623	11,320	12,955	1.8
	San Luis	8,392	10,339	11,288	1.8
	San Vicente de Cañete	24,153	33,121	36,820	2.5
	Zuniga	1,375	1,278	1,284	-0.4
	Subtotal	91,248	111,669	123,509	1.8
Yauyos	Alis	4,535	3,287	3,664	-1.2
	Ayauca	1,181	1,145	1,123	-0.3
	Azángaro	735	703	671	-0.5
	Carca	566	949	892	2.7
	Carania	481	291	268	-3.4
	Catahuasi	907	1,228	1,393	2.6
	Chocos	1,103	792	738	-2.3
	Colonia	1,845	1,571	1,510	-1.2
	Hongos	564	478	465	-1.1
	Huancaya	557	500	462	-1.1
	Huangáscar	1,115	826	735	-2.4
	Huantán	1,148	948	918	-1.3
	Laraos	1,388	1,212	1,179	-1.0
	Lincha	807	508	462	-3.3
	Madean	935	886	845	-0.6
	Miraflores	575	462	441	-1.6
	Putinza	490	457	454	-0.5
	Tanta	573	528	537	-0.4
	Tauripampa	894	748	728	-1.2
	Tomas	1,884	958	946	-4.0
	Tupe	963	668	563	-3.1
	Vinac	1,946	1,707	1,675	-0.9
	Vitis	422	333	313	-1.7
	Yauyos	2,208	2,005	2,001	-0.6
	Subtotal	27,822	23,190	21,567	-1.5
Huarochiri	San Lorenzo de Quinti	1,951	1,771	1,786	-0.5
Total of the Basin		121,021	136,630	146,862	1.2

Source: 1/ INEI, Censo Nacional 1981, 1993

2/ Estimated by the Study Team based on the INEI´s projection

Table 2.1 Evolution of Population in the Study Area

(2) Corridor Lurin-Cañete

Zone	Provinces	Districts	Population 1981[1/]	1993[1/]	1998[2/]	Annual Growth Rate (%) 1981-98
Axis	Cañete	Asia	2,821	3,527	3,890	1.9
Chilca-		Chilca	8,032	12,658	13,519	3.1
Cañete		Coayllo	1,131	1,038	962	-1.0
		Mala	14,445	19,042	22,012	2.5
		San Antonio	2,259	2,861	3,055	1.8
		Santa Cruz de Flores	2,584	2,169	2,240	-0.8
		Subtotal	31,272	41,295	45,678	2.3
Lima	Lima	Lurin	17,834	34,752	42,714	5.3
South		Pachacamac	7,133	20,131	25,807	7.9
Cone		Pucusana	4,318	4,293	4,510	0.3
		Punta Hermosa	1,063	3,327	4,263	8.5
		Punta Negra	582	2,406	3,143	10.4
		San Bartolo	3,065	3,350	3,693	1.1
		San Juan de Miraflores	174,398	287,353	331,287	3.8
		Santa Maria del Mar	101	185	224	4.8
		Villa El Salvador	147,679	258,239	303,574	4.3
		Villa María del Triunfo	182,981	267,278	304,305	3.0
		Subtotal	539,154	881,314	1,023,520	3.8
		Total	570,426	922,609	1,069,198	3.8

Source: 1/ INEI, Censo Nacional 1981, 1993
2/ Estimated by the Study Team based on the INEI´s projection

(3) Pampas Concon-Topara and Chincha Alta

Dept.	Provinces	Districts	Population 1981[1/]	1993[1/]	1998[2/]	Annual Growth Rate (%) 1981-98
Lima	Cañete	San Vicente de Cañete	24,153	33,121	36,820	2.5
		Subtotal	24,153	33,121	36,820	2.5
Ica	Chincha	Crocio Prado	12,011	14,912	16,108	1.7
		Subtotal	12,011	14,912	16,108	1.7
		Total	36,164	48,033	52,928	2.3

Source: 1/ INEI, Censo Nacional 1981, 1993
2/ Estimated by the Study Team based on the INEI´s projection

Table 2.2 Infrastructure Development in the Study Area

(1) Districts with Electric Services, Percentage of Coverage to Residence, 1997

Provinces	No. of Districts	% of Coverage of Residence					Without Services
		0-25	26-50	51-75	76-100	No Inform.	
Lima	43	1	0	12	30	0	0
Cañete	16	1	3	7	4	1	1
Yauyos	33	6	2	7	11	0	7

Source: INEI, Encuesta Nacional de Municipalidades e Infraestructura Socio-Económica Distrial 1997

(2) Districts with Water Supply Services, Percentage of Coverage to Residence, 1997

Provinces	No. of Districts	% of Coverage of Residence					Without Services
		0-25	26-50	51-75	76-100	No Inform.	
Lima	43	3	7	14	19	0	0
Cañete	16	1	6	6	1	2	0
Yauyos	33	6	2	7	16	1	1

Source: INEI, Encuesta Nacional de Municipalidades e Infraestructura Socio-Económica Distrial 1997

(3) Districts with Rationing of Water Supply Services, 1997

Provinces	No. of Districts	With Water Supply Services			Without Services
		With Rationing	Without Rationing	No Inform.	
Lima	43	31	11	1	0
Cañete	16	7	7	2	0
Yauyos	33	12	16	4	1

Source: INEI, Encuesta Nacional de Municipalidades e Infraestructura Socio-Económica Distrial 1997

(4) Districts with Electric Services, Percentage of Coverage to Residence, 1997

Provinces	No. of Districts	% of Coverage of Residence					Without Services
		0-25	26-50	51-75	76-100	No Inform.	
Lima	43	1	9	16	17	0	0
Cañete	16	4	5	4	1	2	0
Yauyos	33	10	2	1	2	5	13

Source: INEI, Encuesta Nacional de Municipalidades e Infraestructura Socio-Económica Distrial 1997

Table 2.2 Infrastructure Development in the Study Area

(5) Length of Road Network by Type of Surface Pavement

		Typr of Surface Development									
	Total	Asphalt Paving		Gravel Paving		Passable with Car		Path		Others	
Provinces	Length	Km	%	Km	%	Km	%	Km	%	Km	%
Lima	4839	3834	79.3	383	7.9	556	11.5	31	0.6	35	0.7
Cañete	458	117	25.6	105	22.9	143	31.2	93	20.3	0	0.0
Yauyos	1311	1	0.1	298	22.7	792	60.4	214	16.3	6	0.5

Source: INEI, Encuesta Nacional de Municipalidades e Infraestructura Socio-Económica Distrial 1997

Table 4.1 Cost Comparison of Canete Scheme and Mantaro Scheme

Unit: In thousand of US$

Year	Cañete Scheme (Single Purpose)							Cañete Scheme (Case Dual Purpose)							Cañete Scheme (Case Multi Purpose-1)										Cañete Scheme (Multipurpose-2)							Mantaro Scheme		
	Conveyance			Dam 1/				Conveyance			Dam & Hydropower2/				Conveyance			Dam & Hydropower3/			Groundwater				Conveyance			Dam & Hydropower4/				Conveyance		
in order	Capital	Recurrent	Subtotal	Capital	Recurrent	Subtotal	Total	Capital	Recurrent	Subtotal	Capital	Recurrent	Subtotal	Total	Capital	Recurrent	Subtotal	Capital	Recurrent	Subtotal	Capital	Recurrent	Subtotal	Total	Capital	Recurrent	Subtotal	Capital	Recurrent	Subtotal	Total	Capital	Recurrent	Total
-4	29500		29500	14290		14290	43790	29500		29500	7146		7146	36646	29500		29500	4660		4660	266		266	34426	29500		29500	18436		18436	47936	21795		21795
-3	29500		29500	14290		14290	43790	29500		29500	7146		7146	36646	29500		29500	4660		4660	266		266	34426	29500		29500	18436		18436	47936	21795		21795
-2	78667		78667	38107		38107	116774	78667		78667	19056		19040	97707	78667		78667	12425		12425	711		711	91803	78667		78667	49163		49163	127830	58120		58120
-1	78667		78667	38107		38107	116774	78667		78667	19056		19040	97707	78667		78667	12425		12425	711		711	91803	78667		78667	49163		49163	127830	58120		58120
0	78667		78667	38107		38107	116774	78667		78667	19056		19040	97707	78667		78667	12425		12425	711		711	91803	78667		78667	49163		49163	127830	58120		58120
1		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
2		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
3		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
4		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
5		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
6		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
7		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
8		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
9		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
10		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
11		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
12		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
13		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
14		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
15		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
16		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
17		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
18		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
19		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
20		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
21		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
22		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
23		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
24		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
25		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
26		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
27		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
28		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
29		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
30		840	840		530	530	1370		840	840		270	270	1110		840	840		165	165		133	133	1138		840	840		690	690	1530		6180	6180
NPV at 12%			204,322			99,538	303,859			204,322			49,768	254,089			204,322			32,420			2,419	239,161			204,322			128,445	332,767			176,366
(Total Cost)			320,201			158,801	479,002			320,201			79,512	399,713			320,201			51,545			6,655	378,401			320,201			205,061	525,262			193,451
NPV at 9%			225,106			109,865	334,971			225,106			54,939	280,045			225,106			35,771				263,748			225,106			141,782	366,888			203,432

Note: 1/ Morro de Arica dam, provided that it will be used exclusively for D/I water supply
2/ 50% of the cost for Morro de Arica dam is allocated for D/I water supply to Lima
3/ 22% of the cost for Morro de Arica and Paucarcocha dams is allocated for D/I water supply to Lima
4/ 26% of the cost for Morro de Arica and San Jeronimo dams is allocated for D/I water supply to Lima

Table 4.2 Benefits of Hydroelectric Power Generation

Unit: In million of US$

	Cost Without Project												Cost With Project													
	At Market Price						At Economic Price						At Market Price						At Economic Price						Benefits	
Year	Hydro Invest.	Hydro O & M	Therrmal Invest.	Fixed O & M	Variable O & M	Total	Hydro Invest.	Hydro O & M	Therrmal Invest.	Fixed O & M	Variable O & M	Total	Hydro Invest.	Hydro O & M	Therrmal Invest.	Fixed O & M	Variable O & M	Total	Hydro Invest.	Hydro O & M	Therrmal Invest.	Fixed O & M	Variable O & M	Total	Financial	Economic
2000	0	35.2	0	12.4	64.1	111.7	0	27.5	0	9.7	35.9	73.0	113.2	35.2	0	12.4	64.1	224.9	93.956	27.5	0	9.7	35.9	167.0	-113.2	-94.0
2001	300	35.2	0	12.4	115.3	462.9	249	27.5	0.0	9.7	64.6	350.7	412.0	35.2	0	12.4	115.3	574.9	341.96	27.5	0.0	9.7	64.6	443.7	-112	-93.0
2002	0	38.6	150	12.4	135.2	336.2	0	30.1	124.5	9.7	75.7	240.0	44.8	38.6	150	12.4	135.2	381.0	37.184	30.1	124.5	9.7	75.7	277.2	-44.8	-37.2
2003	0	38.6	150	13.7	167	369.3	0	30.1	124.5	10.7	93.5	258.8	0	41.4	0	13.7	134.1	189.2	0	32.3	0.0	10.7	75.1	118.1	180.1	140.7
2004	0	38.6	0	15.6	189.6	243.8	0	30.1	0.0	12.2	106.2	148.5	0	41.4	0	13.7	157.1	212.2	0	32.3	0.0	10.7	88.0	131.0	31.6	17.5
2005	0	38.6	0	15.6	222.5	276.7	0	30.1	0.0	12.2	124.6	166.9	0	41.4	0	13.7	190.6	245.7	0	32.3	0.0	10.7	106.7	149.7	31	17.2
2006	0	38.6	0	15.6	241.3	295.5	0	30.1	0.0	12.2	135.1	177.4	0	41.4	0	13.7	210.7	265.8	0	32.3	0.0	10.7	118.0	161.0	29.7	16.4
2007	0	38.6	0	15.6	257.2	311.4	0	30.1	0.0	12.2	144.0	186.3	0	41.4	75	13.7	227.8	357.9	0	32.3	62.3	10.7	127.6	232.8	-46.5	-46.5
2008	0	38.6	0	15.6	319.6	373.8	0	30.1	0.0	12.2	179.0	221.3	0	41.4	0	14.3	289.5	345.2	0	32.3	0.0	11.2	162.1	205.6	28.6	15.7
2009	0	38.6	150	15.6	297.6	501.8	0	30.1	124.5	12.2	166.7	333.4	0	41.4	0	14.3	266.4	322.1	0	32.3	0.0	11.2	149.2	192.6	179.7	140.8
2010	0	38.6	75	17.6	323.8	455.0	0	30.1	62.3	13.7	181.3	287.4	0	41.4	150	14.3	301.4	507.1	0	32.3	124.5	11.2	168.8	336.7	-52.1	-49.3
2011	0	38.6	75	18.9	354	486.5	0	30.1	62.3	14.7	198.2	305.3	0	41.4	75	16.3	324.9	457.6	0	32.3	62.3	12.7	181.9	289.2	28.9	16.1
2012	0	38.6	150	20.2	385.3	594.1	0	30.1	124.5	15.8	215.8	386.1	0	41.4	150	17.6	355.8	564.8	0	32.3	124.5	13.7	199.2	369.8	29.3	16.4
2013	0	38.6	75	22.8	417.5	553.9	0	30.1	62.3	17.8	233.8	343.9	0	41.4	75	20.2	385.8	522.4	0	32.3	62.3	15.8	216.0	326.3	31.5	17.6
2014	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2015	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2016	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2017	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2018	0	38.6	150	24.1	451.7	664.4	0	30.1	124.5	18.8	253.0	426.4	0	41.4	150	21.5	419.8	632.7	0	32.3	124.5	16.8	235.1	408.7	31.7	17.7
2019	0	38.6	150	24.1	451.7	664.4	0	30.1	124.5	18.8	253.0	426.4	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	181.7	142.2
2020	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2021	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2022	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2023	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	75	21.5	419.8	557.7	0	32.3	62.3	16.8	235.1	346.4	-43.3	-44.5
2024	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2025	0	38.6	150	24.1	451.7	664.4	0	30.1	124.5	18.8	253.0	426.4	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	181.7	142.2
2026	0	38.6	75	24.1	451.7	589.4	0	30.1	62.3	18.8	253.0	364.1	0	41.4	150	21.5	419.8	632.7	0	32.3	124.5	16.8	235.1	408.7	-43.3	-44.5
2027	0	38.6	75	24.1	451.7	589.4	0	30.1	62.3	18.8	253.0	364.1	0	41.4	75	21.5	419.8	557.7	0	32.3	62.3	16.8	235.1	346.4	31.7	17.7
2028	0	38.6	150	24.1	451.7	664.4	0	30.1	124.5	18.8	253.0	426.4	0	41.4	150	21.5	419.8	632.7	0	32.3	124.5	16.8	235.1	408.7	31.7	17.7
2029	0	38.6	75	24.1	451.7	589.4	0	30.1	62.3	18.8	253.0	364.1	0	41.4	75	21.5	419.8	557.7	0	32.3	62.3	16.8	235.1	346.4	31.7	17.7
2030	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2031	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2032	0	38.6	0	24.1	451.7	514.4	0	30.1	0.0	18.8	253.0	301.9	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	31.7	17.7
2033	0	38.6	150	24.1	451.7	664.4	0	30.1	124.5	18.8	253.0	426.4	0	41.4	150	21.5	419.8	632.7	0	32.3	124.5	16.8	235.1	408.7	31.7	17.7
2034	0	38.6	150	24.1	451.7	664.4	0	30.1	124.5	18.8	253.0	426.4	0	41.4	0	21.5	419.8	482.7	0	32.3	0.0	16.8	235.1	284.2	181.7	142.2
2035	-120	0	-510	0	0	-630	-99.6	0.0	-423.3	0.0	0.0	-522.9	-228	0	-365	0	0	-593	-189.24	0.0	-303.0	0.0	0.0	-492.2	-37.0	-30.7

Table 4.2a Benefits of Hydroelectric Power Generation for Each Scenario and Case

Benefits attribuitable to capital investment

	Scenario 1				Scenario 2			
	Case 1.1		Case 1.2		Case 2.1		Case 2.2	
Year	Finanancial	Economic	Finanancial	Economic	Finanancial	Economic	Finanancial	Economic
2000	34,770	28,859	39,812	33,044	39,812	33,044	34,770	28,859
2001	34,770	28,859	39,812	33,044	39,812	33,044	34,770	28,859
2002	92,720	76,958	106,165	88,117	106,165	88,117	92,720	76,958
2003	92,720	76,958	106,165	88,117	106,165	88,117	92,720	76,958
2004	92,720	76,958	106,165	88,117	106,165	88,117	92,720	76,958

	Scenario 1					
	Case 3.1		Case 3.2		Case 3.3	
Year	Finanancial	Economic	Finanancial	Economic	Finanancial	Economic
2000	39,812	33,044	39,812	33,044	39,812	33,044
2001	39,812	33,044	39,812	33,044	39,812	33,044
2002	106,165	88,117	106,165	88,117	106,165	88,117
2003	106,165	88,117	106,165	88,117	106,165	88,117
2004	106,165	88,117	106,165	88,117	106,165	88,117

Table 4.3 Agricultural (Irrigation) Benefits

(1) At Market Price

Unit: In thousand of US$

Year	Canete V	Alta de Imp.	Concon-T	Total	Case 1.1	Case 1.2	Case 2.1	Case 2.2	Case 3.1	Case 3.2	Case 3.3
2005	902	517	11,873	13,292	902	1,419	12,775	6,839	13,292	6,839	12,775
2006	1,805	1,034	23,746	26,585	1,805	2,839	25,551	13,678	26,585	13,678	25,551
2007	2,707	1,640	37,022	41,369	2,707	4,347	39,729	21,218	41,369	21,218	39,729
2008	3,610	2,245	50,299	56,154	3,610	5,855	53,909	28,760	56,154	28,760	53,909
2009	4,512	2,851	63,576	70,939	4,512	7,363	68,088	36,300	70,939	36,300	68,088
2010	4,512	2,939	64,980	72,431	4,512	7,451	69,492	37,002	72,431	37,002	69,492
2011	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2012	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2013	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2014	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2015	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2016	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2017	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2018	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2019	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2020	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2021	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2022	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2023	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2024	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2025	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2026	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2027	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2028	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2029	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2030	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2031	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2032	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2033	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896
2034	4,512	3,027	66,384	73,923	4,512	7,539	70,896	37,704	73,923	37,704	70,896

(2) At Economic Price

Year	Canete V	Alta de Imp.	Concon-T	Total	Case 1.1	Case 1.2	Case 2.1	Case 2.2	Case 3.1	Case 3.2	Case 3.3
2005	1,515	626	14,010	16,151	1,515	2,141	15,526	8,520	16,151	8,520	15,526
2006	3,032	1,251	28,020	32,304	3,032	4,284	31,053	17,043	32,304	17,043	31,053
2007	4,548	1,984	43,686	50,218	4,548	6,532	48,234	26,391	50,218	26,391	48,234
2008	6,065	2,716	59,353	68,134	6,065	8,781	65,418	35,741	68,134	35,741	65,418
2009	7,580	3,450	75,020	86,050	7,580	11,030	82,600	45,090	86,050	45,090	82,600
2010	7,580	3,556	76,676	87,813	7,580	11,136	84,257	45,918	87,813	45,918	84,257
2011	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2012	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2013	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2014	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2015	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2016	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2017	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2018	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2019	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2020	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2021	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2022	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2023	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2024	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2025	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2026	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2027	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2028	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2029	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2030	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2031	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2032	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2033	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913
2034	7,580	3,663	78,333	89,576	7,580	11,243	85,913	46,747	89,576	46,747	85,913

Table 4.4 Project's Cash Flow of Costs and Benefits

(1) Case 1.1 (At Market Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	36,057	0	36,057	0	0	0	0	-36,057
2001	36,057	0	36,057	0	0	0	0	-36,057
2002	96,152	0	96,152	0	0	0	0	-96,152
2003	96,152	0	96,152	0	182,900	0	182,900	86,748
2004	96,152	0	96,152	0	34,400	0	34,400	-61,752
2005	29,497	1,340	30,837	0	33,800	902	34,702	3,865
2006	29,497	1,340	30,837	0	32,500	1,805	34,305	3,468
2007	78,659	1,340	79,999	0	-43,700	2,707	-40,993	-120,992
2008	78,659	1,340	79,999	0	31,400	3,610	35,010	-44,989
2009	78,659	1,340	79,999	0	182,500	4,512	187,012	107,013
2010	0	2,170	2,170	48,079	-49,300	4,512	3,291	1,121
2011	0	2,170	2,170	48,079	31,700	4,512	84,291	82,121
2012	0	2,170	2,170	48,079	32,100	4,512	84,691	82,521
2013	0	2,170	2,170	48,079	34,300	4,512	86,891	84,721
2014	0	2,170	2,170	48,079	34,500	4,512	87,091	84,921
2015	0	2,170	2,170	48,079	34,500	4,512	87,091	84,921
2016	0	2,170	2,170	48,079	34,500	4,512	87,091	84,921
2017	0	2,170	2,170	48,079	34,500	4,512	87,091	84,921
2018	0	2,170	2,170	48,079	34,500	4,512	87,091	84,921
2019	0	2,170	2,170	142,740	184,500	4,512	331,752	329,582
2020	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2021	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2022	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2023	0	2,170	2,170	142,740	-40,500	4,512	106,752	104,582
2024	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2025	0	2,170	2,170	142,740	184,500	4,512	331,752	329,582
2026	0	2,170	2,170	142,740	-40,500	4,512	106,752	104,582
2027	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2028	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2029	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2030	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2031	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2032	0	2,170	2,170	142,740	34,500	4,512	181,752	179,582
2033	0	2,170	2,170	142,740	0	4,512	147,252	145,082
2034	0	2,170	2,170	142,740	0	4,512	147,252	145,082
2035	-144,288	840	-143,448	142,740	0	0	142,740	286,188
2036	0	840	840	142,740	0	0	142,740	141,900
2037	0	840	840	142,740	0	0	142,740	141,900
2038	0	840	840	142,740	0	0	142,740	141,900
2039	0	840	840	142,740	0	0	142,740	141,900
2040	-117,988	0	-117,988	0	0	0	0	117,988

IRR=	17.1%
NPV=	156,149

Table 4.4 Project's Cash Flow of Costs and Benefits

(2) Case 1.1 (At Economic Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	29,927	0	29,927	0	0	0	0	-29,927
2001	29,927	0	29,927	0	0	0	0	-29,927
2002	79,806	0	79,806	0	0	0	0	-79,806
2003	79,806	0	79,806	0	142,900	0	142,900	63,094
2004	79,806	0	79,806	0	19,700	0	19,700	-60,106
2005	24,483	1,045	25,528	0	19,300	1,515	20,815	-4,712
2006	24,483	1,045	25,528	0	18,600	3,032	21,632	-3,895
2007	65,287	1,045	66,332	0	-44,300	4,548	-39,752	-106,084
2008	65,287	1,045	66,332	0	17,900	6,065	23,965	-42,367
2009	65,287	1,045	66,332	0	143,000	7,580	150,580	84,248
2010	0	1,693	1,693	30,705	-47,100	7,580	-8,815	-10,507
2011	0	1,693	1,693	30,705	18,300	7,580	56,585	54,893
2012	0	1,693	1,693	30,705	18,500	7,580	56,785	55,093
2013	0	1,693	1,693	30,705	19,800	7,580	58,085	56,393
2014	0	1,693	1,693	30,705	19,900	7,580	58,185	56,493
2015	0	1,693	1,693	30,705	19,900	7,580	58,185	56,493
2016	0	1,693	1,693	30,705	19,900	7,580	58,185	56,493
2017	0	1,693	1,693	30,705	19,900	7,580	58,185	56,493
2018	0	1,693	1,693	30,705	19,900	7,580	58,185	56,493
2019	0	1,693	1,693	91,366	144,400	7,580	243,346	241,654
2020	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2021	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2022	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2023	0	1,693	1,693	91,366	-42,400	7,580	56,546	54,854
2024	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2025	0	1,693	1,693	91,366	144,400	7,580	243,346	241,654
2026	0	1,693	1,693	91,366	-42,400	7,580	56,546	54,854
2027	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2028	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2029	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2030	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2031	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2032	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2033	0	1,693	1,693	91,366	19,900	7,580	118,846	117,154
2034	0	1,693	1,693	91,366	0	7,580	98,946	97,254
2035	-119,759	655	-119,104	91,366	0	0	91,366	210,470
2036	0	655	655	91,366	0	0	91,366	90,711
2037	0	655	655	91,366	0	0	91,366	90,711
2038	0	655	655	91,366	0	0	91,366	90,711
2039	0	655	655	91,366	0	0	91,366	90,711
2040	-97,930	0	-97,930	0	0	0	0	97,930

IRR=	14.2%
NPV=	56,427

Table 4.4 Project's Cash Flow of Costs and Benefits

(3) Case 1.2 (At Market Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	43,593	0	43,593	0	0	0	0	-43,593
2001	43,593	0	43,593	0	0	0	0	-43,593
2002	116,248	0	116,248	0	0	0	0	-116,248
2003	116,248	0	116,248	0	182,900	0	182,900	66,652
2004	116,248	0	116,248	0	34,400	0	34,400	-81,848
2005	45,337	1,650	46,987	0	33,800	1,419	35,219	-11,768
2006	45,337	1,650	46,987	0	32,500	2,839	35,339	-11,648
2007	120,899	1,650	122,549	0	-43,700	4,347	-39,353	-161,902
2008	120,899	1,650	122,549	0	31,400	5,855	37,255	-85,294
2009	120,899	1,650	122,549	0	182,500	7,363	189,863	67,314
2010	0	2,850	2,850	96,159	-49,300	7,451	54,310	51,460
2011	0	2,850	2,850	96,159	31,700	7,539	135,398	132,548
2012	0	2,850	2,850	96,159	32,100	7,539	135,798	132,948
2013	0	2,850	2,850	96,159	34,300	7,539	137,998	135,148
2014	0	2,850	2,850	96,159	34,500	7,539	138,198	135,348
2015	0	2,850	2,850	96,159	34,500	7,539	138,198	135,348
2016	0	2,850	2,850	96,159	34,500	7,539	138,198	135,348
2017	0	2,850	2,850	96,159	34,500	7,539	138,198	135,348
2018	0	2,850	2,850	96,159	34,500	7,539	138,198	135,348
2019	0	2,850	2,850	285,480	184,500	7,539	477,519	474,669
2020	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2021	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2022	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2023	0	2,850	2,850	285,480	-40,500	7,539	252,519	249,669
2024	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2025	0	2,850	2,850	285,480	184,500	7,539	477,519	474,669
2026	0	2,850	2,850	285,480	-40,500	7,539	252,519	249,669
2027	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2028	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2029	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2030	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2031	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2032	0	2,850	2,850	285,480	34,500	7,539	327,519	324,669
2033	0	2,850	2,850	285,480	0	7,539	293,019	290,169
2034	0	2,850	2,850	285,480	0	7,539	293,019	290,169
2035	-144,288	1,200	-143,088	285,480	0	0	285,480	428,568
2036	0	1,200	1,200	285,480	0	0	285,480	284,280
2037	0	1,200	1,200	285,480	0	0	285,480	284,280
2038	0	1,200	1,200	285,480	0	0	285,480	284,280
2039	0	1,200	1,200	285,480	0	0	285,480	284,280
2040	-117,988	0	-117,988	0	0	0	0	117,988

IRR=	17.2%
NPV=	260,023

Table 4.4 Project's Cash Flow of Costs and Benefits

(4) Case 1.2 (At Economic Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	36,182	0	36,182	0	0	0	0	-36,182
2001	36,182	0	36,182	0	0	0	0	-36,182
2002	96,486	0	96,486	0	0	0	0	-96,486
2003	96,486	0	96,486	0	142,900	0	142,900	46,414
2004	96,486	0	96,486	0	19,700	0	19,700	-76,786
2005	37,630	1,287	38,917	0	19,300	2,141	21,441	-17,476
2006	37,630	1,287	38,917	0	18,600	4,284	22,884	-16,033
2007	100,346	1,287	101,633	0	-44,300	6,532	-37,768	-139,401
2008	100,346	1,287	101,633	0	17,900	8,781	26,681	-74,952
2009	100,346	1,287	101,633	0	143,000	11,030	154,030	52,397
2010	0	2,223	2,223	30,705	-47,100	11,136	-5,259	-7,482
2011	0	2,223	2,223	30,705	18,300	11,243	60,248	58,025
2012	0	2,223	2,223	30,705	18,500	11,243	60,448	58,225
2013	0	2,223	2,223	30,705	19,800	11,243	61,748	59,525
2014	0	2,223	2,223	30,705	19,900	11,243	61,848	59,625
2015	0	2,223	2,223	30,705	19,900	11,243	61,848	59,625
2016	0	2,223	2,223	30,705	19,900	11,243	61,848	59,625
2017	0	2,223	2,223	30,705	19,900	11,243	61,848	59,625
2018	0	2,223	2,223	30,705	19,900	11,243	61,848	59,625
2019	0	2,223	2,223	91,366	144,400	11,243	247,009	244,786
2020	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2021	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2022	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2023	0	2,223	2,223	91,366	-42,400	11,243	60,209	57,986
2024	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2025	0	2,223	2,223	91,366	144,400	11,243	247,009	244,786
2026	0	2,223	2,223	91,366	-42,400	11,243	60,209	57,986
2027	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2028	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2029	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2030	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2031	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2032	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2033	0	2,223	2,223	91,366	19,900	11,243	122,509	120,286
2034	0	2,223	2,223	91,366	0	11,243	102,609	100,386
2035	-119,759	936	-118,823	91,366	0	0	91,366	210,189
2036	0	936	936	91,366	0	0	91,366	90,430
2037	0	936	936	91,366	0	0	91,366	90,430
2038	0	936	936	91,366	0	0	91,366	90,430
2039	0	936	936	91,366	0	0	91,366	90,430
2040	-97,930	0	-97,930	91,366	0	0	91,366	189,296

IRR=	11.2%
NPV=	-24,763

Table 4.4 Project's Cash Flow of Costs and Benefits

(5) Case 2.1 (At Market Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	59,540	0	59,540	0	0	0	0	-59,540
2001	59,540	0	59,540	0	0	0	0	-59,540
2002	158,773	0	158,773	0	0	0	0	-158,773
2003	158,773	0	158,773	0	182,900	0	182,900	24,127
2004	158,773	0	158,773	0	34,400	0	34,400	-124,373
2005	0	6,180	6,180	0	33,800	12,775	46,575	40,395
2006	0	6,180	6,180	0	32,500	25,551	58,051	51,871
2007	0	6,180	6,180	0	-43,700	39,729	-3,971	-10,151
2008	0	6,180	6,180	0	31,400	53,909	85,309	79,129
2009	0	6,180	6,180	0	182,500	68,088	250,588	244,408
2010	0	7,010	7,010	0	-49,300	69,492	20,192	13,182
2011	0	7,010	7,010	0	31,700	70,896	102,596	95,586
2012	0	7,010	7,010	0	32,100	70,896	102,996	95,986
2013	0	7,010	7,010	0	34,300	70,896	105,196	98,186
2014	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2015	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2016	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2017	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2018	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2019	0	7,010	7,010	0	184,500	70,896	255,396	248,386
2020	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2021	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2022	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2023	0	7,010	7,010	0	-40,500	70,896	30,396	23,386
2024	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2025	0	7,010	7,010	0	184,500	70,896	255,396	248,386
2026	0	7,010	7,010	0	-40,500	70,896	30,396	23,386
2027	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2028	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2029	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2030	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2031	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2032	0	7,010	7,010	0	34,500	70,896	105,396	98,386
2033	0	7,010	7,010	0	0	70,896	70,896	63,886
2034	0	7,010	7,010	0	0	70,896	70,896	63,886
2035	-144,288	0	-144,288	0	0	0	0	144,288
2036	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0
2040	-117,988	0	-117,988	0	0	0	0	117,988

IRR=	15.6%
NPV=	117,986

Table 4.4 Project's Cash Flow of Costs and Benefits

(6) Case 2.1 (At Economic Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	49,418	0	49,418	0	0	0	0	-49,418
2001	49,418	0	49,418	0	0	0	0	-49,418
2002	131,782	0	131,782	0	0	0	0	-131,782
2003	131,782	0	131,782	0	142,900	0	142,900	11,118
2004	131,782	0	131,782	0	19,700	0	19,700	-112,082
2005	0	4,820	4,820	0	19,300	15,526	34,826	30,006
2006	0	4,820	4,820	0	18,600	31,053	49,653	44,833
2007	0	4,820	4,820	0	-44,300	48,234	3,934	-886
2008	0	4,820	4,820	0	17,900	65,418	83,318	78,498
2009	0	4,820	4,820	0	143,000	82,600	225,600	220,780
2010	0	5,468	5,468	0	-47,100	84,257	37,157	31,689
2011	0	5,468	5,468	0	18,300	85,913	104,213	98,745
2012	0	5,468	5,468	0	18,500	85,913	104,413	98,945
2013	0	5,468	5,468	0	19,800	85,913	105,713	100,245
2014	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2015	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2016	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2017	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2018	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2019	0	5,468	5,468	0	144,400	85,913	230,313	224,845
2020	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2021	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2022	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2023	0	5,468	5,468	0	-42,400	85,913	43,513	38,045
2024	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2025	0	5,468	5,468	0	144,400	85,913	230,313	224,845
2026	0	5,468	5,468	0	-42,400	85,913	43,513	38,045
2027	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2028	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2029	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2030	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2031	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2032	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2033	0	5,468	5,468	0	19,900	85,913	105,813	100,345
2034	0	5,468	5,468	0	0	85,913	85,913	80,445
2035	-119,759	0	-119,759	0	0	0	0	119,759
2036	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0
2040	-97,930	0	-97,930	0	0	0	0	97,930

IRR=	16.9%
NPV=	148,583

Table 4.4 Project's Cash Flow of Costs and Benefits

(7) Case 2.2 (At Market Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	47,549	0	47,549	0	0	0	0	-47,549
2001	47,549	0	47,549	0	0	0	0	-47,549
2002	126,797	0	126,797	0	0	0	0	-126,797
2003	126,797	0	126,797	0	182,900	0	182,900	56,103
2004	126,797	0	126,797	0	34,400	0	34,400	-92,397
2005	0	4,840	4,840	0	33,800	6,839	40,639	35,799
2006	0	4,840	4,840	0	32,500	13,678	46,178	41,338
2007	0	4,840	4,840	0	-43,700	21,218	-22,482	-27,322
2008	0	4,840	4,840	0	31,400	28,760	60,160	55,320
2009	0	4,840	4,840	0	182,500	36,300	218,800	213,960
2010	0	4,840	4,840	0	-49,300	37,002	-12,298	-17,138
2011	0	4,840	4,840	0	31,700	37,704	69,404	64,564
2012	0	4,840	4,840	0	32,100	37,704	69,804	64,964
2013	0	4,840	4,840	0	34,300	37,704	72,004	67,164
2014	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2015	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2016	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2017	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2018	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2019	0	4,840	4,840	0	184,500	37,704	222,204	217,364
2020	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2021	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2022	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2023	0	4,840	4,840	0	-40,500	37,704	-2,796	-7,636
2024	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2025	0	4,840	4,840	0	184,500	37,704	222,204	217,364
2026	0	4,840	4,840	0	-40,500	37,704	-2,796	-7,636
2027	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2028	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2029	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2030	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2031	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2032	0	4,840	4,840	0	34,500	37,704	72,204	67,364
2033	0	4,840	4,840	0	0	37,704	37,704	32,864
2034	0	4,840	4,840	0	0	37,704	37,704	32,864
2035	-144,288	0	-144,288	0	0	0	0	144,288
2036	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0	0

IRR=	15.8%
NPV=	87,789

Table 4.4 Project's Cash Flow of Costs and Benefits

(8) Case 2.2 (At Economic Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	39,466	0	39,466	0	0		0	-39,466
2001	39,466	0	39,466	0	0		0	-39,466
2002	105,242	0	105,242	0	0		0	-105,242
2003	105,242	0	105,242	0	142,900		142,900	37,658
2004	105,242	0	105,242	0	19,700		19,700	-85,542
2005	0	3,775	3,775	0	19,300	8,520	27,820	24,045
2006	0	3,775	3,775	0	18,600	17,043	35,643	31,868
2007	0	3,775	3,775	0	-44,300	26,391	-17,909	-21,684
2008	0	3,775	3,775	0	17,900	35,741	53,641	49,866
2009	0	3,775	3,775	0	143,000	45,090	188,090	184,315
2010	0	3,775	3,775	0	-47,100	45,918	-1,182	-4,957
2011	0	3,775	3,775	0	18,300	46,747	65,047	61,272
2012	0	3,775	3,775	0	18,500	46,747	65,247	61,472
2013	0	3,775	3,775	0	19,800	46,747	66,547	62,772
2014	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2015	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2016	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2017	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2018	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2019	0	3,775	3,775	0	144,400	46,747	191,147	187,372
2020	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2021	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2022	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2023	0	3,775	3,775	0	-42,400	46,747	4,347	572
2024	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2025	0	3,775	3,775	0	144,400	46,747	191,147	187,372
2026	0	3,775	3,775	0	-42,400	46,747	4,347	572
2027	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2028	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2029	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2030	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2031	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2032	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2033	0	3,775	3,775	0	19,900	46,747	66,647	62,872
2034	0	3,775	3,775	0	0	46,747	46,747	42,972
2035	-119,759	0	-119,759	0	0	0	0	119,759
2036	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0	0

IRR=	15.9%
NPV=	81,538

Table 4.4 Project's Cash Flow of Costs and Benefits

(9) Case 3.1 (At Market Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	58,144	0	58,144	0	0	0	0	-58,144
2001	58,144	0	58,144	0	0	0	0	-58,144
2002	155,051	0	155,051	0	0	0	0	-155,051
2003	155,051	0	155,051	0	182,900	0	182,900	27,849
2004	155,051	0	155,051	0	34,400	0	34,400	-120,651
2005	80,810	4,910	85,720	0	33,800	13,292	47,092	-38,628
2006	80,810	4,910	85,720	0	32,500	26,585	59,085	-26,635
2007	215,494	4,910	220,404	0	-43,700	41,369	-2,331	-222,735
2008	215,494	4,910	220,404	0	31,400	56,154	87,554	-132,850
2009	215,494	4,910	220,404	0	182,500	70,939	253,439	33,035
2010	0	7,640	7,640	48,079	-49,300	72,431	71,210	63,570
2011	0	7,640	7,640	48,079	31,700	73,923	153,702	146,062
2012	0	7,640	7,640	48,079	32,100	73,923	154,102	146,462
2013	0	7,640	7,640	48,079	34,300	73,923	156,302	148,662
2014	0	7,640	7,640	48,079	34,500	73,923	156,502	148,862
2015	0	7,640	7,640	48,079	34,500	73,923	156,502	148,862
2016	0	7,640	7,640	48,079	34,500	73,923	156,502	148,862
2017	0	7,640	7,640	48,079	34,500	73,923	156,502	148,862
2018	0	7,640	7,640	48,079	34,500	73,923	156,502	148,862
2019	0	7,640	7,640	142,740	184,500	73,923	401,163	393,523
2020	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2021	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2022	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2023	0	7,640	7,640	142,740	-40,500	73,923	176,163	168,523
2024	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2025	0	7,640	7,640	142,740	184,500	73,923	401,163	393,523
2026	0	7,640	7,640	142,740	-40,500	73,923	176,163	168,523
2027	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2028	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2029	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2030	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2031	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2032	0	7,640	7,640	142,740	34,500	73,923	251,163	243,523
2033	0	7,640	7,640	142,740	0	73,923	216,663	209,023
2034	0	7,640	7,640	142,740	0	73,923	216,663	209,023
2035	-115,976	2,730	-113,246	142,740	0	0	142,740	255,986
2036	0	2,730	2,730	142,740	0	0	142,740	140,010
2037	0	2,730	2,730	142,740	0	0	142,740	140,010
2038	0	2,730	2,730	142,740	0	0	142,740	140,010
2039	0	2,730	2,730	142,740	0	0	142,740	140,010
2040	-323,240	0	-323,240	0	0	0	0	323,240

IRR=	12.6%
NPV=	36,707

Table 4.4 Project's Cash Flow of Costs and Benefits

(10) Case 3.1 (At Economic Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	48,260	0	48,260	0	0	0	0	-48,260
2001	48,260	0	48,260	0	0	0	0	-48,260
2002	128,692	0	128,692	0	0	0	0	-128,692
2003	128,692	0	128,692	0	142,900	0	142,900	14,208
2004	128,692	0	128,692	0	19,700	0	19,700	-108,992
2005	67,072	3,830	70,902	0	19,300	16,151	35,451	-35,451
2006	67,072	3,830	70,902	0	18,600	32,304	50,904	-19,998
2007	178,860	3,830	182,690	0	-44,300	50,218	5,918	-176,772
2008	178,860	3,830	182,690	0	17,900	68,134	86,034	-96,656
2009	178,860	3,830	182,690	0	143,000	86,050	229,050	46,360
2010	0	5,959	5,959	30,705	-47,100	87,813	71,418	65,459
2011	0	5,959	5,959	30,705	18,300	89,576	138,581	132,622
2012	0	5,959	5,959	30,705	18,500	89,576	138,781	132,822
2013	0	5,959	5,959	30,705	19,800	89,576	140,081	134,122
2014	0	5,959	5,959	30,705	19,900	89,576	140,181	134,222
2015	0	5,959	5,959	30,705	19,900	89,576	140,181	134,222
2016	0	5,959	5,959	30,705	19,900	89,576	140,181	134,222
2017	0	5,959	5,959	30,705	19,900	89,576	140,181	134,222
2018	0	5,959	5,959	30,705	19,900	89,576	140,181	134,222
2019	0	5,959	5,959	91,366	144,400	89,576	325,342	319,383
2020	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2021	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2022	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2023	0	5,959	5,959	91,366	-42,400	89,576	138,542	132,583
2024	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2025	0	5,959	5,959	91,366	144,400	89,576	325,342	319,383
2026	0	5,959	5,959	91,366	-42,400	89,576	138,542	132,583
2027	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2028	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2029	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2030	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2031	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2032	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2033	0	5,959	5,959	91,366	19,900	89,576	200,842	194,883
2034	0	5,959	5,959	91,366	0	89,576	180,942	174,983
2035	-96,260	2,129	-94,131	91,366	0	0	91,366	185,497
2036	0	2,129	2,129	91,366	0	0	91,366	89,237
2037	0	2,129	2,129	91,366	0	0	91,366	89,237
2038	0	2,129	2,129	91,366	0	0	91,366	89,237
2039	0	2,129	2,129	91,366	0	0	91,366	89,237
2040	-268,289	0	-268,289	91,366	0	0	91,366	359,655

IRR=	13.0%
NPV=	46,453

Table 4.4 Project's Cash Flow of Costs and Benefits

(11) Case 3.2 (At Market Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	54,614	0	54,614	0	0	0	0	-54,614
2001	54,614	0	54,614	0	0	0	0	-54,614
2002	145,637	0	145,637	0	0	0	0	-145,637
2003	145,637	0	145,637	0	182,900	0	182,900	37,263
2004	145,637	0	145,637	0	34,400	0	34,400	-111,237
2005	29,497	3,860	33,357	0	33,800	6,839	40,639	7,282
2006	29,497	3,860	33,357	0	32,500	13,678	46,178	12,821
2007	78,659	3,860	82,519	0	-43,700	21,218	-22,482	-105,001
2008	78,659	3,860	82,519	0	31,400	28,760	60,160	-22,359
2009	78,659	3,860	82,519	0	182,500	36,300	218,800	136,281
2010	0	4,700	4,700	48,079	-49,300	37,002	35,781	31,081
2011	0	4,700	4,700	48,079	31,700	37,704	117,483	112,783
2012	0	4,700	4,700	48,079	32,100	37,704	117,883	113,183
2013	0	4,700	4,700	48,079	34,300	37,704	120,083	115,383
2014	0	4,700	4,700	48,079	34,500	37,704	120,283	115,583
2015	0	4,700	4,700	48,079	34,500	37,704	120,283	115,583
2016	0	4,700	4,700	48,079	34,500	37,704	120,283	115,583
2017	0	4,700	4,700	48,079	34,500	37,704	120,283	115,583
2018	0	4,700	4,700	48,079	34,500	37,704	120,283	115,583
2019	0	4,700	4,700	142,740	184,500	37,704	364,944	360,244
2020	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2021	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2022	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2023	0	4,700	4,700	142,740	-40,500	37,704	139,944	135,244
2024	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2025	0	4,700	4,700	142,740	184,500	37,704	364,944	360,244
2026	0	4,700	4,700	142,740	-40,500	37,704	139,944	135,244
2027	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2028	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2029	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2030	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2031	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2032	0	4,700	4,700	142,740	34,500	37,704	214,944	210,244
2033	0	4,700	4,700	142,740	0	37,704	180,444	175,744
2034	0	4,700	4,700	142,740	0	37,704	180,444	175,744
2035	-144,288	840	-143,448	142,740	0	0	142,740	286,188
2036	0	840	840	142,740	0	0	142,740	141,900
2037	0	840	840	142,740	0	0	142,740	141,900
2038	0	840	840	142,740	0	0	142,740	141,900
2039	0	840	840	142,740	0	0	142,740	141,900
2040	-117,988	0	-117,988	0	0	0	0	117,988

IRR=	15.0%
NPV=	137,269

Table 4.4 Project's Cash Flow of Costs and Benefits

(12) Case 3.2 (At Economic Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	45,330	0	45,330	0	0	0	0	-45,330
2001	45,330	0	45,330	0	0	0	0	-45,330
2002	120,879	0	120,879	0	0	0	0	-120,879
2003	120,879	0	120,879	0	142,900	0	142,900	22,021
2004	120,879	0	120,879	0	19,700	0	19,700	-101,179
2005	24,483	3,011	27,493	0	19,300	8,520	27,820	327
2006	24,483	3,011	27,493	0	18,600	17,043	35,643	8,150
2007	65,287	3,011	68,298	0	-44,300	26,391	-17,909	-86,207
2008	65,287	3,011	68,298	0	17,900	35,741	53,641	-14,657
2009	65,287	3,011	68,298	0	143,000	45,090	188,090	119,792
2010	0	3,666	3,666	30,705	-47,100	45,918	29,523	25,857
2011	0	3,666	3,666	30,705	18,300	46,747	95,752	92,086
2012	0	3,666	3,666	30,705	18,500	46,747	95,952	92,286
2013	0	3,666	3,666	30,705	19,800	46,747	97,252	93,586
2014	0	3,666	3,666	30,705	19,900	46,747	97,352	93,686
2015	0	3,666	3,666	30,705	19,900	46,747	97,352	93,686
2016	0	3,666	3,666	30,705	19,900	46,747	97,352	93,686
2017	0	3,666	3,666	30,705	19,900	46,747	97,352	93,686
2018	0	3,666	3,666	30,705	19,900	46,747	97,352	93,686
2019	0	3,666	3,666	91,366	144,400	46,747	282,513	278,847
2020	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2021	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2022	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2023	0	3,666	3,666	91,366	-42,400	46,747	95,713	92,047
2024	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2025	0	3,666	3,666	91,366	144,400	46,747	282,513	278,847
2026	0	3,666	3,666	91,366	-42,400	46,747	95,713	92,047
2027	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2028	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2029	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2030	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2031	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2032	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2033	0	3,666	3,666	91,366	19,900	46,747	158,013	154,347
2034	0	3,666	3,666	91,366	0	46,747	138,113	134,447
2035	-119,759	655	-119,104	91,366	0	0	91,366	210,470
2036	0	655	655	91,366	0	0	91,366	90,711
2037	0	655	655	91,366	0	0	91,366	90,711
2038	0	655	655	91,366	0	0	91,366	90,711
2039	0	655	655	91,366	0	0	91,366	90,711
2040	-97,930	0	-97,930	91,366	0	0	91,366	189,296

IRR=	14.3%
NPV=	83,782

Table 4.4 Project's Cash Flow of Costs and Benefits

(13) Case 3.3 (At Market Price)

Unit: In thousand of US$

	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	60,350	0	60,350	0	0	0	0	-60,350
2001	60,350	0	60,350	0	0	0	0	-60,350
2002	160,932	0	160,932	0	0	0	0	-160,932
2003	160,932	0	160,932	0	182,900	0	182,900	21,968
2004	160,932	0	160,932	0	34,400	0	34,400	-126,532
2005	29,898	5,450	35,348	0	33,800	12,775	46,575	11,227
2006	29,898	5,450	35,348	0	32,500	25,551	58,051	22,703
2007	79,729	5,450	85,179	0	-43,700	39,729	-3,971	-89,150
2008	79,729	5,450	85,179	0	31,400	53,909	85,309	130
2009	79,729	5,450	85,179	0	182,500	68,088	250,588	165,409
2010	0	6,290	6,290	48,079	-49,300	69,492	68,271	61,981
2011	0	6,290	6,290	48,079	31,700	70,896	150,675	144,385
2012	0	6,290	6,290	48,079	32,100	70,896	151,075	144,785
2013	0	6,290	6,290	48,079	34,300	70,896	153,275	146,985
2014	0	6,290	6,290	48,079	34,500	70,896	153,475	147,185
2015	0	6,290	6,290	48,079	34,500	70,896	153,475	147,185
2016	0	6,290	6,290	48,079	34,500	70,896	153,475	147,185
2017	0	6,290	6,290	48,079	34,500	70,896	153,475	147,185
2018	0	6,290	6,290	48,079	34,500	70,896	153,475	147,185
2019	0	6,290	6,290	142,740	184,500	70,896	398,136	391,846
2020	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2021	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2022	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2023	0	6,290	6,290	142,740	-40,500	70,896	173,136	166,846
2024	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2025	0	6,290	6,290	142,740	184,500	70,896	398,136	391,846
2026	0	6,290	6,290	142,740	-40,500	70,896	173,136	166,846
2027	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2028	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2029	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2030	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2031	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2032	0	6,290	6,290	142,740	34,500	70,896	248,136	241,846
2033	0	6,290	6,290	142,740	0	70,896	213,636	207,346
2034	0	6,290	6,290	142,740	0	70,896	213,636	207,346
2035	-146,250	840	-145,410	142,740	0	0	142,740	288,150
2036	0	840	840	142,740	0	0	142,740	141,900
2037	0	840	840	142,740	0	0	142,740	141,900
2038	0	840	840	142,740	0	0	142,740	141,900
2039	0	840	840	142,740	0	0	142,740	141,900
2040	-119,593	0	-119,593	0	0	0	0	119,593

IRR=	16.1%
NPV=	208,299

Table 4.4 Project's Cash Flow of Costs and Benefits

(14) Case 3.3 (At Economic Price)

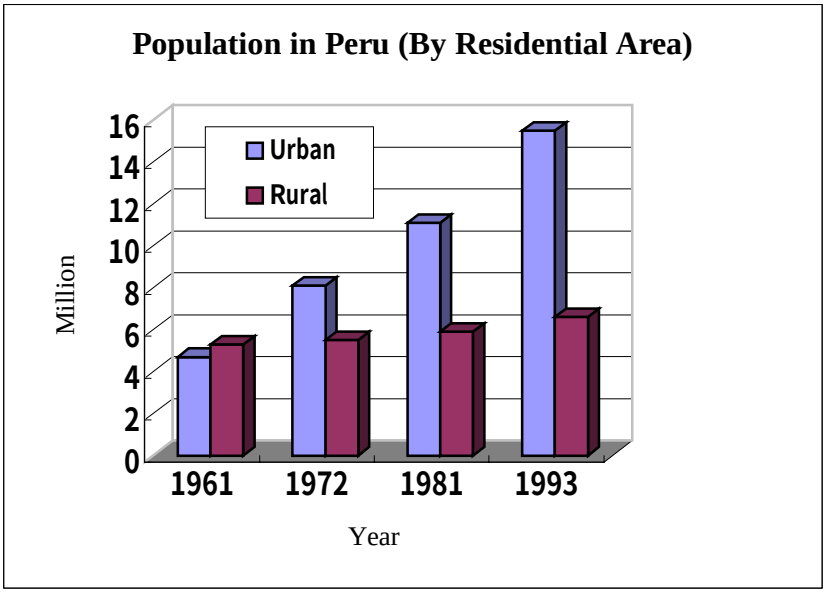
Unit: In thousand of US$

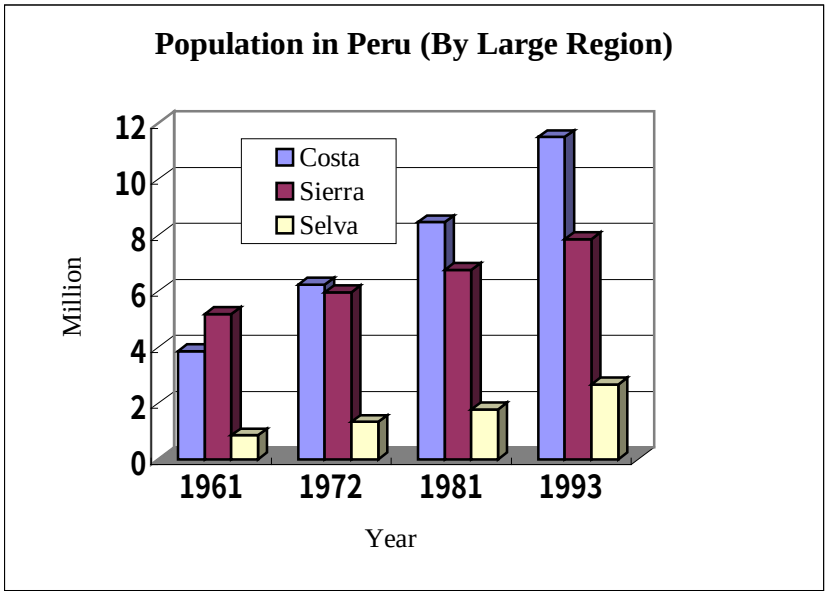
	Costs			Benefits				Incremental
Year	Capital	Recurrent	Total	D/I Water	Hydropower	Irrigation	Total	Benefits
2000	50,091	0	50,091	0	0	0	0	-50,091
2001	50,091	0	50,091	0	0	0	0	-50,091
2002	133,574	0	133,574	0	0	0	0	-133,574
2003	133,574	0	133,574	0	142,900	0	142,900	9,326
2004	133,574	0	133,574	0	19,700	0	19,700	-113,874
2005	24,815	4,251	29,066	0	19,300	15,526	34,826	5,760
2006	24,815	4,251	29,066	0	18,600	31,053	49,653	20,587
2007	66,175	4,251	70,426	0	-44,300	48,234	3,934	-66,492
2008	66,175	4,251	70,426	0	17,900	65,418	83,318	12,892
2009	66,175	4,251	70,426	0	143,000	82,600	225,600	155,174
2010	0	4,906	4,906	30,705	-47,100	84,257	67,862	62,956
2011	0	4,906	4,906	30,705	18,300	85,913	134,918	130,012
2012	0	4,906	4,906	30,705	18,500	85,913	135,118	130,212
2013	0	4,906	4,906	30,705	19,800	85,913	136,418	131,512
2014	0	4,906	4,906	30,705	19,900	85,913	136,518	131,612
2015	0	4,906	4,906	30,705	19,900	85,913	136,518	131,612
2016	0	4,906	4,906	30,705	19,900	85,913	136,518	131,612
2017	0	4,906	4,906	30,705	19,900	85,913	136,518	131,612
2018	0	4,906	4,906	30,705	19,900	85,913	136,518	131,612
2019	0	4,906	4,906	91,366	144,400	85,913	321,679	316,773
2020	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2021	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2022	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2023	0	4,906	4,906	91,366	-42,400	85,913	134,879	129,973
2024	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2025	0	4,906	4,906	91,366	144,400	85,913	321,679	316,773
2026	0	4,906	4,906	91,366	-42,400	85,913	134,879	129,973
2027	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2028	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2029	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2030	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2031	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2032	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2033	0	4,906	4,906	91,366	19,900	85,913	197,179	192,273
2034	0	4,906	4,906	91,366	0	85,913	177,279	172,373
2035	-121,388	655	-120,732	91,366	0	0	91,366	212,098
2036	0	655	655	91,366	0	0	91,366	90,711
2037	0	655	655	91,366	0	0	91,366	90,711
2038	0	655	655	91,366	0	0	91,366	90,711
2039	0	655	655	91,366	0	0	91,366	90,711
2040	-99,262	0	-99,262	91,366	0	0	91,366	190,628

IRR=	16.4%
NPV=	184,672

FIGURES

Figure 1.1
Demographic Features in Peru





STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT IN THE CAÑETE RIVER BASIN IN THE REPUBLIC OF PERU	**Figure 1.1** **Demographic Features in Peru**
JAPAN INTERNATIONAL COOPERATION AGENCY	

Attachment

Brief Description of the Cost Allocation Methodology for Multi-Purpose Dam

1. Introduction

In a multipurpose water resources development project some facilities such as dam and reservoir serve more than one project function. Different users of the separate project functions are called upon to repay the appropriate cost of the separate project accomplishments. Agreement is necessary on some acceptable sharing of cost of join-use facilities. The cost to be shared by different users includes investment cost as well as operation and maintenance cost.

Cost allocation aims at an equitable distribution of the project costs among the purpose it serves. Allocation provides a rational and fair basis for the sharing of project costs in accordance with the set policies of repayment.

A fundamental premises of multipurpose water development is that through the communal use of facilities, each purpose may be more economically served as part of joint enterprise than sd an independent individual undertaking.

Al lease nine different methods have been devised and used at one time or another for allocating costs. They are identified by name as follows:

a. Benefit method
b. Alternative justifiable expenditure (AJE) method
c. Separable costs – remaining benefits (SCRB)
d. Use of facilities method
e. Separate projects method
f. Equal apportionment method
g. Priority of use method
h. Incremental method
i. Direct costs method

Among these methods the Separable Costs – Remaining Benefits (SCRB) Method is the method recommended for general use in allocating costs of multiple-purpose river basin projects in the United States of America and has been used extensively by relevant development agencies.

The SCRB method is as briefly described hereinafter.

2. Principal for cost allocation

In principal, an allocation includes the costs incurred solely for any one purpose and those to be shared among all the purposed served. The cost incurred solely for any one purpose set the minimum amount to be allocated to that purpose.

The maximum allocation to any one purpose will be limited by either capitalized benefits derived from that purpose or the cost of a single purpose alternative producing equivalent benefits, which is less.

Each purpose shares the cost of joint-use facilities as well as saving from such use.

Briefly, the principles of cost allocation may be summarized as follows:

(i) In a multipurpose project, the provision of one facility to serve several purposes is more economical than the provision of individual separate facilities.

(ii) Cost of joint-use facilities is equitably distributed among the purposes served.

(iii) Saving effected by the joint-use of facilities are distributed among all the purposes served.

(iv) Cost assigned (maximum allocation) to any one purpose should not be greater than the benefits it produces or the cost of a single-purpose project which would produce equivalent benefits.

(v) The minimum cost allocated to any one purpose should not be less than the identifiable costs (specific or separable) incurred for the said purpose alone.

3. Method of cost allocation

a. Definitions

Cost allocation will vary widely unless common terminology and interpretation are used in the allocation procedures.

Specific costs are the costs of individual physical features that serve only one purpose. Examples are irrigation works, power plant, transmission lines and water purification works.

Separable cost are the costs which would be omitted from the total cost of a project if any one purpose were excluded. The separable cost of any one purpose is derived by subtracting the estimated cost of the project with the said purpose excluded from the cost of the project with all purposes included. The design or site should not be changed in computing the separable cost; only the size of the structure and its appurtenant works is varied to obtain the resulting cost figure.

Separable cost may vary from zero to more than the specific costs. For some project purposes which produce benefits wholly incidental to the use of facilities for other purposes, the separable cost may be zero. For certain joint-use facilities, the size or design of a feature may not be changed by excluding any one purpose, so that the separable cost of the feature would also be zero.

Joint costs are the cost of project features that serve more than one purpose.

The *justifiable expenditure* is the lesser of benefits or single-purpose alternative economic costs. It is the upper limit to which costs may be allocated to any one purpose, i.e., the maximum allocation.

The single-purpose alternatives provide comparable treatment for each purpose in turn as the first increment or sole purpose of the project. This alternative represents the most economic means of provided service to each purpose equivalent to that provided by the multiple-purpose project, computed under the same standards as project economic costs. It may be located at the multiple-purpose site or at other sites, and several alternatives in turn may occupy the same site. It may be of different size and may serve the purpose by entirely different physical means than the multiple-purpose plan. The most economic alternative for power may be a single-purpose hydroelectric plant in the same general area or a steam-plant at some other location. The single-purpose alternative is used in cost allocation as a limit to the justifiable expenditure or maximum allocation to each purpose. It is thus basically different from the costs of alternatives used to indicate a simulated market price for the derivation of benefits.

b. Allocation procedure

The cost allocation may be computed in terms of average annual equivalent values or as lump sums representing present worth. The allocation process includes the following principal steps:

(A) List the benefits for each purpose.

(B) List the single-purpose alternative cost for each purpose.

(C) List the lesser of the benefits or the single-purpose alternative cost as the justifiable expenditure for each purpose.

(D) For each purpose, list the specific cost (when using the alternative justifiable expenditure method) or the separable cost (when using the separable costs-remaining benefits method).

(E) Deduct the specific or the separable cost from the justifiable expenditure and list the remaining justifiable expenditure for each purpose.

(F) List the percentage distribution of each remaining justifiable expenditure in relation to their total.

(G) Deduct the total of specific or separable costs from the cost to be allocated and list the distribution of the remainder to each purpose in proportion to the percentage of remaining justifiable expenditure.

(H) List the total of (D) and (G) for each purpose.

(I) Convert the amounts determined in (H) to annual or lump sum values as necessary. .

(J) Where economic costs have been allocated, convert to the itemized costs in project estimates and financial records

4. Cost allocation for Cañete Scheme

Following cost allocation method for the SCRB mentioned before, the cost to be allocated to for each independent function of dual purpose scenario (Case 1.1) and multi-purpose scenario (Case 3.1 and Case 3.3) of the Cañete Scheme is as given below.

(1) Cost allocation for dual purpose scenario (Case 1.1)

Item	D/I Water Supply	Power Generation	Total
1. Cost to be allocated			
(a) Capital cost			142.91
(b) Recurrent cost			0.53
2. Benefits	207,81	295,32	
3. Alternative cost	142.91	142.91	285.82
4. Justifiable expenditure1/	142.91	142.91	285.82
5. Separate cost2/	0	0	0
(a) Capital cost	0	0	0
(b) Recurrent cost	0	0	0
6. Remaining justifiable expenditure3/	142.91	142.91	285.82
7. Percentage distribution	50	50	100
8. Cost to be allocated			
(a) Capital cost	71.46	71.46	142.91
(b) Recurrent cost	0.27	0.27	0.53

Note: 1/ - The lesser of items 2 and 3
2/ - To be ignores at master plan level
3/ - Item 4 minus item 5

(2) Cost allocation for multi-purpose scenario

1) Case 3.1

Item	D/I Water Supply	Power Generation	Irrigation	Total
1. Cost to be allocated				
(a) Capital cost				709.08
(b) Recurrent cost				2.64
2. Benefits	207,81	295,32	254.07	757.20
3. Alternative cost	142.91	211.80	196.08	550.79
4. Justifiable expenditure1/	142.91	211.80	196.08	550.79
5. Separate cost2/	0	0	0	0
(a) Capital cost	0	0	0	0
(b) Recurrent cost	0	0	0	0
6. Remaining justifiable expenditure3/	142.91	211.80	196.08	550.79
7. Percentage distribution	26	38	36	100
8. Cost to be allocated				
(a) Capital cost	184.36	269.45	255.27	709.08
(b) Recurrent cost	0.69	1.00	0.95	2.64

Note: 1/ - The lesser of items 2 and 3
2/ - To be ignores at master plan level
3/ - Item 4 minus item 5

2) Case 3.3

Item	D/I Water Supply	Power Generation	Irrigation	Total
1. Cost to be allocated				
(a) Capital cost				196.08
(b) Recurrent cost				0.72
2. Benefits	207,81	295,32	254.07	757.20
3. Alternative cost	96.60	196.08	142.91	435.59
4. Justifiable expenditure1/	96.60	196.08	142.91	435.59
5. Separate cost2/	0	0	0	0
(a) Capital cost	0	0	0	0
(b) Recurrent cost	0	0	0	0
6. Remaining justifiable expenditure3/	96.60	196.08	142.91	435.59
7. Percentage distribution	22	45	33	100
8. Cost to be allocated				
(a) Capital cost	46.60	88.24	64.70	196.08
(b) Recurrent cost	0.17	0.32	0.24	0.72

Note: 1/ - The lesser of items 2 and 3
2/ - To be ignores at master plan level
3/ - Item 4 minus item 5