

**JAPAN INTERNATIONAL  
COOPERATION AGENCY**

**POTABLE WATER AND SEWERAGE SERVICE OF LIMA  
THE GOVERNMENT OF THE REPUBLIC OF PERU**

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

**FINAL REPORT**

**VOLUME II MAIN REPORT**

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

**LIST OF FINAL REPORT VOLUMES**

**Volume I : Executive Summary/ *Resumen Ejecutivo***

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**Volume III : Supporting Report**

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**Volume IV : Supporting Report**

**M: Supplemental Investigation on Water Use and Loss  
in Rímac River Basin**

**Volume V : Data Book**

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## **SUMMARY AND CONCLUSION**

### **Background and Scope of The Study**

The capital, Lima, which accommodates a population of over 7 million, about 30% of the national total in the area of coastal dry land, has always grappled with the problem of primary water supply to meet domestic and industrial demand. The Government of Peru therefore made a request to the Government of Japan for technical assistance to study an integrated water resources development of the Cañete river basin by paying due consideration to the conveyance of water from the basin to the capital Lima. The Japan International Cooperation Agency (JICA) and the Potable Water and Sewerage Service of Lima (SEDAPAL) agreed on the Scope of Work for the Study on the Integrated Water Resources Development in the Cañete River Basin in the Republic of Peru on November 22<sup>nd</sup>, 1996.

The objectives of the Study are ‘to formulate an integrated master plan for the development of water resources in the Cañete river basin up to the year 2020, with priority to increase the water resources for the Lima water supply (Phase I), ‘to conduct a feasibility study of the priority project(s) to be identified and agreed upon by the two sides based on the master plan up to year 2003 (Phase II)’, and ‘to transfer technology to the counterpart personnel in the course of the Study.

The Study area is shown on the map “The Study Area” and is composed of the area of the Cañete river basin for water resources development, the coastal corridor to the south of Lima for water conveyance, and the southern area of the capital Lima for domestic and industrial water supply.

### **Implementation of the Study**

The Study was commenced in March 1999 by preparing an Inception Report. At the outset of the Study, it was agreed between JICA and SEDAPAL to extend the study horizon of the Phase I (master plan study) from 2020 to 2030. The Interim Report was completed on December 27<sup>th</sup>, 1999, by incorporating the outputs prepared up to that time.

On March 1<sup>st</sup>, 2000, JICA and SEDAPAL agreed that supplemental investigation of water use and water loss in the Rimac river (the main water source managed by SEDAPAL for domestic and industrial water supply in the capital Lima) would be carried out, and implementation of Phase II and contents of its TOR would be determined based on the results of the investigation. The supplemental investigation was started in August 2001 and Progress Report (2) was submitted to SEDAPAL on September 28<sup>th</sup>, 2001.

On October 19<sup>th</sup>, 2001, JICA and SEDAPAL agreed that Phase II would not be implemented in the near future and the Draft Final Report would be submitted by December 2001, by finalizing the Interim Report and the Progress Report (2). On December 13<sup>th</sup>, 2001, upon the acceptance of the Draft Final Report, JICA and SEDAPAL

agreed that the Final Report would be submitted as soon as possible after obtaining comments of SEDAPAL by January 10<sup>th</sup>, 2002.

### **The Cañete River Basin**

The Cañete river is approximately 230 km long and has a catchment area of 6,189 km<sup>2</sup> with its riverbed gradient of 1/53 (approximately 2%). A numbers of glacial lakes are dotted in the Glacial/Alpine area of the upper reach at altitude over 3,500 m asl, but no large dam has been constructed yet on the river.

Annual rainfall is less than 50 mm in the coastal area of the lower reach and increases with altitude up to 1,000 mm in the upper reach higher than 4,000 m. The mean annual basin rainfall is about 437 mm (2,576 MCM/year). The basin run off ratio is about 0.54 at the Socsi Station (5,980 km<sup>2</sup>). The annual basin runoff varied from 600 MCM/year (19.0 m<sup>3</sup>/s) to 2,572 MCM/year (81.6 m<sup>3</sup>/s) at Socsi (5,980 km<sup>2</sup>), the mean being 1,385 MCM/year (43.9 m<sup>3</sup>/s) during the period 1965 - 1997. Water resources in the basin have not yet been well developed except for the irrigation in the coastal agricultural land, domestic water uses and rubber rafting tourism in the downstream river stretch. However, plans for large scale development of hydropower and irrigation have been proposed.

Total population in the area in 1998 was estimated at 1.23 million, while that in the provinces (Canete and Yauyos) in the river basin was 191,000. The annual growth rate (1981-1998) was 1.9% for Cañete and – 1.5% for Yauyos, indicating the exodus of inhabitants from the hilly Yauyos to the coastal Cañete and the capital Lima. The agricultural and livestock sector constitutes the mainstay of the basin area, playing an important role in the wholesale market of Lima. According to the census in 1993, the economically active population was distributed by sector to primary 46%, secondary 11% and tertiary 43%.

### **Integrated Master Plan**

The integrated master plan for the water resources development of the Cañete river basin is concluded as follows in terms of ‘development of water resources’ and ‘management of water resources’:

#### Development of water resources

Preference would remain with the Mantaro river basin, not the Cañete river basin, to convey new water to the capital Lima for D/I supply, as indicated by an economic assessment and other screening criteria.

Development of water resources would be realized, shown as Scenario-2/Case 2.1 on Table 1, by constructing the Morro de Arica dam supplemented with the construction of the Paucarcocha dam as needed with increase in demand;

- Development of D/I water supply (total of 1.03 m<sup>3</sup>/s) including expansion in the Cañete river basin (0.87 m<sup>3</sup>/s) and provision to the Concón-Topará area

(0.15 m<sup>3</sup>/s) to be accompanied by the implementation of agriculture development therein.

- Development of irrigation, total of 51,000 ha, including the rehabilitation and improvement of the existing Cañete Valley agriculture land (24,000 ha) and new development in the Concón-Topará (27,000 ha).
- Development of hydroelectric power, total at 270 MW including new development at Morro de Arica (50 MW) and at El Platanal (220 MW).

The implementation schedule for development is prepared as shown in Figure 15;

- Expansion of D/I water supply in Cañete river basin (0.87 m<sup>3</sup>/s) will be carried out step by step to meet the demand growth by use of groundwater and/or surface water. D/I water supply to Concón-Topará (0.15 m<sup>3</sup>/s) will be implemented over the period from 2003 to 2007 together with the implementation of the irrigation development therein.
- On-going rehabilitation of the existing Valle de Cañete irrigation system (24,000 ha) is assumed to be completed by 2004. Concón-Topará development (27,000 ha) is assumed to be realized over the period from 2003 to 2011.
- Hydropower development including Morro de Arica (dam and 50 MW power plant) and El Platanal (220 MW power plant) is planned to be realized over the period from 2003 to 2006.

Among the above, a private firm, Cementos Lima is carrying out the implementation of both the hydroelectric power (both Morro de Arica and El Platanal) and irrigation (Concón-Topará) with the construction of the Morro de Arica dam. Rehabilitation and improvement of the irrigation system for the existing agricultural land at the Valle de Cañete is being implemented with co-finance by OECF (now JBIC) of Japan and the World Bank.

#### Management of water resources

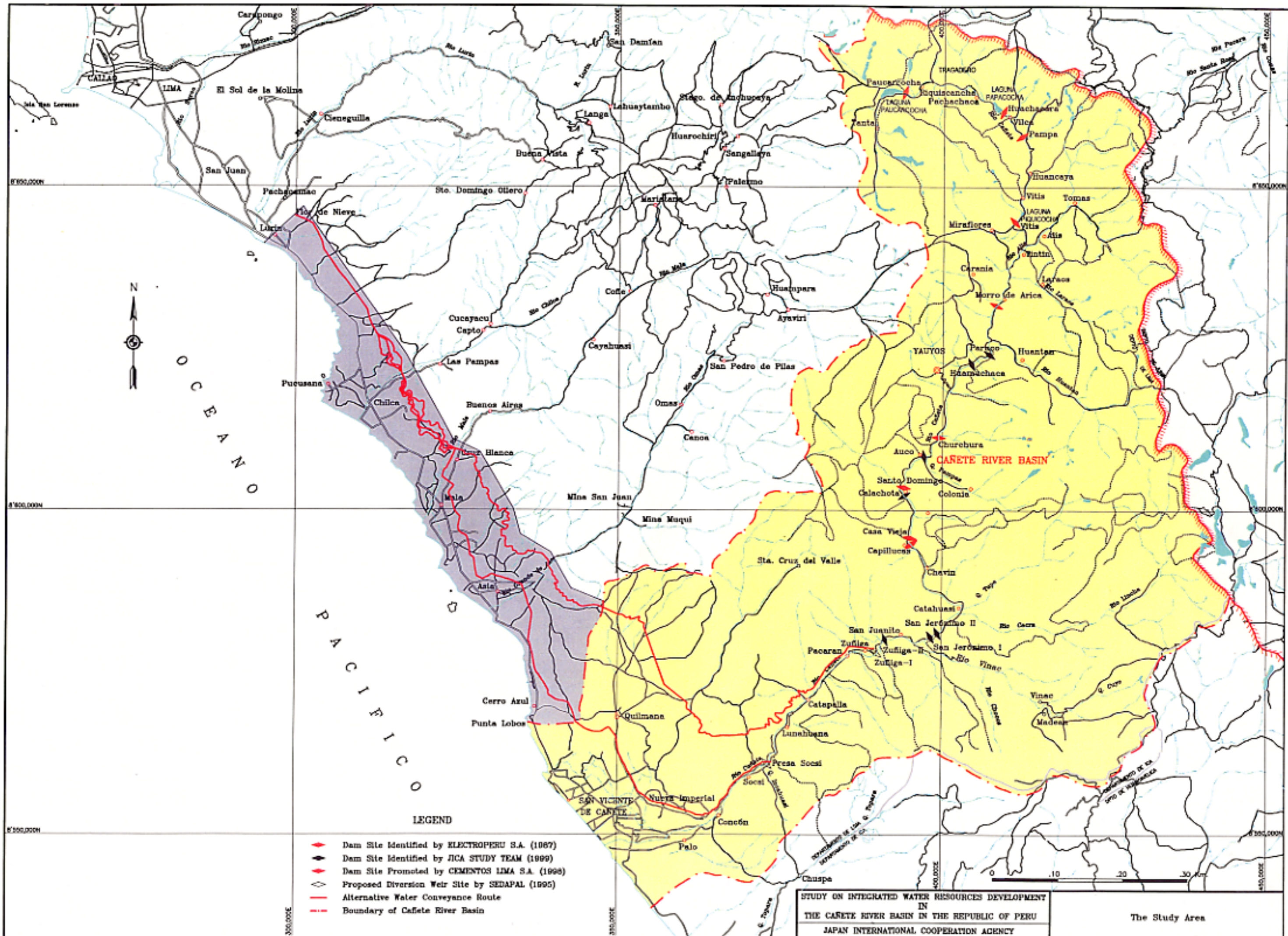
The requirement for water resources management in the Cañete river basin, in respect of natural disasters, flood control, water use, water quantity and monitoring system, is not immediate at present. It would however be highlighted when the development of water resources will proceed and there are indications that there will be arguments on water allocation and contamination.

#### **Management of Water Resources in the Rimac River Basin**

The Rimac river basin currently faces more acute issues compared to the Cañete river basin in terms of water allocation and quality of the potable water supply to the capital Lima. Water in the Rímac river is in multiple use for potable water supply (in charge of SEDAPAL), hydropower generation (in charge of EDEGEL) and irrigation and industrial

uses. Water use between SEDAPAL and EDEGEL is being coordinated by meetings. There is, however, no formal agreement on the water allocation between SEDAPAL and agricultural and industrial users, in particular during low flow period, which is deemed to be one of the causes of the appreciable loss to the potable water take. Water in the Rímac river is contaminated, particularly by the discharge of toxic heavy metals from mining, sewage from residences, and drainage water from agricultural lands and industries, with the results that the content of toxic materials in raw water sometimes exceed the allowable limit of the Peruvian General Water Law.

The Rimac river basin would require prudent consideration to prepare and implement guidelines and measures for water resources management including water quantity and quality monitoring, institutional arrangements and structural measures.



STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT  
 IN  
 THE CARETE RIVER BASIN IN THE REPUBLIC OF PERU  
 JAPAN INTERNATIONAL COOPERATION AGENCY

The Study Area

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## List of Acronyms

AACH	:	<i>Autoridad Autónoma de la Cuenca Hidrográfica</i> (Autonomous Hydrographic Basin Authority)
ATR	:	<i>Administración Técnica de Distrito de Riego</i> (Technical Administration for Irrigation District)
COES	:	<i>Comité de Ocupación Económica del Sistema Interconectado Nacional</i> (Committee for Economic Operation of the National Interconnected System)
CONAM	:	<i>Consejo Nacional del Ambiente</i> (National Environment Council)
DGAA	:	<i>Dirección General Asuntos Ambientales</i> (Directorate General for Environmental Affairs)
DGAS	:	<i>Dirección General de Aguas y Suelos</i> (General Board of Water and Soil)
DGE	:	<i>Dirección General de Electricidad</i> (Directorate General for Electricity)
DGM	:	<i>Dirección General de Minas</i> (Directorate General for Mining)
DIGESA	:	<i>Dirección General de Salud Ambiental</i> (Directorate General for Environmental Health)
EDEGEL	:	<i>Empresa de Generación Eléctrica de Lima S.A.</i> (Electric Generation Company of Lima)
ELECTROPERU	:	<i>Empresa de Electricidad del Perú</i> (Peru Electricity Enterprise)
FONCODES	:	<i>Fondo Nacional de Compensación y Desarrollo</i> (National Fund for Compensation and Social Development)
IDB	:	Inter-American Development Bank
INADE	:	<i>Instituto Nacional de Desarrollo</i> (National Institute of Development)
INDECI	:	<i>Instituto Nacional de Defensa Civil</i> (National Institute of Civil Defense)
INRENA	:	<i>Instituto Nacional de Recursos Naturales</i> (National Institute of Natural Resources)
JBIC	:	Japan Bank for International Cooperation
JICA	:	Japan International Cooperation Agency
MAG	:	<i>Ministerio de Agricultura</i> (Ministry of Agriculture)
MD	:	<i>Ministerio de Defensa</i> (Ministry of Defense)
MEF	:	<i>Ministerio de Economía y Finanzas</i> (Ministry of Economy and Finance)
MEM	:	<i>Ministerio de Energía y Minas</i> (Ministry of Energy and Mining)



MIPRE	:	<i>Ministerio de la Presidencia</i> (Ministry of Presidency)
MITINCI	:	<i>Ministerio de Industria, Turismo, Integración y Negociaciones Comerciales Internacionales</i> (Ministry of Industry, Tourism, Integration and International Trade)
MS	:	<i>Ministerio de Salud</i> (Ministry of Health)
OECD	:	The Overseas Economic Cooperation Fund, Japan
OUA	:	<i>Organizaciones de Usuarios de Aguas</i> (Water Users' Association)
PRONAMACHS	:	<i>Proyecto Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos</i> (National Program for River Basin Management and Soil Conservation)
SEDAPAL	:	<i>Servicio de Agua Potable y Alcantarillado de Lima</i> (Potable Water and Sewage Service of Lima)
SENAMHI	:	<i>Servicio Nacional de Meteorología e Hidrología</i> (National Service for Meteorology and Hydrology)
SUNASS	:	<i>Superintendencia Nacional de Servicios de Saneamiento</i> (National Superintendence of Sanitary Service)