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Report No: PAD2104

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$ 40 MILLION

TO THE

REPUBLIC OF PERU

FOR A

PERU INTEGRATED WATER RESOURCES MANAGEMENT IN TEN BASINS PROJECT

APRIL 05, 2017

Water Global Practice
Latin America and the Caribbean Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective February 23, 2017)

Currency Unit	=	Peruvian Soles Nuevos (PEN)
PEN 3.2459	=	US$1
US$1	=	SDR 1

PERU GOVERNMENT FISCAL YEAR
January 1 - December 31

Regional Vice President:	Jorge Familiar Calderon
Country Director:	Alberto Rodriguez
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Task Team Leader(s):	Erwin De Nys, Habab Taifour

ABBREVIATIONS AND ACRONYMS

AAA	Administrative Water Authority (for its acronym in Spanish - *Autoridad Administrativa del Agua*)
ALA	Local Water Authority (for its acronym in Spanish - *Autoridad Local del Agua*)
ANA	National Water Authority (for its acronym in Spanish - *Autoridad Nacional del Agua)*
AO	Administrative Office
CAF	Development Bank of Latin America (for its acronym in Spanish – *Corporación Andina de Fomento*)
CC	River Basin Council (for its acronym in Spanish - *Consejo de Cuenca)*
DA	Designated Account
EMP	Emergency Management Plan
ESMF	Environmental and Social Management Framework
GDP	Gross Domestic Product
GoP	Government of Peru
IBRD	International Bank for Reconstruction and Development
ICB	International Competitive Bidding
IDB	Inter-American Development Bank
IFR	Interim Financial Report
IPPF	Indigenous Peoples Planning Framework
IWRM	Integrated Water Resources Management
M&E	Monitoring and Evaluation
MEF	Ministry of Economy and Finance (for its acronym in Spanish - *Ministerio de Economía y Finanzas*)
MINAGRI	Ministry of Agriculture and Irrigation (for its acronym in Spanish - *Ministerio de Agricultura y Riego)*
MINAM	Ministry of Environment (for its acronym in Spanish - *Ministerio de Ambiente*)
MINEDU	Ministry of Education (for its acronym in Spanish - *Ministerio de Educación*)
MVCS	*Ministry of Housing, Construction and Sanitation* (for its acronym in Spanish - *Ministerio de Vivienda, Construcción y Saneamiento*)
NCB	National Competitive Bidding
NWRIS	National Water Resources Information System
NWSP	National Water Sector Plan
PFMA	Potential Failure Mode Analysis
PIU	Project Implementing Unit
POM	Project Operational Manual
PSC	Project Steering Committee
SIAF	Integrated Financial Management System (for its acronym in Spanish - *Sistema Integrado de Administración Financiera*)
SOE	Statement of Expenditures
WB	World Bank
WRM	Water Resources Management
WRMMP	Water Resources Management Modernization Project

BASIC INFORMATION

Is this a regionally tagged project?	Country(ies)	Lending Instrument
No		Investment Project Financing

[ ] Situations of Urgent Need of Assistance or Capacity Constraints

[ ] Financial Intermediaries

[ ] Series of Projects

Approval Date	Closing Date	Environmental Assessment Category
28-Apr-2017	30-Dec-2022	B - Partial Assessment

Bank/IFC Collaboration
No

Proposed Development Objective(s)

The proposed Project Development Objective (PDO) is to strengthen the capacity of targeted water resources management related institutions to plan, monitor and manage water resources at the national level and in selected river basins in Peru.

Components

Component Name	Cost (US$, millions)
Component 1: Consolidating IWRM at the National Level	65.16
Component 2: Improving WRM in Selected Pilot River Basins	14.80
Component 3: General Project Adminstration	8.19

Organizations

Borrower :	REPUBLIC OF PERU
Implementing Agency :	National Water Authority of the Ministry of Agriculture - Autoridad Nacional del Agua (ANA)

[✓] Counterpart Funding	[✓] IBRD	[ ] IDA Credit [ ] Crisis Response Window [ ] Regional Projects Window	[ ] IDA Grant [ ] Crisis Response Window [ ] Regional Projects Window	[ ] Trust Funds	[ ] Parallel Financing

Total Project Cost:	Total Financing:	Financing Gap:
88.15	88.15	0.00
	Of Which Bank Financing (IBRD/IDA):	
	40.00	

Financing (in US$, millions)

Financing Source	Amount
Borrower	48.15
International Bank for Reconstruction and Development	40.00
Total	**88.15**

Expected Disbursements (in US$, millions)

Fiscal Year	2017	2018	2019	2020	2021	2022	2023
Annual	0.00	1.82	5.52	12.36	12.96	5.16	2.18
Cumulative	0.00	1.82	7.34	19.70	32.66	37.82	40.00

INSTITUTIONAL DATA

Practice Area (Lead)
Water

Contributing Practice Areas

Agriculture
Environment & Natural Resources

Gender Tag

Does the project plan to undertake any of the following?

a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF

Yes

b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment

Yes

c. Include Indicators in results framework to monitor outcomes from actions identified in (b)

No

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Moderate
2. Macroeconomic	Low
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Moderate
5. Institutional Capacity for Implementation and Sustainability	Substantial
6. Fiduciary	Moderate
7. Environment and Social	Substantial
8. Stakeholders	Substantial
9. Other	
10. Overall	Substantial

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✓] No

Does the project require any waivers of Bank policies?

[ ] Yes [✓] No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✓	
Natural Habitats OP/BP 4.04	✓	
Forests OP/BP 4.36	✓	
Pest Management OP 4.09		✓
Physical Cultural Resources OP/BP 4.11	✓	
Indigenous Peoples OP/BP 4.10	✓	
Involuntary Resettlement OP/BP 4.12		✓
Safety of Dams OP/BP 4.37	✓	
Projects on International Waterways OP/BP 7.50	✓	
Projects in Disputed Areas OP/BP 7.60		✓

Legal Covenants

Sections and Description

Prior to the development of any dam safety management plan for any given Selected Dam under Part 1 (c) (iv) of the Project, the Borrower shall ensure that ANA shall provide to the Bank relevant information on the dam safety status of the Selected Dam, including, but not limited to, existing operation and maintenance plans and procedures, existing findings and recommendations for any necessary remedial work, and emergency preparedness plans. If, upon the Bank's review of the aforesaid information, the Bank determines that a Selected Dam represents a high hazard case involving significant remedial work, the Borrower shall ensure that ANA shall: (a) appoint a panel of independent dam safety experts, under terms of reference satisfactory to the Bank, to review and advise on the development of the pertinent dam safety management plan for such Selected Dam; and (b) upon completion of the pertinent dam safety management plan, cause the owner of the Selected Dam to carry out said plan in accordance with its terms and in a manner acceptable to the Bank.

Conditions

Type	Description
Effectiveness	The Operational Manual has been adopted by ANA, in form and substance satisfactory to the Bank;
Effectiveness	The PIU's executive director, finance and administration specialist and procurement specialist have been hired by ANA, all in a manner acceptable to the Bank.
Disbursement	Notwithstanding the provisions of Part A of this Section, no withdrawal shall be made from the Loan Account until the Bank has received payment in full of the Front-end Fee.

PROJECT TEAM

Bank Staff

Name	Role	Specialization	Unit
Erwin De Nys	Team Leader(ADM Responsible)	Water Resources Management	LCC1C
Habab Taifour	Team Leader	Water Resources Management	GWA04
Juan Carlos Martell Rivera	Procurement Specialist(ADM Responsible)	Procurement	GGO04
Nelly Ikeda	Financial Management Specialist	Financial Management	GGO22
Beatriz Lougedo Lorente	Team Member	Operations	GWA04
Catarina Isabel Portelo	Counsel	Legal	LEGLE
Eliana Jimenez Rico	Team Member	Operations	GWA04
Fabio Pittaluga	Safeguards Specialist	Social	GSU04
Griselle Felicita Vega	Team Member	Agriculture	GFA04
Hector Alexander Serrano	Team Member	Water Resouces Management	GWA03
Mara Elena La Rosa	Team Member	Operations	LCC6C
Maria Virginia Hormazabal	Team Member	Disbursement	WFALA

Raul Tolmos	Safeguards Specialist	Environment	GEN04
Satoru Ueda	Team Member	Dam Safety	GWASO

Extended Team

Name	Title	Organization	Location

PERU
PERU INTEGRATED WATER RESOURCES MANAGEMENT IN TEN BASINS

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I. STRATEGIC CONTEXT

A. Country Context

1. **Peru, an upper-middle-income country of roughly 31 million inhabitants, has experienced robust economic growth throughout the last decade, despite the recent slowdown.** It is the fourth-largest economy in Latin America and the Caribbean (the gross national income per capita at market exchange rate reached US$6,177 in 2015). Economic growth was largely due to prudent macroeconomic policies, a favorable external environment, and strong investments. For the 2004–2015 period, the country's economy grew at 6.2 percent per year on average and exports increased by almost five times in nominal terms. In 2016, growth was estimated at slightly below 4 percent.[1]

2. **Over the last decade, Peru has experienced unprecedented progress in poverty reduction, and for the first time in several decades, inequality declined, albeit modestly.** Between 2004 and 2015, the poverty incidence rate fell from 58 percent to 22 percent with extreme poverty dropping from 16 percent to 4 percent. During the same period, a small decline in inequality was noted: the expenditure-based Gini coefficient declined from 0.49 to 0.44. Despite these results, a great deal of disparity remains across the country: 60 percent of the poor reside in rural areas and about 50 percent of those living in the highlands are poor, against 22.7 percent at the national level. Also, a large share of the population remains vulnerable to exogenous shocks, which undermine economic growth at the national level and threaten this segment of society back into poverty.

3. **Sustaining the pace of economic development and poverty reduction in times of lower external demand for commodities is expected to be a continuing challenge and is an integral part of the Government's 2016-2021 National Plan period.**[2] It is contingent on increasing productivity and export competitiveness, which are strongly linked to improved water resources management (WRM). Indeed, the Peruvian export-oriented economy is based on goods that use significant amounts of water in their production processes (irrigated agriculture, which accounts for nearly 80 percent of water consumption, mining 2 percent and manufacturing 6 percent). About 60 percent of electricity generation comes from hydropower, which still has room for further development. Furthermore, a significant share of social conflicts and environmental damages are related to competition for scarce and increasingly contaminated water resources. There is a concerted effort to adhere to Organisation for Economic Co-operation and Development (OECD) economic, environmental and social standards as Peru gears up its membership application process.

B. Sectoral and Institutional Context

4. **The situation of water resources in Peru has been heavily influenced by the ongoing development of water-intensive productive sectors, such as mining and irrigated agriculture, and the growing urban centers**. The National Water Sector Policy and Strategy and the National Water Sector Plan (NWSP) for the 2015–2035 period[3] identify five major issues and corresponding policy lines for WRM: water quantity, water quality, opportunities, water culture, and adaptation to climate change and extreme weather events.

5. **In Peru, water quantity—and particularly increasing water scarcity—is a major issue in many river basins,**

1 World Bank. 2017. Peru Systematic Country Diagnostic (SCD). World Bank Group. http://documents.worldbank.org/curated/en/919181490109288624/Peru-Systematic-Country-Diagnostic
2 Plan del Gobierno 2016-2021 PPK (*Peruanos Por el Kambio*). http://ppk.pe/documentos/plandegobierno.pdf
3 National Water Resources Plan (*Plan Nacional de Recursos Hídricos*), D.S. N 013-2015-MINAGRI.

especially those in the Pacific watershed, where most of the economic activities and exports take place and more than half of the country's population reside, but receives only 1.8 percent of the country's water resources endowment. The deterioration of water quality, due to untreated mining effluents, insufficient wastewater treatment in urban and industrial areas, unrestrained dumping of municipal and industrial waste, and uncontrolled use of agrochemicals is affecting people's health, increasing the cost of potable water supply treatment, and reducing prospects for agricultural exports.

6. **The NWSP recognizes the opportunity to build on the work led by the National Water Authority (ANA for its acronym in Spanish - *Autoridad Nacional del Agua*) in partnership with regional and local entities**. It does so by promoting more integrated water resources management (IWRM) strategies at the river basin level, formalizing water rights, and encouraging greater public and private investments in water infrastructure. It highlights the need of a new water culture involving various stakeholders in the IWRM planning process.

7. **Finally, climate change is raising the complexity of WRM, as uncertainty over hydrological parameters increases.** Figures from the Special Report on Emissions Scenarios[4] indicate that Peru will be one of the countries hardest hit by temperature rises due to climate change. These figures predict a dry season with an average temperature increase in the range of 0.7°C and 1.8°C by 2020 and between 1.0°C and 4.0°C by 2050, increasing the risk of water scarcity and quality deterioration. Furthermore, while the Peruvian piedmont and coastline are also prone to floods and mudslides due to high precipitation in degraded upper basins, the southern part of the country is affected by droughts. In general, the frequency and intensity of floods and droughts has increased in some basins due to the continuous deterioration of watersheds and climate change impacts, including glacial retreat and variability in precipitation patterns.

8. **Strong institution*s*, reliable data and information for decision making, and adequate mechanisms for the operation and maintenance (O&M) of strategic water infrastructure are pivotal, to address the above challenges.** While major progress has been made over the last years on these fronts, substantial gaps remain, many of which the proposed project aims to address.

9. **Strengthening the new institutional framework**. In 2008, the outlook for sound WRM improved substantially with the approval of a new Water Resources Law (Law No. 29338) and the creation of ANA to oversee its implementation and act as the regulator. Consistent with international best practices, it is based on the IWRM principles: (i) integration of sectoral policies, (ii) participation of stakeholders, (iii) decentralized management of water resources at the river basin level, and (iv) recognition of water as a social and economic good.

10. **As the governing body for WRM in Peru, ANA is in charge of establishing the rules and norms for WRM in accordance with the Water Resources Law and enforcing their implementation through control and sanctions.** Its main functions include: (i) planning of water resources at the basin and national levels; (ii) setting economic incentives to increase water use efficiency and decrease pollution; (iii) issuing and controlling water rights and discharge permits; (iv) collecting, analyzing, and disseminating water-related information; (v) setting-up and controlling ambient water quality standards and environmental flows in coordination with the Ministry of Environment (MINAM for its acronym in Spanish - *Ministerio de Ambiente)*; (vi) managing riverbeds; (vii) promoting stakeholders' participation in IWRM; (vii) managing water conflicts; (viii) adapting climate change in water resources; and (ix) managing water-related risks, including dam safety. ANA does not have the mandate of implementing infrastructure projects.

4 Intergovernmental Panel on Climate Change (IPPC), 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

11. **ANA is ascribed to the Ministry of Agriculture and Irrigation (MINAGRI for its acronym in Spanish - *Ministerio de Agricultura y Riego*), an arrangement, which carries the legacy of a past where water resources management was focused largely on increasing the availability of water for irrigation expansion.** ANA is comprised of a central office in Lima and 14 Administrative Water Authorities *(*AAAs for their acronym in Spanish - *Autoridades Administrativas del Agua*), each responsible for one of Peru's 14 hydrographic regions. The 14 AAAs have additional decentralized offices called Local Water Authority (ALAs for their acronym in Spanish - *Autoridad Local del Agua*), currently 72 offices responsible for a river basin or group of river basins.[5] These decentralized bodies are responsible for WRM at the local level and are supported in their functions by the newly created River Basin Councils (CC for their acronym in Spanish - *Consejos de Cuencas*). The CCs are responsible for facilitating cross-sectoral and stakeholder participation in IWRM and planning. The newly created CCs have led the multi-stakeholder process to develop and monitor the implementation of the IWRM plans.

12. **From 2010 to 2015, the new legal and institutional framework was successfully implemented at the national level, and in six pilot selected river basins (all in the Pacific watershed)[6] with support of the Water Resources Management Modernization Project (WRMMP).[7]** Through the WRMMP, and a number of reimbursable and grant-funded technical assistance activities, the World Bank supported the implementation of the 2009 Water Resources Law and the 2012 National Water Resources Policy, by pursuing IWRM through the creation and strengthening of ANA at the central and river basin levels (AAA, ALA, and CC). At the national level, the WRMMP was instrumental in defining the methodology for setting water use and pollution charges, which was approved in December 2012. The collection of these charges currently covers 77 percent of ANA's budget.

13. **Other outcomes under the WRMMP included:** (i) the establishment of the basic infrastructure and the design of the National Water Resources Information System (NWRIS) [8] and the strengthening of the National Meteorological Service (SENAMHI for its acronym in Spanish - *Servicio Nacional de Meteorología e Hidrología del Peru*) and ANA's hydrometeorological and water quality observation networks in the six pilot basins; (ii) the improvement of water rights administration framework and the formalization and registration of 75,000 water rights and discharge permits in the six pilot basins; (iii) the formulation and adoption of the National Water Quality Strategy; (iv) increased human capacity through various training initiatives, including development and deployment of a diploma program that has successfully trained over than 100 water resources professionals; and (v) the design and implementation of the Water Culture (*Cultura del Agua*) Program, which increased awareness of water quality and quantity issues among decision makers, water professionals, youth (in partnership with the Ministry of Education (MINEDU for its acronym in Spanish - *Ministerio de Educación*), and general public. At the basin level, the WRMMP was instrumental in creating the CCs in six pilot river basins formulating their corresponding participatory IWRM plans. These plans aim to achieve IWRM and guarantee water security[9] for all water users, and define the structural and nonstructural investments necessary in the short (5 years) and long-term (15 years) to achieve such water security

14. **Despite this progress, water resources management at the basin level remains in its early stages, and requires**

5 The Andes range divides Peru into three natural drainage basins or watersheds: Pacific watershed (279,000 km²), Atlantic watershed (959,000 km²), and Lake Titicaca watershed (47,000 km²). According to ANA, there are 159 river basins in Peru (62 in the Pacific watershed, 84 in the Atlantic watershed, and 13 in the Titicaca Lake watershed). These are grouped administratively in 72 ALAs that are themselves merged into 14 River Basin Authorities (AAA) corresponding to the 14 hydrographic regions. So far, CCs have been created in 6 out of 159 river basins.

6 Tumbes, Chira-Piura, Chancay-Lambayeque, Chancay-Huaral, Quilca-Chili, and Locumba-Sana-Caplina. Together these six river basins represent approximately 18 percent of Peru's gross domestic product (GDP).

7 The Water Resources Management Modernization Project was co-financed by the World Bank and the Inter-American Development Bank (IDB). World Bank ICR Report No: 00003535.

8 The NWRIS is the technological and institutional network created to give support to the decision making of the National Water Resources Management System. http://portal.snirh.gob.pe/.

9 Water security implies guaranteeing a reliable supply of water of adequate quality for human consumption, productive use, and ecosystem services. It is also intended to assist in reducing the risks associated with critical events such as droughts and floods.

continued strengthening going forward. Moreover, integrated and participatory basin-scale WRM requires the continued empowerment of ANA at the national and local levels so that it becomes a more efficient and respected water authority, including (i) vesting it with greater autonomy in relation to MINAGRI; (ii) improving water governance in priority basins to strengthen autonomy of basin organizations to adequately represent stakeholders' needs and secure financial resources to fulfill their mandates; and (iii) continuing to strengthen ANA's human, technical, and administrative resources, as well as with regard to equipment and financing.

15. **Water resources information gaps and needs**. While, good progress was likewise made in supporting the generation and use of information for IWRM. Except for the six pilot basins, water resources information remains limited. There is a pressing need to improve the quality and availability of information and develop relevant information products for decision makers, operators of hydraulic infrastructure (dams, dykes, irrigation schemes, and domestic water supply), and the general public. Hydrometeorological data are scarce; the observation network is incomplete and suboptimal for most of the country. Water data storage, backup, and processing capacity in ANA is limited. Applications to translate data into valuable information for WRM (for example, early warning systems, analysis to inform planning of investments, operation of hydraulic infrastructure, and so on) are still at an early stage. Complementary decision support systems (DSSs) need to be developed to close the data-information-knowledge chain.

16. **Similarly, groundwater information, monitoring, and management is limited, resulting in a proliferation of illegal wells and the lack of control over water abstractions.** The Regions of Tacna and Ica are emblematic of this problem. Both rely primarily on groundwater to sustain agricultural activities that contribute significantly to the country's GDP, employment, and livelihood activities. The Ica, Pampas de Villacuri and Lanchas aquifers in the Ica Valley, and the Caplina aquifer are among the most overexploited aquifers in Peru. The current rates of recharge cannot cope with the volumes of abstraction. This situation has affected groundwater quantity and quality, creating conflicts among farmers and other groundwater users; jeopardizing economic activities; and increasing overall susceptibility to land subsidence, particularly in these geologically seismic areas.

17. **Gaps in the O&M of large hydraulic infrastructure**. As in many other Latin American countries, large hydraulic infrastructure, particularly dams, are aging. In 2002, the government handed over the O&M of major hydraulic infrastructure to regional and local governments and water users associations. Uncertainty about their respective roles and responsibilities remains.[10] ANA does not have a technical office responsible for dam safety. There are no technical guidelines and procedures to evaluate dam safety risks and most of the surveying and monitoring equipment is obsolete. A number of large dams could cause severe damage in case of failure due to geological, hydrological, or seismic events. The creation of a legal and technical framework for dam safety management is crucial to address these gaps.

18. **Rationale for the World Bank's involvement**. Previous World Bank engagement through the WRMMP focused, on strengthening ANA's capacity *inter alia* establishment of the NWRIS, the formulation of a national water quality management strategy, and a program to promote a new 'water culture'. A limited number of pilot river basins in the Pacific watershed were selected to introduce and test the new institutional and legal framework. This enabled the revision of guidelines based on actual implementation and generated successful results, fostering an interest among stakeholders in other river basins to replicate the approach. The proposed Project represents a subsequent phase of this engagement, which will address key gaps remaining at the national and river basin levels. Based on a thorough assessment, there is a recognition that the creation of new institutions will be limited to critical basins that require a dedicated entity to manage and plan WRM activities at local levels. Accordingly, 24 out of a total 159 basins in Peru were prioritized as "critical basins" and would require the creation of CCs. To this end, the Project will support four out

10 Decentralization Framework Law (Law no. 27783) approved in July 2002.

of the 24 prioritized river basins: Mantaro, Alto Mayo, Urubamba-Vilcanota, and Pampas, which are all located in the Atlantic watershed and have been selected based on the following criteria: (i) local and regional governments' interest in participatory IWRM, (ii) significance of water conflicts, (iii) socioeconomic importance related to water resources, and (iv) perceived vulnerability to climate change and extreme events.

C. Higher Level Objectives to which the Project Contributes

19. **The Project contributes to the ambitious water agenda of the 2016–2021 Government Plan.**[11] The Plan highlights the need for a multisectoral approach to achieve sustainable and efficient use of natural resources and consolidate processes and tools needed for climate change mitigation and adaptation. A key guideline under this plan is the efficient and sustainable management of water resources for human consumption and productive uses.

20. **The Project is consistent with the World Bank Group Country Partnership Strategy for the Republic of Peru for the period FY12-FY16 (Report No.66187-PE)**, in particular Objectives III 'Sustainable growth and productivity' and IV 'Improved public sector performance for greater inclusion'.

21. **Consistent with this approach, the World Bank has laid out a long-term programmatic engagement for the water sector in Peru**. This includes technical assistance, advisory services, and investments in WRM that underpins development across various productive sectors, the expansion of access, and quality of water supply and sanitation services, as well as interventions in irrigation.

22. **The Project will likewise support the World Bank's twin goals (end extreme poverty and boost shared prosperity) by improving participatory IWRM in 10 priority river basins that are characterized by deficits in water and sanitation service, water pollution, and vulnerability to climate change and extreme weather events**. The implementation of the IWRM plans is expected to yield significant benefits, such as, improved water quality resulting in a reduction of waterborne illnesses and a fairer and more inclusive process of water allocation, thus decreasing water-related conflicts and promoting prospects for agricultural productivity and food security, and reduced ecosystem degradation. Finally, the strengthened NWRIS will provide free access to water-related information, benefitting all segments of society, including those with lower economic means. The improved information system is expected to help the Government of Peru (GoP) better mitigate the risks associated with extreme events, which often disproportionately affects the poor and vulnerable groups.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

23. The proposed Project Development Objective (PDO) is to strengthen the capacity of targeted water resources management related institutions to plan, monitor and manage water resources at the national level and in selected river basins in Peru.

B. Project Beneficiaries

24. **The first group of beneficiaries consists of the public institutions in charge of WRM at the central level and in**

11 Pedro Pablo Kuczynski (PPK). Plan del Gobierno 2016–2021.

selected river basins. These are ANA at the central level; its decentralized offices, including the AAAs and the ALAs; the 10 CCs; as well as the regional governments and municipalities, particularly, those involved in the 10 selected river basins.

25. **The second group of beneficiaries includes a wider range of stakeholders.** It includes but is not limited to: (i) water users in the 10 selected river basins who would benefit from WRM improvements such as, formalized water rights, enhanced monitoring of water abstraction for irrigation, better forecasting and early warning, conflict resolution mechanisms, water quality monitoring, and so on; (ii) owners and operators of dams, particularly, the ones selected for improved dam safety measures; and (iii) NWRIS users such as, decision makers, public institutions, private sector, academia, nongovernmental organizations, and civil society at large.

C. PDO-Level Results Indicators

26. The PDO will be measured against the following indicators:

(a) National Water Resources Information System providing validated online data, analysis and information products to decision makers, water professionals, and general public.
(b) Dam safety unit established and operational.
(c) Groundwater committees established for targeted aquifers with participatory management plans approved and under implementation.
(d) Basin councils/committees[12] with integrated, participatory basin management plans approved and under implementation.

III. PROJECT DESCRIPTION

A. Project Components

27. **The Project consists of three components: Component 1 on consolidating IWRM at the National Level; Component 2 on improving WRM in Selected Pilot River Basins; and Component 3 on General Project Administration.** (For a detailed description of Project financed activities and details on sectoral context underpinning underlying the selection of priority activities under each component refer to Annexes 1 and 4, respectively).

28. **A Climate and Disaster Risk Screening was undertaken for the Project**. The screening identified droughts and extreme precipitation as the main natural hazards in the planned Project intervention areas. The Project is mitigating these risks by supporting: (i) the expansion and modernization of the hydrometeorological network; (ii) the development of flood and drought forecasting tools; (iii) the implementation of dam safety procedures; (iv) installation of equipment for monitoring and preventing impacts of extreme weather events on dam management, water quality, and water abstraction; and (v) enhancing the capacity to elaborate climate-responsive IWRM plans, including identifying structural and nonstructural measures for adaptation to climate change. On the basis of an assessment carried out by the World Bank, it is estimated that US$40 million can be attributed as climate change co-benefits.

12 For selected basins that are considered primary sub-basins of the Amazon River Basin, creation of legally recognized basin councils is not feasible. In such instances, a Basin Committee will be created to help with the IWRM at local levels.

Component 1: Consolidating IWRM at the National Level (Estimated cost: US$65.16 million, of which US$35.86 million IBRD financing)

29. This Component aims to improving the capacity of ANA and other water institutions to plan, monitor, and manage water resources at the national level by: (i) enhancing and expanding monitoring systems to improve water resources' data on the quantity (meteorology, streamflow, and groundwater), quality, and use in irrigated agriculture; (ii) developing robust mechanisms for dam safety; and (iii) strengthening institutions and tools for IWRM. Detailed activities under this Component are outlined in Annex 1.

Sub-component 1a: Enhancing Data Generation for IWRM (Estimated cost: US$40.57 million)

30. This sub-component will finance the acquisition and installation of equipment for: (i) the expansion of a digitized, real-time, national hydrometeorological network; (ii) monitoring of water quality; (iii) water use, namely surface water abstraction for irrigated agriculture; (iv) monitoring of groundwater for selected critical aquifers;[13] and (v) the modernization of monitoring equipment for dam safety in selected dams.[14]

Sub-component 1b: Improvement of Water Resources Planning and Decision Making (Estimated cost: US$24.59 million)

31. This sub-component will finance the following: (i) strengthening of NWRIS' capacity to store and process data collected from various monitoring networks; (ii) development of WRM decision-making modelling tools (e.g., groundwater modeling, water quality modeling, flood and drought forecasting) and their integration into the NWRIS for use at the national and basin levels; (iii) establishment and strengthening institutions responsible for groundwater evaluation and management; (iv) design and implementation of a Surface Water Abstraction Monitoring Program for the irrigated agricultural sector, which will formalize water rights and facilitate monitoring and enforcement of efficient water use; (v) design and implementation a Water Quality Program at the national level, based on the National Water Quality Strategy developed under the WRMMP; (vi) improvement of water conflict resolution mechanism; and (vii) strengthening economic incentives for increased water use efficiency and reduced pollution, which will increase revenues that finance WRM activities.

32. As part of the overall efforts to strengthen ANA's water resources planning and management, this sub-component will also improve information accessibility to end users and simplify ANA's administrative procedures related to aspects such as dissemination of information, water use rights, and water quality.

33. This sub-component will also design and implement a technical assistance Dam Safety Program, including the following activities: (i) support the adoption of a regulatory framework for dam safety management; (ii) develop technical guidelines and capacity building for dam monitoring; (iii) carrying out of a dam safety risk assessment and formulation of guidelines for the elaboration of dam safety plans and emergency plans; (iv) development and partial implementation dam safety management plans for six major dams and two small dams in the Pacific watershed; and (v) create a dam safety information module within the NWRIS.

Component 2: Improving WRM in Selected Pilot River Basins (Estimated cost: US$14.80 million, of which US$2.62 million IBRD financing)

34. This Component aims to improve IWRM at the basin level taking into consideration basin needs, future

13 Ica Valley Villacurí and Lanchas aquifers in the Ica region and La Yarada in the Tacna Region. See Annex 1 for more details.
14 Six large dams and two small dams. See annex 1 for more details.

developments, as well as climate change implications, in both the Pacific and Atlantic watersheds.

Sub-component 2a: Strengthening IWRM in Pilot Prioritized River Basins in the Pacific Watershed (Estimated cost: US$4.63 million)

35. The aim of this sub-component is to strengthen the capacity of the existing CCs in six river basins (Chancay-Lambayeque, Chancay-Huaral, Quilca-Chili, Tumbes, Chira-Piura, and Locumba-Sama-Caplina) through the following activities: (i) strengthening of the technical capacities of Decision Support Nodes (Water Resources Monitoring Centers Level 1) to develop and implement forecasting, early warning, and water rights analyses; (ii) capacity building and training, including the updating and monitoring of the existing IWRM plans, ensuring balanced representation of basin stakeholders in the CCs, and improving communication mechanisms; and (iii) define financing mechanisms and legally binding arrangements to finance the IWRM plans.

Sub-component 2b: Development of IWRM in Pilot River Basins in the Atlantic Watershed (Estimated cost: US$10.17 million)

36. This sub-component is geared to improving IWRM in the four newly prioritized river basins in the Atlantic watershed (Alto Mayo, Mantaro, Urubamba-Vilcanota, and Pampas) through activities tailored to the specifics of each basin. These include: (i) establish new CCs; (ii) create water resources monitoring centers – Level 1 in each basin to be connected to the NWRIS at the central level; (iii) develop participatory IWRM plans; and (iv) implement the *Cultura del Agua* Program to promote a 'water culture' among policy makers, water professionals, youth, and public.

Component 3: General Project Administration (Estimated cost: US$8.19 million, of which US$1.52 million IBRD financing)

37. This Component will support the management and monitoring of activities associated with Project implementation through a national Project Implementation Unit (PIU), including technical assistance and administrative support on monitoring and evaluation (M&E) (baseline surveys, midterm reporting, annual audits, final project evaluation), procurement, financial management (FM), safeguards, training, and communication.

B. Project Cost and Financing

38. **The lending instrument will be Investment Project Financing. Table 1 shows Project costs and financing by component.** The total Project cost is US$88.15 million. The cost distribution between the GoP (transfers from Central Government), the implementing agency (ANA), and the World Bank is outlined in Table 1.

Table 1. Project Costs and Financing by Component (US$, in millions)

Project Components	Project cost	IBRD Financing	Central GoP	ANA (implementing agency)	IBRD Financing (%)
Component 1: Consolidating IWRM at the National Level	65.16	35.86	9.85	19.45	55.03%
Component 2: Improving WRM in Selected Pilot River Basins	14.80	2.62	6.01	6.17	17.7%
Component 3: General Project Administration	8.19	1.52	5.52	1.14	18.55%
Total Costs	88.15	40.00	21.39	26.76	45.38%
Front End Fees	0.10				
Total Financing Required	**88.25**				

C. Lessons Learned and Reflected in the Project Design

39. **Experience from the WRMMP has demonstrated that the introduction of WRM through a basin approach and institutional strengthening at various levels is complex and requires time and investments in information, analytical tools, development of skills, and institutional capacity**. It also highlighted the following lessons learned:

(a) **Implementation of the CCs requires time, budget, and technical expertise from ANA**. Therefore, the replication of the CC in other river basins should only be carried out where issues related to WRM are significant. A proliferation of CC overburden of ANA. The proposed Project, therefore, aims to strengthen the existing CCs and intervene in prioritized basins based on selection criteria that factor: (i) local and regional governments' interest in participatory IWRM, (ii) the overall significance of water conflicts, (iii) socioeconomic importance of water resources, and (iv) perceived vulnerability to climate change and extreme events.

(b) **Care should be taken in the identification of the stakeholders groups and the election of the representatives of each group to foster a balanced representation of stakeholders' views and interests in the CCs.** After a review of representation, there is an ongoing dialogue to reform the composition and representation of the CCs to ensure adequate engagement of pertinent stakeholders based on basin needs.

(c) **Climate change should be accounted for in the IWRM plans to inform investment prioritization, given its importance in future strategies and decisions related to public and private investments.** On the other hand, the plans must become comprehensive investment programs to inform the allocation of resources to key areas like river basin conservation, pre-investment, and capacity building for management and to develop an adequate system for the M&E of the results and impacts linked to their implementation. Enhancement to the existing IWRM plans and development of new plans will take into account climate change.

(d) While on average 30 percent of the investments proposed in the plans in the pilot basin plans have already been financed, the definition of sustainable funding mechanisms should be a priority to maintain current CC engagement and political interest in the WRM plans. Planned activities under the proposed Project include activities to strengthen basin entities and define mechanisms for financing activities prioritized

within the basin plans.

40. The proposed Project also draws on international and regional experience. The main lessons of which are:

(a) **WRM requires an integrated, participatory approach with long-term planning to foster the development of institutions and implementation of reforms.** Creating institutions with the knowledge and convening power over multiple uses and sectors requires time and trust to build confidence in information produced and ensure stakeholder participation in the WRM processes. A phased approach building on the lessons learned from the WRMMP have been reflected in the Project design to continue supporting the CCs in the Pacific watershed and adjust institutional arrangements in the creation of new CCs in the Atlantic watershed.

(b) **Limited capacity and reliable data**. The Project will invest substantially in building human capacity for WRM, modernizing monitoring networks, data storage systems to support dissemination of information, and informed decision making. Where data are scarce or hard to collect, earth observation information and products will be used to complement physical monitoring networks.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

41. **Project implementation responsibilities.** The Project will follow the same institutional and implementation arrangements established for the WRMMP. ANA will be responsible for overall Project implementation. The fiduciary aspects of the Project have been centralized in ANA headquarters. ANA has signed an agreement with SENAMHI for the coordination and implementation of activities related to the expansion of the hydrometeorological network.

42. **PIU.** The unit that managed WRMMP within ANA[15] will serve as the PIU and will be responsible for Project implementation. It will be granted administrative, financial, and budgetary autonomy. The PIU will interface with the responsible units and directorates within ANA to ensure that the capacity, tools, and approaches developed are institutionalized within ANA and its decentralized entities.

43. **Participation and coordination mechanisms.** Participatory, integrated WRM involves many stakeholders. Thus, the Project will rely on a number of existing mechanisms to ensure their adequate participation:

(a) A multi-sectoral Project Steering Committee (PSC), which provides high-level guidance, oversight, and control to the Project. It is chaired by the Minister of Agriculture and Irrigation, and is composed of the Head of ANA; one representative from the Ministry of Economy and Finance (MEF for its acronym in Spanish - *Ministerio de Economía y Finanzas*); one representative from agrarian water users, and one representative from non-agrarian water users.

(b) The CCs established in the existing six basins in the Pacific watershed will participate in updating the basin IWRM plans and in water quality and discharge monitoring and control in their jurisdiction. For the three new CCs and one basin committee (Alto Mayo) to be established in the Atlantic watershed, they will be

15 Also called PIU No 2 of ANA.

responsible for the formulation and validation of the basin-wide IWRM plans.

44. **Project implementation will require close coordination with the MINEDU and the regional governments of the four pilot basins in the Atlantic watershed**. Regional governments will participate, as will members of the CC, in the formulation and implementation of the basin-scale WRM plans. ANA will provide technical inputs to the design and implementation of the Water Culture Program, and more specifically to the activities targeting primary and secondary schools' programs (Sub-component 2b) that will be implemented with the MINEDU.

B. Results Monitoring and Evaluation

45. **ANA will have overall responsibility for Project M&E. WRMMP's M&E arrangements will be enhanced by incorporating the lessons learned on this topic.** The NWRIS will be used as the primary portal to document M&E activities. Particular attention will be given to the M&E plans for the individual sub-components and activities and how they are fed into the overall M&E plan of the Project. ANA will submit semi-annual progress reports to the World Bank covering the status of implementation in terms of outputs, outcomes, financial statements, procurement plans, environmental and social safeguards instruments, and actions taken to ensure satisfactory Project implementation. Baseline studies including a gender gap analysis, a Mid-term Review, and a final evaluation will be conducted. More details on the M&E arrangements are provided in Annex 3 and in the Project Operational Manual (POM).

C. Sustainability

46. **There is a high level of commitment of Government to the Project and various entities at the regional and river basin levels.** The GoP's five-year plan clearly articulates the need for enhancing management of water resources that underpin development. ANA has increased its revenues from water use and pollution discharge fees (*retribución económica* in Spanish) steadily, a pattern that is expected to be carried on with the continued formalization of water rights and discharge permits. These fees represent 77 percent of ANA's budget (as of December 2015) and are key to the sustainability of Project outcomes. ANA is expected to continue integrating PIU staff and Project activities into ANA's budget and work program and its associated performance monitoring indicators, as carried out under the WRMMP. At the basin level, ANA has assumed financial and technical support of the CCs created. A decision has also been taken to establish the CCs in 24 of the 159 basins, where issues related to WRM are significant. A proliferation of the CC could result in an overburdening of ANA. Since January 2016, ANA is fully financing the existing CCs with its own resources, and has incorporated them in its budget.

47. **Particular attention will be paid to the sustainability of the investments in the hydrometeorological equipment and services, as well as the groundwater, water quality, surface water abstraction measurement, and dam safety equipment.** The Framework Agreement between ANA and SENAMHI that was signed under the WRMMP (March 2011), specifies the responsibilities of the respective institutions on the O&M of Peru's national hydrometeorological network and data sharing arrangements. The Framework Agreement has been renewed as part of the Project and will extend beyond Project closure. Similarly, agreements will be signed between ANA and the relevant regional governments and/or local users for the O&M of the dam safety and groundwater monitoring equipment, respectively. In general, protection against vandalism, illegal use, or negligence of monitoring equipment to be provided by the Project will be given the needed importance.

48. **The high degree of community participation in the Project activities, particularly, in the 10 selected river basins under Component 2, as well as the Water Culture Program, are expected to generate and strengthen high**

level of consciousness about the value of water and IWRM, which are key factors for the social sustainability of the Project investments. The Framework Agreement between ANA and the MINEDU that was signed under the WRMMP, to institutionalize the water culture in the curricula of primary and secondary schools, was renewed as part of the project and will extend beyond Project closure.

D. Role of Partners

49. **The GoP has engaged with several development partners to contribute to IWRM throughout the country**. The Development Bank of Latin America (CAF for its acronym in Spanish - *Corporación Andina de Fomento*) is preparing a US$30 million loan to support Peru in its endeavor to achieve a more efficient IWRM system. It will use a similar approach as the proposed Project in improving IWRM at the national level and in nine targeted river basins.[16] Parallel engagements in WRM are further detailed in Annex 1.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

50. **The overall Project risk is deemed Substantial.** In general, the Project has built upon the risks identified and mitigated throughout the WRMMP. The main risks that may affect the achievement of the Project's objectives include the following:

(a) High-level changes within the GoP and ANA could affect ownership of the Project, and consequently PIU staffing, implementation, institutional capacity building, and sustainability efforts. This risk is substantial, but its potential impacts on the Project outcomes is considered moderate given the WRMMP's success, where a dedicated PIU successfully managed to implement the overall project. Moreover, most activities planned under this Project are aligned with ANA's work plan. This will ensure continuity and ownership. To avoid the substantial risk of assignation of ANA's counterpart funds, explicit obligations have been articulated in the project loan document.

(b) The social and stakeholder risks are estimated as Substantial, considering the potential resistance of water users to the monitoring and control of water abstractions (surface and groundwater) and discharges, which could affect the successful implementation of related interventions in the target basins. To mitigate this risk, the Project will convey the needs for participatory monitoring and planning, through extensive consultations and communication, building on the successful experience acquired under the WRMMP.

VI. APPRAISAL SUMMARY

A. Economic and Financial (if applicable) Analysis

51. **Improving WRM includes a range of co-benefits in several sectors and for the general public, making the economic analysis of potential impacts a complex task.** The analysis for this Project established conservative

16 The nine river basins targeted by the CAF-financed project are six in the Pacific watershed (Jequetepeque, Chillón, Rimac, Lurín, Chilca, and Camaná-Majes-Colca) and three in the Atlantic watershed (Chamaya, Chinchipe, and Alto Apurimac).

assumptions based on quantitative information that only took into consideration impacts attributable to this Project. This analysis is based on the main objectives of the Project: (a) improvement in IWRM, and (b) improvement in the NWRIS. In the methodological framework it is important to point out that the economic impacts are responding to changes in decision-making processes improved by a better information system, empowered institutions, or more efficient management mechanisms. The Project will be implemented by the IWRM-related institutions, but the consequences of that will highly depend on the use that the stakeholders—general public, firms, other institutions from other sectors, and so on—will make of these improved processes. This is why the economic value of the Project lies in its ability to involve users in implementation, and therefore some of the mechanisms proposed for evaluation are based on surveys to stakeholders.

52. **To keep conservative assumptions, the evolution of the effectiveness rate of the Project for this analysis ranges from 0 to 50 percent of the foreseen outcomes during the implementation period.** The benefits have been computed on the basis of a long term (15 years) timeframe. This is due to the type of investment, oriented to produce durable effects in the economy of the country. Averted losses reduction factor of 20 percent has been considered to establish a conservative assumption profile and computed only half of the averted losses as attributed to the Project. To avoid potential double account for the indirect effects of productivity in the whole economy, only 60 percent of the expected contribution to GDP changes has been accounted for. Additionally, a sensitivity analysis was considered for three different scenarios and for different discount rates: (a) Scenario 1 (estimated) considers the estimated benefits and accounted costs for the Project; (b) Scenario 2 (lower bond) considers a sensitivity analysis of a 20 percent increased of accounted costs and a 20 percent reduction of estimated benefits; and (c) Scenario 3 (upper bond) considers a sensitivity analysis of a 20 percent reduction of accounted costs and a 20 percent increased of estimated benefits.

53. **Table 2 shows the potential benefits attributed to the Project.** The analysis shows high returns even under conservative assumptions. Details of the socio-economic impacts identified as a response to these two main objectives and the main components of the Project are outlined in Annex 5, along with the proposed methodologies for the analysis.

Table 2. Potential Benefits Attributed to the Project on a Yearly Basis (in US$ millions)

Drivers	Type of Impact	Benefits Attributed to the Project (yearly)
Improved drought management	Direct economic losses avoided	114.30
Increased water productivity	Impacts on GDP	129.34
Reduced costs of water treatment	Treatment cost reduction	1.47
Empowered institutions	Water conflicts losses avoided + avoided deaths	102.81
Improved dam safety	Averted losses from collapse	11.53
Improved NWRIS (institutional cooperation)	Disaster Risk Management (DRM) economic losses avoided	85.19
Improved general public information (NWRIS)	Willingness to pay (WTP) from households	4.10

54. **The benefit-cost ratio has been computed for the three scenarios described.** The net present value (NPV) was calculated for discount rates from 6 to 12 percent. The analysis indicated that, in all cases, benefits that exceed costs, given that the benefit-cost ratio is greater than 1. A sensitivity analysis was conducted to analyze the robustness of the results to variations in benefits and costs. The analysis concluded that even with a 20 percent increase in cost or 20 percent reduction in benefits, the expected benefits of this Project are robust to varying levels of uncertainty analyzed.

B. Technical

55. **The Project relies on approaches, methodologies, and designs that are in line with international best practices, appropriate for the Peruvian context, and technically sensible to strengthen the country's capacity to plan, monitor, and manage water resources at the national level and in selected river basins.** All Project activities fall within the scope of the NWSP 2015–2035. The Project approach builds on the one adopted for the WRMMP, enhancing and expanding the NWRIS, and adjusting the approach for strengthening river basin management capacity (Component 2) to the context of the new pilot basins in the Atlantic watershed. A thorough assessment was carried out for the new strategic activities included, particularly, the management of groundwater in critical overexploited aquifers and the introduction of a technical assistance Dam Safety Management Program. This was completed through a close collaboration between ANA and high-level local and international experts. See Annex 4 for more details.

C. Financial Management

56. **The PIU's Administrative Office (AO) and the Planning, Budget, and Monitoring Unit will manage the fiduciary aspects, whose functions and responsibilities will be outlined in detail in the POM.** The PIU will be the only responsible entity to manage the Project funds. Implementation will comply with Peru's laws governing budget and FM, including the use of the Integrated Financial Management System (SIAF for its acronym in Spanish - *Sistema Integrado de Administración Financiera*) and the General Chart of Accounts established therein. The General Comptroller Office will select the audit firm to audit the Project. The World Bank funds will be disbursed to a Designated Bank Account opened at *Banco de la Nación*.

57. **The relevant challenges faced by the Project include:** (i) timely appointment of a financial management specialists with the capacity to rapidly get acquainted with procurement and FM guidelines to avoid situations of misprocurement or ineligible expenditures; (ii) timely appointment of the audit firm to submit to the Bank the audit report of the project on; (iii) timely delivery of unaudited financial information reports to the Bank; and (iv) complete the final version of the Operational Manual including the FM chapter.

58. **In order to reduce the fiduciary risk, the Project recommend the implementation of the following mitigating measures:** (i) approval of the final version of the Operational Manual by effectiveness; (ii) recruitment of financial management and administrative specialist by effectiveness; (iii) recruitment of other FM key staff (mentioned in Annex 2) no later than 30 days after effective date; (iv) training to the new staff on Bank FM policies; (v) prepare the audit terms of reference with Bank's approval upon Loan Agreement signature; and (vi) initiate the selection of the audit firm, through the General Comptroller Office, no later than 3 months of the signature of the Loan Agreement. Once the mitigating measures have been put in place, then the proposed Financial Management arrangements will meet the Bank's minimum fiduciary requirements.

D. Procurement

59. **An assessment of ANA's capacity to implement procurement activities for the Project was carried out**. The Project will follow the same institutional and implementation arrangements established for the WRMMP. Currently, the PIU is adequately staffed and will maintain its capacity to conduct procurement under this operation.

60. **The capacity assessment looked into the PIU's**: (i) organizational structure, (ii) facilities and support capacity, (ii) qualifications and experience of the staff who will work in procurement, (iv) record-keeping and filing systems, (v)

procurement planning and monitoring/control systems used, and (vi) capacity to meet the World Bank's procurement contract reporting requirements. It also reviewed the procurement arrangements proposed in the Procurement Plan.

61. **Procurement for the Project will be carried out in accordance with the World Bank's 'Guidelines:** Procurement of Goods, Works, and Non-Consulting Services under IBRD Loans and IDA Credits and Grants by World Bank Borrowers', dated January 2011 and revised July 2014; 'Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits and Grants by World Bank Borrowers', dated January 2011 and revised July 2014; and the provisions stipulated in the Loan Agreement. Implementation of procurement activities will be outlined in the POM. For each contract to be financed by the loan, the different procurement methods or consultant selection methods, the need for pre-qualification, estimated costs, prior review requirements, and time frame are agreed between the Borrower and the World Bank in the Procurement Plan.

62. **A procurement capacity assessment was carried out for the PIU.** The Borrower has prepared a comprehensive Procurement Plan that includes all contracts for which bid invitations and invitations for proposals are to be issued in the first 18 months of Project implementation. The Procurement Plan will be available at the World Bank's Systematic Tracking of Exchanges in Procurement (STEP). Goods and works shall be procured under contracts awarded on the basis of International Competitive Bidding (ICB), National Competitive Bidding (NCB), Shopping or Direct Contracting. Consultants' services shall be procured under contracts awarded on the basis of Quality-and-Cost-Based Selection, Quality-Based Selection, Selection under a Fixed Budget, Least-Cost Selection, Selection Based on the Consultants' Qualifications, Single-Source Selection, and Procedures set forth in Section V of the Consultant Guidelines for the Selection of Individual Consultants, including Sole Source Selection for Individual Consultants.

E. Social (including Safeguards)

63. **The Project has triggered OP/BP 4.10 on Indigenous Peoples due to the presence of indigenous peoples under Sub-component 2b that will support, at the river basin level, the preparation of participatory IWRM plans, as well as the creation of CCs.** Some of the target river basins include the presence of indigenous peoples both in the highlands, as well as in the Upper Amazon. ANA has prepared an Indigenous Peoples Planning Framework (IPPF) and with support from the World Bank have identified the presence of indigenous peoples in the following basins: (a) Urubamba River Basin: in the upper areas 370 Quechua peasant communities, in the middle area and lower areas 68 Machiguenga, 4 Ashaninka, and some Piro native communities; (b) Alto Mayo River Basin: 15 Awajun native communities; (c) Mantaro River Basin: 318 peasant communities; and (d) Pampas River Basin: 188 peasant communities. The IPPF was consulted on December 20, 2016 and disclosed on the World Bank's external website[17] and in-country[18] on February 21, 2017. These are preliminary figures obtained from official registers. During Project preparation it is not possible to determine the actual number of communities that will be participating and benefiting from Project activities. During implementation and as the Project advances, more precise information on the participating indigenous communities will be made available.

64. **During implementation, social assessments will be carried out and tools will be developed to ensure adequate representation and participation of indigenous communities in Project activities.** The assessments will also ensure that specific issues and knowledge of indigenous people, including indigenous forest dependent communities, are adequately identified, assessed, and taken into consideration, particularly, in the preparation of the IWRM plans. The IPPF will guide the work of ANA's social specialists in the preparation of the IPPF, as well as in the implementation of

17 World Bank IPPF disclosure: February 21, 2017 (http://documents.worldbank.org/curated/en/832941487835299356/pdf/SFG3074-IPP-SPANISH-P151851-Box402890B-PUBLIC-Disclosed-2-21-2017.pdf)
18 Borrower IPPF disclosure: February 21, 2017 (http://www.ana.gob.pe/sites/default/files/girh/marco_de_planificacion_para_pueblos_indigenas_final.pdf)

the participatory strategies. The former WRMMP implemented by ANA was highly participatory and this positive legacy will be built upon for the proposed Project.

65. **OP/BP 4.12 on Involuntary Resettlement is not triggered because no involuntary use of land will be required for Project activities.** The installation of hydrometeorological and other monitoring stations will be on public land, and due to the small size of land required, places can be found where no people or assets are affected. In the case of technical assistance activities, the terms of references, as well as the outputs for designing the framework and guidelines for potential activities that may be identified as part of the IWRM plans will reflect and be consistent with OP 4.12 principles. These will be subject to the guidelines contained in the document titled Interim Guidelines on the Application of Safeguard Policies to Technical Assistance (TA) Activities in Bank-Financed Projects and Trust Funds Administered by the Bank.

66. **Gender.** The Project leverages the World Bank's global[19] and Peru-specific experience[20] to promote gender equality from design to implementation, and monitoring and evaluation. The POM includes an 'Intercultural Protocol on Information and Gender Perspective' that foresees several gender-sensitive approaches to design, carry out and monitor and evaluate the participatory IWRM planning exercise, such as the participation of women's associations, gender-specific meetings, and workshops, among others. Considerations of gender in composition and decision-making positions of the CC is a key element that the Project aims to promote.

F. Environment (including Safeguards)

67. **As in the case of the successful WRMMP, improving environmental conditions through improved WRM is an integral part of Project design.** The Project is expected to have positive environmental impacts by contributing to: (i) more efficient use of water resources and reducing surface and groundwater overexploitation; and (ii) improved water quality, thereby reducing negative impacts on people's health and on the environment. The very small scale physical investments related to the installment of equipment (that is, for the monitoring of water quantity and quality) that the Project may support in the selected river basins may have small, localized, and temporary environmental adverse impacts.

68. **During Project preparation, environmental and social screening was conducted according to OP/BP 4.01 on Environmental Assessment.** The Project is classified as Category B and the following environmental safeguard policies apply: OP/BP 4.01 on Environmental Assessment, OP/BP 4.36 on Forests, OP/BP 4.04 on Natural Habitats, and OP/BP 4.11 on Physical Cultural Resources.

69. **OP/BP 4.01 on Environmental Assessment.** Given the specific location and potential of the Project, very small works that will be needed to install hydrometeorological equipment will only be known during Project implementation, as specific factors such as, environmental impacts, location, and magnitude cannot be ascertained at present. Therefore, ANA prepared an Environmental and Social Management Framework (ESMF) to ensure that the very small civil works are subjected to an adequate environmental assessment process, so that they do not create any serious adverse impacts on the local environment, and that appropriate mitigation measures are included. The ESMF was consulted on December 2, 2016 and disclosed on the World Bank's external website[21] and in-country[22] on February 21,

19 http://globalpractices.worldbank.org/waterpractice/Knowledge%20Base/Forms/DispPage.aspx?ID=419&Title=Toolkit for Mainstreaming Gender in Water Operations&Author= Toyoko Kodama &Unit=Water GP&Topics=Gender, Water
20 http://documents.worldbank.org/curated/en/722401468088459634/Empowering-women-in-irrigation-management-the-Sierra-in-Peru
21 WB IPPF disclosure: February 21, 2017: http://documents.worldbank.org/curated/en/983721487829493168/pdf/SFG3073-EA-SPANISH-P151851-Box402890B-PUBLIC-Disclosed-2-21-2017.pdf
22 Borrower's ESMF disclosure: February 21, 2017: (http://www.ana.gob.pe/sites/default/files/girh/marco_de_gestion_social_y_ambiental_final.pdf)

2017. The ESMF also includes principles, regulations, institutional arrangements, screening procedures, and mitigation measures to be followed to prevent any adverse impact on forests, natural habitats, and physical cultural resources.

70. **In addition, while implementation of the participatory IWRM plans for the selected basins will not be financed by the World Bank, some of the activities identified in the plans could have potential adverse environmental impacts once implemented.** To ensure conformity with the World Bank and Government environmental polices beyond the life of the Project, terms of reference for the formulation of the plans, and the plan formulation process, will include a comprehensive assessment of key relevant environmental and social impacts and risks and corresponding mitigation measures and be subject to prior review by the World Bank. In particular, technical assistance activities, such as plan formulation and hydrological assessments, will be subject to the guidelines contained in the document entitled Interim Guidelines on the Application of Safeguard Policies to Technical Assistance (TA) Activities in Bank-Financed Projects and Trust Funds Administered by the Bank.

G. Other Safeguard Policies

71. **OP/BP 4.37 on Safety of Dams is triggered due to non-structural, technical assistance interventions to be supported by the Project.** This includes the development of dam safety regulatory framework, development of technical guidelines for dam monitoring, risk assessment, formulation of guidelines for the elaboration of dam safety plans and emergency plans, and creation of dam safety information platforms. Formulation of dam safety management plans of six major dams in the Pacific watershed and two small dams need to be prepared in accordance with the World Bank's guidelines OP/BP 4.37.

72. **OP/BP 7.50 on Projects on International Waterways is triggered**. The Project includes activities in La Yarada (Caplina) aquifer, which is a transboundary aquifer with Chile, as well as the basins of Alto Mayo, Mantaro, Urubamba-Vilcanota, and Pampas, which belong to the Amazon hydrographic basin. The Project meets the criteria defined in paragraph 7(b) of OP 7.50 that no riparian notification is required.

H. World Bank Grievance Redress

73. **Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS).** The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit *http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service*. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

VII. RESULTS FRAMEWORK AND MONITORING

Results Framework
COUNTRY: Peru
Peru Integrated Water Resources Management in Ten Basins

Project Development Objectives

The proposed Project Development Objective (PDO) is to strengthen the capacity of targeted water resources management related institutions to plan, monitor and manage water resources at the national level and in selected river basins in Peru.

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: National Water Resources Information System providing validated online data and information products to decision makers, water resources professionals and general public		Text	NWRIS databases established.	NWRIS fully integrated with monitoring systems, DSS tools and providing data and information products.	Bi-annual	NWRIS	ANA, AAA, ALA and CCs (technical secretariats)
Description: NWRIS will be centralized at national levels with decentralized nodes in 14 hydrographic offices of AAA and in 10 ALA at basin levels. Validated online will be measured through the increase in data sources (new monitoring stations and digitization of historical records).							

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Dam safety unit established and operational		Text	-	Dam safety program in place with unit operational, legal framework established, guidelines and tools developed. Implementation of monitoring systems in place for selected dams	Bi-annual	Dedicated dam safety unit	ANA
Description: This will be measured through, provision of technical assistance to dedicated organizations established: 1 dam safety unit at ANA central level adequately staffed and equipped to perform its functions as per its mandate, which includes setting up guidelines, norms and instrumentation for dam safety as well as leading capacity building for dam operators.							
Name: Groundwater committees established for targeted aquifers with participatory management plans approved under implementation.		Text	-	Participatory groundwater management committees			

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
				operational with management plans under implementation			
Description: Measures the number of integrated groundwater management plans developed based on monitoring systems installed, analytical analysis (modeling of aquifer dynamics) and participatory campaigns to ensure stakeholder engagement. This indicator seeks to ensure that developed plans are approved by committees, stakeholders and regional governments providing legal backing for ANA and groundwater management committees.							
Name: Basin councils /committees with approved IWRM plans and under implementation		Text	6	10	Bi-annual	Integrated Basin Plans and progress reports from CCs	ANA, AAA, ALA, CCs/committee
Description: 6 basins in the Pacific Watershed will be strengthened to update existing integrated basin plans (using analytical tools of NWRIS) and to promote financing of approved plans. 3 new basin councils and 1 committee (Alto Mayo) will be created in Atlantic Watershed with representation of various stakeholders across the basins. The newly created CCs will prepare participatory, integrated basin plans using analytical tools developed by NWRIS and heavily consulted. The plans will be approved, which implies a government decree formalizing and certifying the plans. On average the project seeks to implement and or find financing commitments for 50% of activities outlined in the plans.							

Intermediate Results Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Monitoring systems with O&M arrangements in place		Text	-	2825	Bi-annual	NWRIS	ANA
Description: This includes all monitoring systems: hydro-meteorology (rainfall, streamflow, water body levels); groundwater (abstraction, water table levels); water quality (various physical and chemical parameters including sediment transport); irrigated agriculture surface water abstraction and dam safety monitoring equipment.							
Name: Percentage increase on the number of annual hits for NWRIS web portal		Text	0	40% increase in hits to NWRIS web site and web portal demonstrating increased use of databases and, analysis information products	Bi annual	NWRIS	ANA
Description: This indicator will measure the usage of NWRIS data and analysis through the i) percentage increase of hits to NWRIS through web portal; ii) number of information products produced from data (publications, applications, communication material, etc.).							
Name: Number of dams with dam safety assessments completed and monitoring instruments installed		Text	0	8	Bi annual	Dam operators, site visits, Dam Safety Unit	Dam operators, ANA

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Description: Measures the establishment of an integrated program that includes establishment of a dam safety unit, adoption of legal framework, development of tools and guidelines for dam safety (large and small dams), training of dam operators and design and implementation of dam safety measures in 6 large dams (which includes installation of instrumentation and PFMA) and 2 small dams.							
Name: Monitoring and inspection of water use rights formalized for irrigation units (bloques) by ALA and water users associations		Text	-	An increase in the number of formalized water rights in 800 irrigation units based on installation and monitoring of surface water abstraction for irrigation use	Bi annual	NWRIS, water rights registry	Water users associations, ANA
Description: Measures the number of water rights formalized in 800 targeted irrigation units (bloques)							
Name: Number of water quality points monitored on a periodic basis		Text	-	33 permanent monitoring stations	Bi annual	NWRIS, mobile water quality campaigns	Consejos de cuencas (CCs), ANA

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
				providing real-time data and 30 mobile monitoring campaigns carried out on an annual or bi-annual basis			
Description: This indicator measures the number of water quality points that have been identified by the national water quality strategy. This includes points that will have permanent water quality monitoring stations and others that will require perennial water quality campaigans (mobile monitoring).							
Name: An increase in collection fees (retribución economica) for use of surface, groundwater and discharge of wastewater		Text	-	20% increase in collection of water use and discharge fees.	Bi annual	Water rights registry (NWRIS)	ANA
Description: Measures the increase in revenue due to collection of water use (surface and groundwater) information (measurements of irrigated as well as discharges of wastewater. These fees are intended to promote water use efficiency and reduce contamination strengthened to finance water resources management at national, regional and basin levels.							
Name: Number of water resources related conflicts adequately addressed by		Text	40 (registered by Defensoría	20 conflicts satisfactorily addressed	Bi annual	Defensoria del pueblo, ANA's conflict resolution unit	ANA

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
ANA			del Pueblo)	with analysis and expert knowledge			
Description: Measures the number of water related conflicts in the 10 targeted basins that are registered with the Defensoría del Pueblo and subsequently addressed by ANA. This indicator measures ANA's role carrying out analysis, provision of information and support through conflict resolution process.							
Name: Number of basins in the Pacific Watershed with IWRM plans updated with financing and under implementation		Text	6 (with average 30% of plans implemented)	6 plans with financing secured and under implementation	Bi annual	CCs	CCs, ANA
Description: Measures updating of existing basin plans to include new developments in the basin, take into account climate change considerations and seek approval of plans that will provide legal backing of these documents with an average 50% of activities implemented.							
Name: Cultura del Agua program tailored to Atlantic Watershed context to build capacity and improve knowledge and practices of the general public in IWRM at the river basin level		Text	Cultura de Agua program rolled out in 6 basins in Pacific Watershed	Cultura de Agua program rolled out in primary schools, targeted user groups and general public through various	Bi annual	Number of training of trainer campaigns	Regional offices for Ministry of Education, ANA

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
				campaigns and capacity building activities			
Description: Measures the implementation of Cultura de Agua program, which includes rolling out and providing Training of Trainers (teachers) of Blue Planet curriculum in coordination with Ministry of Education in primary schools in 4 basins of Atlantic Watershed; targeted stakeholder campaigns for (farmers, water supply providers, energy production, general public); collaboration with public institutions to disseminate IWRM educational and promotional materials (videos, flyers, etc.). It also captures capacity building of water professionals in the targeted basis to complete a Diploma program.							
Name: Integrated forecasting and early warning plans implemented in targeted basins and provide real-time information to general public		Text	0	2 integrated forecasting and early warning plans implemented in targeted basins and providing information to general public	Bi annual	Tools identified and developed using data collected within NWRIS	CCs, ANA
Description: Development of basin level forecasting tools to respond to real-time or semi-real-time needs of end users and general public that provide information related to forecasting of droughts, frost and floods as well as corresponding early warning systems. The plans also include implementation measures that defines responsible national and sub-national entities and dissemination procedures.							

Target Values

Project Development Objective Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
National Water Resources Information System providing validated online data and information products to decision makers, water resources professionals and general public	NWRIS databases established.						NWRIS fully integrated with monitoring systems, DSS tools and providing data and information products.
Dam safety unit established and operational	-	Institutional and legal framework established	Dam safety unit established			Guidelines and tools developed	Dam safety program in place with unit operational, legal framework established, guidelines and tools developed. Implementation of monitoring systems in place for selected dams

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
Groundwater committees established for targeted aquifers with participatory management plans approved under implementation.	-	Creation of 2 groundwater management committees for Ica and Tacna	Diagnostic of groundwater resources and design of monitoring network	Draft participatory management plan developed	Participatory groundwater management plan reviewed and approved		Participatory groundwater management committees operational with management plans under implementation
Basin councils /committees with approved IWRM plans and under implementation	6	4 CC/ committee established with technical secretariats in place in Atlantic watershed		6 IWRM plans for Pacific Watershed updated		CCs/committee with participatory, integrated basin plans approved	10

Intermediate Results Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
Monitoring systems with O&M arrangements in place	-					-153 hydromet stations -1000 groundwater abstraction loggers -139 piezometers -33 water	2825

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
						quality stations -1500 surface water abstraction stations (for irrigated agriculture) - dam safety monitoring equipment for 6 large dams and 2 small dams	
Percentage increase on the number of annual hits for NWRIS web portal	0					40%	40% increase in hits to NWRIS web site and web portal demonstrating increased use of databases and, analysis information products
Number of dams with dam safety assessments completed and monitoring instruments installed	0		2	4	6	8	8
Monitoring and inspection of water use rights formalized for irrigation units (bloques) by ALA and water users associations	-					Water use rights controlled and inspected for	An increase in the number of formalized water rights in

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
						800 irrigation units (bloques) in 19 river basins	800 irrigation units based on installation and monitoring of surface water abstraction for irrigation use
Number of water quality points monitored on a periodic basis	-					63	33 permanent monitoring stations providing real-time data and 30 mobile monitoring campaigns carried out on an annual or bi-annual basis
An increase in collection fees (retribución economica) for use of surface, groundwater and discharge of wastewater	-	0				20% increase in amount generated from water use and discharge fees (retribución económica).	20% increase in collection of water use and discharge fees.
Number of water resources related conflicts adequately addressed by ANA	40 (registered by Defensoría del Pueblo)					20 conflicts satisfactorily addressed	20 conflicts satisfactorily addressed with analysis

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
							and expert knowledge
Number of basins in the Pacific Watershed with IWRM plans updated with financing and under implementation	6 (with average 30% of plans implemented)		6 plans updated			6 updated and approved plans (with average 50% financing plans developed/committed).	6 plans with financing secured and under implementation
Cultura del Agua program tailored to Atlantic Watershed context to build capacity and improve knowledge and practices of the general public in IWRM at the river basin level	Cultura de Agua program rolled out in 6 basins in Pacific Watershed	Cultura de Agua program adapted to Atlantic Watershed program				- 100 water resources professionals capacitated through Diploma program. - 180 teachers primary and secondary school teachers capacitated - Development of 60 water culture promoters to implement water culture program in targeted basins	Cultura de Agua program rolled out in primary schools, targeted user groups and general public through various campaigns and capacity building activities
Integrated forecasting and early warning plans implemented in targeted basins and	0						2 integrated forecasting

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
provide real-time information to general public							and early warning plans implemented in targeted basins and providing information to general public

ANNEX 1: DETAILED PROJECT DESCRIPTION

COUNTRY: Peru
Peru Integrated Water Resources Management in Ten Basins

1. This Annex provides a more detailed description of the activities to be financed by the proposed Project.

Component 1: Consolidating IWRM Capacity at the National Level (Estimated cost US$65.16 million, of which US$35.86 million IBRD financing)

2. The component will provide support to strengthen Peru's capacity for IWRM at the national level through the expansion of monitoring networks and the development and strengthening of tools and human capacity to address the main water resource issues described in the project context. Further details about sector challenges can be found in Annex 4.

Sub-component 1a: Enhancing Data Generation for IWRM (Estimated cost US$40.57 million)

3. The Project will enhance data generation through expansion and modernization of monitoring systems for hydrological, meteorological, water quality, and groundwater (in selected aquifers)), monitoring of surface water abstraction for irrigation; as well as data captured from dam monitoring instrumentation.

4. More specifically, the sub-component will finance the procurement and improvement of data observation networks through the purchase and installation of the following:

(a) A total of 103 automatic hydrometeorological stations at the national level in 42 high priority, selected basins where information is insufficient or nonexistent to provide reliable data for planning regional and national sustainable development. An additional 50 hydrometeorological stations will be installed in the selected basins of the Atlantic watershed (Sub-component 2b).

(b) A total of 1,000 automated water abstraction data loggers and 139 new piezometers to monitor groundwater abstraction and quantity (aquifer dynamics). The data loggers will be installed in existing wells, while some of the piezometers will require drilling of dedicated boreholes.

(c) A total of 33 water quality monitoring stations based on assessments in 30 selected river basins and procurement of 30 portable water quality testing equipment to facilitate monitoring campaigns.

(d) A total of 1,500 irrigation water abstraction monitoring stations in selected collective irrigation units (*bloques*) in 14[23] prioritized basins. All stations will be automated, digitized, and equipped with real-time communications systems.

(e) Installation of dam monitoring equipment in six large dams and two small dams.

5. There is a risk of vandalism, illegal misuse, or negligence of various monitoring equipment to be procured under this Project. For hydrometeorological monitoring stations and water quality, ANA has forecasted and planned to

23 The equipment will be installed in six targeted basins in the Pacific watershed as well as Jequetepeque, Chimaca, Virú, Foraleza, Pativilca, Huarua, and Cañete.

allocate the budget needed for future O&M of equipment. ANA's decentralized structure with regional offices (AAA) and basin-level offices, such as ALA, will play a key role in safeguarding the equipment. For groundwater monitoring wells, to avoid potential invasion by illegal agriculture expansion, ANA will apply lessons learned from the Ica Valley, which include strong enforcement through its local offices, stronger physical structures, and creating and capacity building for local groundwater management committees to support self-regulation. For some equipment, ANA will work with local water users' associations and locate equipment in or near existing farms, where members of the association will be tasked with safeguarding the equipment. Equipment for monitoring abstraction of water for irrigation will be supported through capacity-building efforts to water users' associations, as well as strong awareness campaigns. Dam safety equipment will be safeguarded through training and capacity building of local dam operators.

Sub-component 1b: Improvement of Water Resources Planning and Decision Making (Estimated cost US$24.59 million)

6. As a response to the demand for water resources, increasing variability and change and increasing number of conflicts around water resources quantity and quality groundwater, this sub-component will strengthen crucial ANA responsibilities, water resources planning and management. This sub-component will also strengthen the NWRIS databases and data quality and control. More specifically, the Project will finance the activities described below.

7. **Strengthening of the NWRIS and development of decision support tools**. Considering the growing and changing information demands within ANA, as well as from external users, this sub-component will strengthen the NWRIS to streamline data collection and transmission; data security and backup; and the development of information products and DSSs that are relevant for water managers and users. The Project will strengthen data collection and transmission systems, through:

(a) Expanding, optimizing, and modernizing observation networks for surface water monitoring (national network), groundwater monitoring (in four selected aquifers), and water quality and water use monitoring (in selected areas).

(b) Strengthening of databases and data control and quality through the digitalization and correction/completion of historic hydrological data; setting up of data quality control mechanisms; establishing a facility to test hydrometeorological instrumentation and design, and providing quality control over installation.

(c) Upgrading the NWRIS hardware and software to ensure data security and backup, through: (i) Improving the data transmission mechanisms between the data collection networks, the NWRIS central office, and the information nodes at the basin level; (ii) upgrading the database and establishing backup mechanisms that will allow for reliable data collection, collation, processing, analysis, storage, and dissemination at national, regional (AAA), and river basin levels (CC and ALA); and (iii) installing information technology equipment and software to receive and process data.

8. **Development of DSSs**. The Project will strengthen the NWRIS functionality to include the development of an information management system (hydrologic design aids), DSSs, and an enhanced interface with the dissemination system (portal, website, and so on) for the central NWRIS and nodes in the six existing basins, as well as the four new nodes to be established in selected basins in the Atlantic watershed. This activity will also support the development of a suite of analytical tools and hydrological and information products, in a participatory manner with relevant information users, to support their decision making for IWRM, particularly for activities such as:

(a) Evaluation of water resources availability (surface and groundwater).

(b) Climatological characterization of the basin to better understand climate change and variability and prepare climate change studies.

(c) Demand calculations and development of reliable water balances.

(d) Support assessment and granting of water rights.

(e) Design of early warning systems (risk of flood, drought, frost).

(f) Water quality monitoring.

(g) Enhancement of the platform to register and account for payments of water use and pollution discharge fees.

(h) Development of an information platform for the management of dam safety.

(i) Improvement of data and information access in the existing NWRIS portal[24] for publications, knowledge and interactive products, and services to share information and improve communications among stakeholders.

9. **National Program for monitoring and control of abstractions for irrigated agriculture.** The Project will facilitate the scale-up of activities of monitoring of water use for irrigated abstractions and formalization of water rights. In addition to installation of monitoring equipment outlined in Sub-component 1a, the Project will support formalization of water rights, integration of water abstraction information into the NWRIS, and technical capacity building to various stakeholders, such as ALAs, CCs' technical secretariats, and water users' associations, to enforce water rights and raise awareness about water use efficiency and the significance of monitoring interventions.

10. **Implement National Water Quality Monitoring Program in accordance with the approved National Water Quality Strategy.** The Project will support formalization of discharge permits, identification of polluting entities, and implementation of water quality campaigns to ensure monitoring and control of water quality in prioritized basins. Water quality data will be integrated into the NWRIS and into decentralized Decision-making Rooms (nodes) to facilitate decisions at the basin level and avoid the duplication of efforts of multiple government agencies.

11. **Groundwater Management Pilot Program**. The Project will support management of groundwater in the overexploited aquifers of Ica Valley (Ica, Pampas de Villacuri, and Lanchas aquifers) and Caplina (also known as La Yarada) in Tacna. The Groundwater Management Pilot Program encompasses the use of monitoring equipment installed to better understand aquifer dynamics, improve water use efficiency through formalization of water rights, and develop a program for integrated groundwater management, which includes creation and strengthening of groundwater management committees, information dissemination, and awareness raising. Technical and institutional arrangements established by this Project will support the development of conjunctive use and potentially aquifer recharge strategies. The groundwater management program will encompass

(a) Updating technical guidelines and the regulatory framework for the assessment and monitoring of groundwater resources.

24 NWRIS portal: http://portal.snirh.gob.pe.

(b) Updating the inventory of wells, with detailed information about their characteristics, equipment and power supply, use of the resource, exploitation regime, and exact destination of the extracted groundwater.

(c) Updating hydrogeological studies and paying particular attention to the water balance, specifying phreatic levels and their evolution, recharge volumes, reserves, storage changes, and water available as exploitable resources.

(d) Considering reasonable possibilities, technically and economically, of increasing the recharge of each aquifer (for example, water transfers, artificial recharge plants, cleaning and maintenance of pre-existing canals, and so on).

(e) Formulating rational, sustainable, and efficient groundwater management plans for each watershed, including pipeline networks for water supply with conjunctive use of surface and groundwater.

(f) Disseminating technical recommendations to end users, to increase the efficiency in their utilization of water resources and energy consumption. These recommendations should be integrated into some proposed Dissemination and Technology Transfer programs.

(g) Preparing a plan to monitor extractions in individual wells and distribution networks by means of counters, evaluating the costs of installation, and O&M. The initial investment must consider appropriate financing mechanisms.

(h) Implementing surveillance committees for the proper operation of the groundwater hydrological network.

(i) Establishing measures to apply the law with greater severity, preventing the drilling of new wells without the prior authorization of ANA.

12. **Technical Assistance Dam Safety Management Program.** The Project will provide technical assistance to strengthen ANA's dam safety regulatory framework and the human capacity of ANA as well as dam owners and operators on risk assessment and dam safety, to be applied in a pilot phase on eight prioritized dams. This will include:

(a) Strengthening the regulatory framework for dam safety management, including proposals of improvements to the existing legal framework to strengthen ANA's regulatory function for dam safety management; and the implementation of an institutional framework on dam safety, including tools and resources to ensure dams are kept at a satisfactory level of safety.

(b) Strengthening the institutional capacity for dam safety management. This will include

(i) Supporting the creation and operation of a technical unit, within ANA, for dam safety (*Unidad Técnica de Monitoreo de Seguridad de Presas*) that will serve as its technical secretariat. The role of the technical unit within ANA will be, among others, to elaborate a Technical Assistance Dam Safety Program and supervise and enforce the implementation of the regulation by owners or operators, reporting the results to the Multisectoral Commission. The whole process should start by the approval and implementation of the technical unit, followed by the regulation, and finally, the Multisectoral Commission.

(ii) Designing and implementing technical trainings on dam safety for ANA personnel and dam owners and operators, with the participation of national and international experts.

(iii) Preparing and updating technical files of the dam, such as the manual of operation, maintenance, and inspection of the dam and its reservoir, as well as formulation of guidelines for the elaboration of dam safety plans and emergency plans. Also, during the operation of the dam, adopt the relevant measures, first, to detect and correct any defects that have developed over time, as well as the deterioration caused by the ageing of the structures and the electromechanical equipment, and second, incorporate those changes derived from technological innovations so that it would be advisable to apply them in a particular case so as to improve safety of the dam.

(iv) Training dam operating teams on preparation of the emergency procedures plan for guidance in case of the occurrence of serious anomalies or exceptional events such as, exceptional floods. This includes addressing at least the following questions: how to proceed in response to instrumentation alerts, what needs to be done to keep the population informed and prepared, and what are the measures to be taken regarding damage to property and the environment.

(v) Developing dam safety management tools. This will include updating the country's dam inventory, including risk analysis and classification to identify priority dams in need of structural fixes; designing a National Dam Safety Information System to systematize the basic information needed for dam safety management and record and report the safety conditions of dams throughout the country; and preparing dam safety manuals and guidelines, to be used by ANA and to serve as a countrywide reference for dam owners and operators, engineers, and technicians.

(c) Implementing the tools developed for eight priority dams (six large dams, that is, San Lorenzo, Poechos, Tinajones, Gallito Ciego, Condoroma, and El Frayle; and two small dams, that is, Huascacocha and Sutunta). In addition, the Project will include a task of classifying small dams according to their characteristics and the potential for damage caused downstream in the event of a failure. The criteria available at the international level should be adjusted to the conditions of the country and progressively improved to arrive at a satisfactory methodology to capture the safety situation. This includes:

(i) Performing the risk and potential hazard analysis for all eight dams; the design of their corresponding dam safety plan; and the identification of risk reduction measures, such as instrumentation and rehabilitation needs.

(ii) Promoting the implementation of the dam safety plan for all eight dams.

13. **Institutional strengthening of ANA and its decentralized entities.** This will help simplify ANA's technical-administrative processes, to be more responsive to the needs of the different water users. The Project will support:

(a) Improvement of water conflict management mechanisms. This will include improving existing tools for water conflict prevention and management, particularly those used by ANA; revising the structure and staff requirements in ANA responsible for managing water conflicts; and training of ANA's staff in the prevention and management of water conflicts.

(b) Strengthening of economic incentives for increased water use efficiency and reduced pollution into water bodies as established in the Water Resources Law. This will include the revision of the water use and

discharge fees, measures to increase its coverage and collection rate, and definition of new financing mechanisms to support ANA's operation at the national and local levels and the financing of river basin plans.

(c) An assessment and a proposal for simplifying ANA's administrative procedures related to aspects such as information from monitoring systems that will support ANA's functions for water use rights and water quality.

Component 2: Improving WRM in Selected Pilot River Basins (Estimated cost US$14.80 million, of which US$2.62 million IBRD financing)

14. This component will support the improvement of IWRM in 10 selected river basins. More specifically, the project will support strengthening of the six CCs established under the previous IBRD and IDB projects in the Pacific watershed (Chancay-Lambayeque, Chancay-Huaral, Quilca-Chili, Tumbes, Chira-Piura, and Locumba-Sama-Caplina), and improving IWRM in four new pilot river basins in the Atlantic watershed with limited IWRM capacity (Alto Mayo, Mantaro, Urubamba-Vilcanota, and Pampas).

Sub-component 2a: Strengthening IWRM in Pilot Prioritized River Basins in the Pacific Watershed (Estimated cost US$4.63 million)

15. The WRMMP[25] supported the strengthening of decentralized WRM at the basin level by supporting the creation of CCs in Chancay-Lambayeque, Chancay-Huaral, Quilca-Chili, Tumbes, Chira-Piura, and Laocumba-Sama-Caplina; developing participatory IWRM river basin plans; (c) establishing and operating information nodes and decision-making rooms in each CC connected to the NWRIS at the central level; formalizing and registering water rights and discharge permits; and monitoring water quantity and quality. The evaluation of the WRMMP has shown positive impacts: the CCs are contributing to reducing conflicts over WRM, the information system has been effective in supporting decision making to mitigate impacts from the El Niño event of 2016, and an estimated 30 percent of the participatory IWRM plans have hitherto been implemented.[26]

Table 1.1. Main Characteristics of the Selected Pacific River Basins

Basin Name	Surface		Inhabitants	Volume (Hm^3)
	Basin Surface (km^2)	Agricultural Surface (ha)		Hydrological Availability at 75% Confidence
Puyango Tumbes	5,285	13,000	200,000	1,873.24
Chira-Piura	29,853	141,000	1,725,488	1,683.6
Chancay-Lambayeque	5,555	117,000	1,000,000	801.45
Chancay-Huaral	3,480	25,198	170,000	482.00
Quilca-Chili	13,817	36,872	925,295	
Locumba-Sama-Caplica	16,389	28,601	288,781	175.00

16. Sub-component 2a will support:

(a) The enhancement of Decision Support Nodes (Water Resources Monitoring Centers) and development of improved analytical tools for planning and management of water resources, including

25 PE WRMMP P107666 and IDB PE-L1070.
26 See Report No. ICR00003535.

(i) Development of early warning systems for floods and droughts;

(ii) Development of analytical tools (simulation, optimization, and multi-criteria analysis) for design and evaluation of investments and provision of water rights;

(iii) Development of tools for real-time or semi real-time operations of hydraulic infrastructure; and

(iv) Dissemination and use of analytical products to improve the quality of and access to water information and to expand public access beyond data to analytical results (trends, water balance, and so on) as well as for operational and investment plans.

(b) The implementation of a program for the control of water infrastructure management and water rights withdrawals (developed under Component 1) in the six river basins, based on the work performed in Sub-component 1b.

(c) Capacity building and training for the six CCs, including the updating and monitoring of existing integrated river basin plans and support for ensuring balanced representation of basin stakeholders in the six CCs and the improvement of communication mechanisms.

(d) The definition of financing mechanisms and legally binding arrangements for the financing of the participatory IWRM plans.

Sub-component 2b: Development of IWRM in Pilot River Basins in the Atlantic Watershed (Estimated cost US$10.67 million)

17. Investments in Chancay-Lambayeque, Ica-Alto Pampas (Huancavelica), and Quilca-Chili through the WRMMP served as pilot interventions that could be replicated in other priority basins in the country. Learning from these experiences, this Project has prioritized four new pilot river basins (see Table 1.2) in the Atlantic region. These new basins have been selected on the basis of the prevalence of WRM issues. A summary of these main issues are briefly described in Annex 4.

Table 1.2. Main Characteristics of the New Pilot River Basins

Basin Name	Surface		Inhabitants	Volume (Hm^3)	
	Basin Surface (km^2)	Agricultural surface (ha)		Hydrological Availability at 75% confidence	Uses
Urubamba	58,735	31,990	1,089,183	48,761	674
Pampas	23,236	39,606	421,617	31,400	429
Mantaro	34,547	98,329	2,086,995	443	196
Alto Mayo	7,940	81,615	221,642	4,592	681
Total	124,458	251,540	3,819,437	85,196	1,980

18. Sub-component 2b will strengthen the decentralized WRM in each new priority basin, through

(a) The provision of technical assistance for the establishment of CCs in all four basins, including

(i) Capacity building of the local water authorities, AAA and ALA, for WRM; and

(ii) Support for the creation and strengthening of four technical secretariats to advise and help each CC deliver on their mandate.

(b) The implementation of water resources information nodes in each basin to be connected to the NWRIS at the central level, including

(i) The procurement of hardware and software for the development of modelling tools and information products for WRM, in a participatory manner with relevant information users, tailored to the needs of each basin (for example, flood forecasts and drought monitoring); and

(ii) The design and implementation of water quality monitoring programs—in coordination with the MINAM—including a base line, the selection of monitoring sites, the establishment of working groups for water quality monitoring, and training.

(c) The preparation, validation, and monitoring of participatory IWRM plans. The preparation of these plans will be based on modelling tools that will use the data being improved as a result of the strengthening of the information system and will follow the methodology and guidelines developed under the WRMMP, adapted to the reality of the four basins.

(d) Implementation of the *Cultura del Agua* Program—designed under the WRMMP and adjusted to the reality of the four basins, to raise awareness and promote structured stakeholder involvement and outreach for IWRM.

Component 3: General Project Administration (Estimated cost: US$8.19 million, of which US$1.52 million IBRD financing)

19. This Component will support the management and monitoring of activities associated with Project implementation through a national Project Implementation Unit (PIU), including technical assistance and administrative support on monitoring and evaluation (M&E) (baseline surveys, midterm reporting, annual audits, final project evaluation), procurement, financial management (FM), safeguards, training, and communication.

ANNEX 2: IMPLEMENTATION ARRANGEMENTS

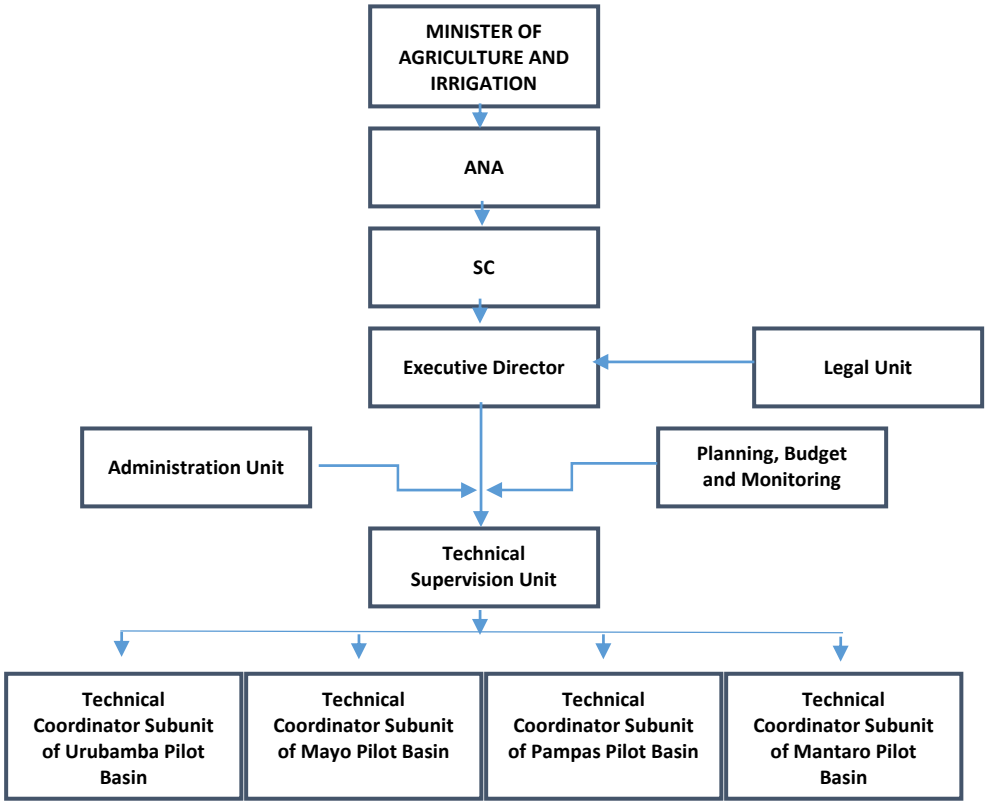
COUNTRY: Peru
Peru Integrated Water Resources Management in Ten Basins

Project Institutional and Implementation Arrangements

1. **Borrower.** The recipient of the IBRD loan will be the Republic of Peru, through the MEF, which will transfer the loan proceeds to MINAGRI-ANA. ANA will be the implementing agency through the PIU, which will be responsible for the implementation of all Project activities, internal and external communications, FM, procurement, and compliance with safeguards policies.

2. The institutional arrangements for the execution of the Project are shown in Figure 2.1.

Figure 2.1. Project Institutional Arrangements



3. **PIU.** The PIU will have the following main duties and responsibilities: developing annual operational plans and management instruments; ensuring the successful and integral execution of the Project; performing the procurement processes; approving contracts and agreements; establishing FM arrangements (budget, accounting systems, financial and internal control, financial reporting, and audit) to ensure proper management of resources and allocation of funds; carrying out M&E activities; coordinating with ANA directorates/areas to ensure the support and proper execution; and ensuring compliance with the contractual conditions of the Project.

4. The POM provides details related to the Project's institutional setup, fiduciary arrangements, M&E procedures, safeguards compliance arrangements, and governance arrangements.

5. The PIU will consist of the following key staff: Executive Director; Technical Supervision Director; Head of Planning, Budget and Monitoring; legal advisor; environmental specialist; and administrative staff (Head of Administration, financial specialist, accountant, treasurer, procurement specialist, and budget and planning officer) and four technical coordinators of each pilot basin of the Atlantic watershed (Alto Mayo, Mantaro, Urubamba-Vilcanota, and Pampas.

6. The Executive Director will provide overall leadership to the Project. The duties and responsibilities of the Executive Director will include, among others: managing the PIU, representing the Project, proposing programmatic strategies and operational plans to the PSC, directing Project implementation according to the management tools and POM, approving and monitoring the budget execution, approving management documents, approving the selection and contracting of the technical and administrative staff, assuming the role and tasks of Executive Secretary of the PSC, complying with the Loan Agreement, and providing advice to the ANA head on WRM issues.

7. Four management units within the PIU (planning, budget, and monitoring; administration; and legal) will be responsible for planning, FM, management of human and physical resources, and procurement of goods and services. These three units will operate under the Executive Director's supervision. The management units will formulate rules and procedures, develop procurement and disbursement plans, prepare biannual and annual financial reports, and ensure compliance with all contracts in accordance with the procedures of ANA and World Bank. The main functions of these management units are described in the following paragraphs.

8. **Planning, Budget, and Monitoring Unit**. This unit will be responsible for planning the work program of the Project, developing the budget, and monitoring the implementation taking into account fiduciary and technical aspects. Its main duties will include: planning, elaborating, and monitoring the annual budget; coordinating the elaboration of annual operations plans and biannual budgets with technical areas; M&E of the annual operation plans and budgets; coordinating with MINAGRI, ANA, MEF, and the World Bank, for the programming and execution, financing, and supervision of the Project; keeping the POM up to date; and providing advice to the Technical Supervision Director and Executive Director in the areas of planning, budget, and M&E.

9. **Administrative Unit**. This unit will be responsible for carrying out administrative functions. Its principal duties will include: managing the economic, financial, and human resources of the Project, directing, executing, and supervising the administrative strategies, norms, and internal policies that allow to optimize the activities; ensuring compliance with the standards issued by the public sector and the World Bank regarding all administrative activities; assessing the Executive Director and Technical Supervision Director in all matters related to administration and FM, procurement, budget execution, and disbursements; assessing the Technical Coordination Subunits of the four pilot river basins of the Atlantic watershed in the execution of their annual budget; establishing the administrative and financial control of the Project activities; establishing the administrative and financial control system of the Project; coordinating with the external auditor under the terms of the Loan Agreement and providing any documentation that they may request; and carrying out any other duties as requested by the Executive Director or Technical Supervision Director.

10. **Legal Unit**. This unit will be responsible for ensuring that the PIU operates within the current legislation's framework. Its main duties will include: coordinating and supervising the correct application of World Bank guidelines in processes such as procurement; addressing the legal consultations that may be formulated by the PIUs; preparing, proposing, and expressing opinions about the regulations and legal provisions that contribute to the improvement of

the legal framework that could affect the Project; carrying out the monitoring, analysis, and interpretation of the norms that may affect the Project; supporting the heads of units such as, SENAMHI, MINAM, and regional governments, among others, in their endeavor to achieve the agreements and documents to be signed with institutions involved in Project execution; and designing internal norms that contribute to compliance with current legislation.

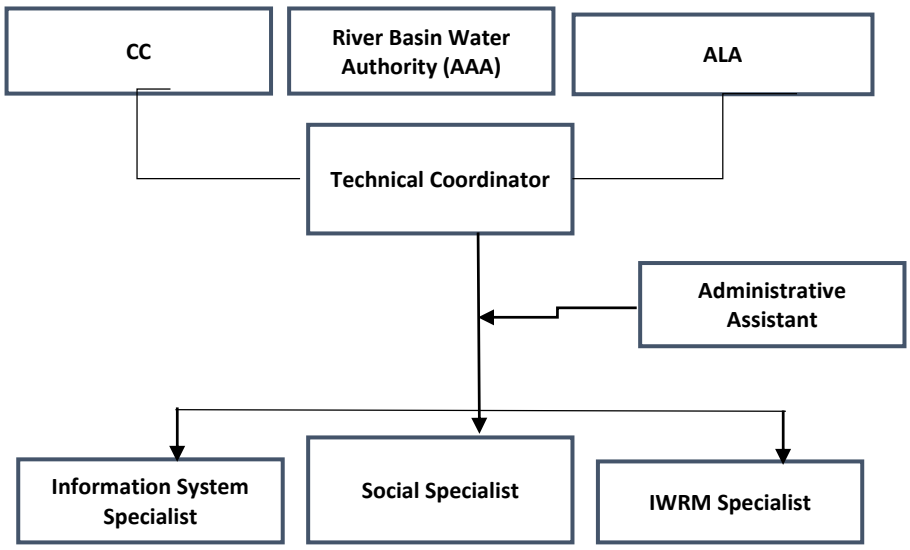
11. **Technical Supervision Unit.** This unit will supervise the day-to-day operations of the Project. The duties and responsibilities of this unit will include, among others: supporting the Executive Director in proposing programmatic strategies and operational plans to the PSC; leading technically the Project activities to be implemented in the six selected river basins of the Pacific watershed; supervising the Technical Coordination Subunits of the four pilot basins of the Atlantic watershed; coordinating and following the activities in each subunit related to AAAs and ALAs support; preparing the annual operating plans and associated budgets; overseeing M&E activities and safeguards and supervising the preparation of progress reports as requested by ANA, MINAGRI, MEF, and the World Bank; coordinating and supervising the formulation/revision of the IWRM plans of the 10 selected river basins and the activities planned therein; and contributing to administrative and budgetary control, led by the PIU administrative units.

12. **Implementation arrangements in the four pilot basins of the Atlantic watershed.** Four Technical Coordination Sub-units within the PIU will be established and will be operated under the supervision of the Executive Director and Technical Supervision Director. These four subunits will be located in the four pilot river basins of the Atlantic watershed: Alto Mayo, Mantaro, Urubamba-Vilcanota, and Pampas. Their main functions will include: executing and coordinating the interinstitutional management at the basin level; executing and coordinating the information system at the basin level; establishing the CCs; providing technical support to the CC for their leadership in the formulation and validation of detailed, participatory IWRM plans; providing guidance and overseeing the design, installation, and utilization of basin-specific models, decision aid tools, and monitoring equipment; controlling the budget assigned to the respective subunit; implementing the *Cultura del Agua* Program; and coordinating with the River Basin Water Authority (AAA) and ALA, and other administrative institutions or entities involved in the river basin jurisdiction.

13. The Technical Coordination Subunits in each of the four river basins will include: a technical coordinator; an information system specialist; a socio-environmental specialist, also in charge of the *Cultura del Agua* Program; an IWRM specialist; a socioenvironmental specialist; an administrator; three assistants; a secretary; and two drivers. The river basin technical coordinator will report to the AAA head and will be located in the office of the ALA.

14. The implementation arrangements at the river basin level are shown in Figure 2.2.

Figure 2.2. Project Institutional Arrangements at the Basin Level for the Four Pilot River Basins of the Atlantic Watershed



15. **Implementation arrangements in the six river basins of the Pacific watershed.** The Project activities in the six target basins of the Pacific watershed (Chancay-Lambayeque, Chancay-Huaral, Quilca-Chili, Tumbes, Chira-Piura, and Laocumba-Sama-Caplina) will be led from the Lima-based technical supervision unit of the PIU.

16. The PIU's technical teams will coordinate with the CCs, AAAs, and ALAs. Their main functions are described in the following paragraphs.

17. **River Basin Council**. The CCs, already established in the existing six basins of the Pacific watershed, will participate in updating the basin-scale IWRM plans and in water quality and discharge monitoring and control in their jurisdiction. Three new CCs and one basin committee (Alto Mayo) to be established in the Atlantic watershed will be responsible for the formulation and validation of the basin-wide IWRM plans and they will coordinate with the Technical Coordination Subunit in the river basin.

18. **Administrative Water Authority.** The coordination and technical implementation at the river basin level will be undertaken with the participation and responsibility of the respective AAA in the jurisdiction, with support of the ANA headquarters. The following functions are within their competence: execute policies and strategies defined by ANA at the central level for IWRM in its territorial area; authorize and approve the elaboration of studies and the execution of corresponding hydraulic works; supervise the fulfillment of dam flow release plans, as well as the O&M manuals of major public hydraulic infrastructure; support the CC in the preparation and validation of the IWRM plans in their respective river basins, as well as supervise compliance; participate in the formulation and implementation of awareness programs, trainings, and dissemination campaigns for the establishment of a water culture in its area; and others that correspond to current regulations and assigned by the Head of ANA[19].

19. **Local Water Administration.** The ALA is the organic unit of the AAA, which manages the waters of agrarian and non-agrarian use in their respective territorial areas that are approved by a Ministerial Resolution. The implementation of the Project activities in each target river basin will be done in coordination with the respective ALA.

20. **Project Steering Committee**. ANA through the PIU will establish the PSC. The PSC will be the highest governing body of the Project. It will provide general strategic guidance and ensure technical implementation oversight. The PSC

will be chaired by the Minister of Agriculture and Irrigation or his/her representative and will be composed of eight members appointed by the Ministerial Resolution and acceptable to the World Bank. These members will include one representative from the MEF, the Head of ANA, one representative of the agrarian water users, and one representative of the non-agrarian water users. The composition of the PSC will be renewed every two years. The PSC will meet regularly (at least twice per year) to review implementation progress, provide guidance on implementation issues, and coordinate actions needed to resolve problems that may adversely affect the performance of the project. More specifically, the main functions of the PSC are to: provide guidance and approve Project implementation policies and Project programmatic strategies; follow-up on the implementation of the activities and take any corrective action to achieve Project goals; promote coordination; approve the annual operating plan and annual budget, annual reports, and other documents as needed; revise the partial results about reducing the gap between water uses and discharge fees collection and operational and administrative cost of the basin; and participate in the selection of the Executive Director and Technical Supervision Director. In addition, in order to ensure efficient coordination and participation in the Project of ANA's entities at central level, ANA will establish an **Internal Technical Committee** (ITC), made up of the Head of ANA who will preside over it, the Executive Director of the PIU, and the Directors of the Offices and Directorates of ANA Headquarters. The roles and responsibility of the ITC are specified in the POM.

Financial Management

21. **Organization and staffing.** The PIU is administratively and financially autonomous, and it will be responsible for implementing the fiduciary activities of the Project. The Project's fiduciary aspects will be under the responsibility of ANA's AO. Budget functions will be under the responsibility of the planning, budget, and monitoring unit of the PIU. Currently, the PIU is adequately staffed. However, there is a risk that the PIU may lose its staff during Project preparation. Therefore, it is important to note that the PIU will need to cover key fiduciary positions: (i) by effectiveness: the administrative and financial specialist; and (ii) after 30 days of effectiveness the following positions: Head of Administration, accountant, treasurer, procurement specialist, budget and planning officer for project implementation. The terms of reference and the recruitment of staff for key positions will need the World Bank's 'no objection'. The PIU should have adequate capacity to conduct FM aspects and activities under this Project. Specific roles and responsibilities are outlined in the POM.

22. **Planning and budgeting**. Preparation of annual work program and budgets will be in accordance with the procedures established by the MEF through its *Dirección General de Presupuesto Público*. Those procedures will be complemented by specific processes and procedures established in the POM (preparation of an annual operating plan with at least the semiannual budget, including all sources of financing—IBRD and counterpart funds). To ensure adequate budget control, the PIU will be responsible for ensuring: timely provision of resources for each year, established in the work plan and budget formulation and approval; proper recording of the approved budget in the respective information systems following a classification by project component/subcomponent; and timely recording of commitments, accruals, and payments to allow adequate budget monitoring and provide accurate information on project commitments for programming purposes. The PIU will make the necessary budget provision for the Project external and counterpart funds according to the annual operational plan.

23. **Accounting and information system.** ANA and the PIU have to comply with Peru's laws governing budget and FM, including the use of SIAF and the General Chart of Accounts established in SIAF. Accounting and payment transactions of the Project will be recorded in SIAF. Considering the nature of Project activities and information needs for monitoring purposes, there is a need to complement the use of SIAF with a management information system for further issuance of financial reports and prepare statements of expenditures according to the project components and in U.S. Dollars. Therefore, the PIU has defined that they will use the financial information system, SIMAF (used by other PIUs).P It is expected that the financial information system will be operational before the beginning of Project

implementation.

24. **Financial reporting.** The PIU will have to prepare interim financial reports (IFRs) from the transaction information recorded in SIAF and then download it in the financial information system that the PIU will use for this purpose. The IFRs will include: (i) a Statement of Sources and Uses of funds, including reconciling items (as needed) and cash balances, with expenditures classified by Project component/subcomponent; and (ii) Statement of Investments, reporting the current semester and the accumulated operations against ongoing plans and footnotes explaining the important variances. The reports will include loan proceeds and local counterpart funds. The IFRs will be prepared in local currency and in U.S Dollars and submitted to the World Bank on a semiannual basis no later than 45 days after the end of each calendar semester. The format and content of the IFRs (including a subproject report) is under design and should be completed by appraisal. The format and content of the IFRs have designed and they are satisfactory to the Bank.

25. On an annual basis, the PIU will also prepare Project financial statements that includes a Statement of Sources and Uses of Funds, Statement of Investments, including cumulative figures, for the year and as of the end of the year, and explanatory notes in accordance with the International Public Sector Accounting Standards, and statement of Disbursement reflecting the application of withdrawal presented by the PIU to request disbursement of Bank funds. These financial statements, duly audited in accordance with World Bank's requirements, will be submitted to the World Bank within six months after the end of GoP's fiscal year (December 31). Working papers for the preparation of the semester and annual financial statements will be maintained by the PIU and made easily accessible to the World Bank's supervision missions and to external auditors.

26. **Internal controls and audit.** Overall, the PIU has to comply with local requirements related to FM, including internal controls and procedures. In addition, the World Bank has agreed with the PIU on specific processes and procedures for Project implementation. Procedures for approval and processing of payments to suppliers and service providers for all components will be reviewed and agreed with the World Bank. Those procedures are reflected in the POM showing clear segregation of responsibilities among ANA and the PIU and other participant bodies in both areas —technical and fiduciary— and authorization for disbursements/approval of physical progress for project activity implementation. The draft version of the POM (including Fiduciary chapter) will be submitted to the Bank during Appraisal. The final version of POM is an effectiveness condition. ANA's organizational structure includes an Internal Control Office (OCI) oversight of the PIU and has the authority to perform ex post internal control on project transactions; in case this happened, the PIU will make available the report to the Bank.

27. **External audit.** Annual audit reports on Project financial statements, including management letters should be submitted to the World Bank, within six months of the end of the borrower's fiscal year (December 31). The audit should be conducted by an independent audit firm acceptable to the World Bank and under the terms of reference approved by the World Bank. The selection of the audit firm should be performed through the General Audit Comptroller Office. The audit cost can be financed out of loan proceeds. The scope of the audit will be defined by the PIU in agreement with the World Bank based on Project-specific requirements and responding, as appropriate, to identified risks, including a management letter, and review of compliance with agreed processes and procedures. The audit requirements will include the activities shown in Table 2.1.

Table 2.1. Audit Due Dates

Audit Type	Due Date
Project financial statements	June 30

Disbursements[27]

28. **Designated Account**. A Designated Account (DA) in U.S. dollars will be opened and maintained in the Banco de la Nación by the PIU, which will have direct access to funds advanced by the World Bank to the DA. Funds deposited into the DA as advances, will follow the World Bank's disbursement policies and procedures, to be described in the Legal Agreement and Disbursement Letter. To process payments, the PIU will be able to withdraw the required amount from the DA to a local currency bank account from where payments will be made to the consultants', suppliers', and beneficiaries' bank accounts.

29. **Counterpart funds.** The PIU will manage the counterpart funds for the Project using the Single Treasury Account established by the Government. Funds for the project will be identified with a specific project code and account in SIAF to process payments.

30. **Retroactive financing.** Retroactive financing will not be considered for this Project.

31. **Disbursement methods.** The following disbursement methods may be used to withdraw funds from the loan: (a) advance, (b) reimbursement, and (c) direct payment.

(a) Advance method. The DA will have a ceiling of US$1,000,000.
(b) Direct payment. The minimum application size for a direct payment request will be US$500,000.
(c) Reimbursement method. The minimum application size for the reimbursement method will be US$500,000.

32. **Supporting documentation.** Supporting documentation for documenting Project expenditures under advances and reimbursement methods will be Statements of Expenditures and a DA Activity Statement, with a copy of the DA Bank Statement, when reporting eligible expenditures paid from the DA. For Direct Payments, records evidencing eligible expenditures (for example, copies of receipts and supplier invoices) will be required.

33. **Disbursement deadline date.** The disbursement deadline date will be four months after the closing date specified in the Loan Agreement.

34. **Disbursement categories.** Loan proceeds will be disbursed against the following expenditure categories:

Table 2.2. Table of Loan Proceeds (in US$)

Category	Amount of the Loan Allocated	% Expenditures to be Financed
Works, goods, consultants' services, non-consulting services, Training and Operating Costs	40,000,000	100%
Total Amount	40,000,000	100%

35. **Supervision plan.** The World Bank plans to conduct at least two supervision missions per year, while also reviewing the annual audit reports and the semester IFRs.

27 The Disbursement arrangements was discussed and agreed with WFA

Procurement

36. **Procurement of works.** Works for the Project will include minor works for the installation of monitoring equipment. To the extent possible, contracts for these civil works will be grouped in bidding packages. Contracts with estimated values of more than US$10,000,000 equivalent will be procured following ICB procedures. Contracts with estimated values below US$10,000,000 equivalent per contract may be procured using NCB procedures. Contracts which cannot be grouped into larger bidding packages and which are estimated to cost less than US$250,000 per contract may be procured using Shopping procedures. The procurement will be done using the World Bank's standard bidding documents (SBDs) and a model of request for quotations, satisfactory to the World Bank, will be included in the POM.

37. **Procurement of goods**. Goods procured under the Project will include equipment for hydrological and meteorological monitoring, as well as equipment to measure groundwater, water quality, water abstraction for irrigation, and dam safety instrumentation. To the extent possible, contracts for these goods will be grouped in bidding packages of more than US$2,000,000 equivalent and procured following ICB procedures. Contracts with estimated values below this threshold, per contract, may be procured using NCB procedures. Contracts for goods which cannot be grouped into larger bidding packages and estimated to cost less than US$50,000 per contract may be procured using Shopping (national/international) procedures. The procurement will be done using the World Bank's SBDs for all ICB and national SBDs and a model of request of quotations agreed with (or satisfactory to) the World Bank in the POM.

38. **Selection of consultants**. Short lists of consultants for services estimated to cost less than US$350,000 equivalent per contract may be composed entirely of national consultants in accordance with the provisions of paragraph 2.7 of the Consultant Guidelines. Where firms are not required, individual consultants will be hired according to Section V of the Consultant Guidelines.

39. **Country's procurement capacity**. In the last few years, Peru's national procurement system has made significant progress, particularly, with regard to access to information and adoption of SBDs. However, it still suffers from serious setbacks that affect both the efficiency and transparency of government purchasing. Of most concern is the distortion of competition generated by the use of the referential price and the permanent concern for literal compliance with the requirements set forth in the national regulatory framework, as well as the lack of procurement capacity in some sectors, particularly, at the local level.

40. **Procurement capacity of the implementing agency.** Following the implementation arrangements, the Project will follow the same institutional and implementation arrangements established for the WRMMP. The PIU will be responsible for the implementation of the Project. This is an administratively and financially autonomous PIU, and it will be responsible for implementing the procurement activities of the Project. Currently, the PIU is adequately staffed and is expected to maintain its capacity to conduct procurement under this operation.

41. An assessment of ANA's capacity to implement procurement activities for the Project was updated in November 2016. The capacity assessment looked into the PIU's: organizational structure, facilities and support capacity, qualifications and experience of the staff who will work in procurement, record-keeping and filing systems, procurement planning and monitoring/control systems used, and capacity to meet the World Bank's procurement contract reporting requirements. It also reviewed the procurement arrangements proposed in the Procurement Plan.

42. Considering ANA's procurement capacity, the overall Project risk for procurement is rated **Moderate**. The corrective mitigating measures proposed are shown in Table 2.5.

Table 2.4 Procurement Risk Mitigating Measures

Mitigating Measures	Stage
The hiring of a skilled procurement staff	By effectiveness
The Procurement Plan must be included and managed through STEP	During implementation

43. **Procurement Plan**

- World Bank's approval Date of the Procurement Plan: February 23, 2017
- Date of General Procurement Notice: February 23, 2017
- Period covered by this Procurement Plan: 18 months

44. **Prior review threshold.** Procurement decisions are subject to prior review by the World Bank as stated in Appendix 1 to the Guidelines for Procurement.

Table 2.5 Thresholds for Procurement Methods and Prior Review (US$, thousands)

Expenditure Category	Contract Value (Thresholds) (US$, thousands	Procurement Method	Contracts Subject to Prior Review
1. Works	> 10,000	ICB	All
	250–10,000	NCB	According to the Procurement Plan
	< 250	Shopping	
	Regardless of the amount	DC	
2. Goods	> 2,000	ICB	All
	50–2,000	NCB	According to the Procurement Plan
	< 50	Shopping	
	Regardless of the amount	DC	

Note: DC = Direct Contracting

Environmental and Social (including safeguards)

45. Safeguards management capacity will be strengthened within the PIU through the creation of a decentralized environmental and social expert team. A senior environmental specialist will be placed at ANA's headquarters in Lima, who will coordinate and provide guidance to socio and environmental specialists placed at the PIU's Technical Coordination Subunits' offices in the four pilot river basins located in the Atlantic watershed. These specialists will be responsible for supervising and monitoring the implementation of the environmental and social safeguards instruments in all of the Project activities being undertaken, as well as adherence to the Project's environmental management and IPPF. This will also include the gender actions that have been agreed on during appraisal, which are mainly focused around consultations to be carried out as part of the development process of the IWRM plans.

M&E

46. The PIU with be supported by ANA's technical units, decentralized bodies (ALAs and AAAs), CCs, groundwater management committees, as well as water users' associations, who will monitor and evaluate the Project's performance based on the Results Framework (detailed in Section VII). The M&E functions will be integrated, to the extent possible, into the NWRIS to facilitate activities and streamline the process. Twice a year, the PIU will produce a report containing key performance indicators, safeguards, and fiduciary activities. The primary sources of data will be the implementing agency, ANA, through the NWRIS, and operational reports. The POM will contain a detailed chapter on M&E arrangements.

ANNEX 3: IMPLEMENTATION SUPPORT PLAN

COUNTRY: Peru
Peru Integrated Water Resources Management in Ten Basins

Strategy and Approach for Implementation Support

1. The approach for the Implementation Support Plan is built on the lessons learned from the supervision of the WRMMP as well as the experience gained from the preparation of the proposed Project, in particular its new features such as the Groundwater Management Pilot Program, the Technical Assistance Dam Safety Management Program, and the strengthening of the NWRIS and related decision support tools.

Implementation Support Plan and Resource Requirements

2. Many of the World Bank team members are based out of the Lima Country Office, which ensures timely and effective implementation support to the client. Semi-annual supervision missions and targeted follow-up technical missions will focus on the areas described in the following paragraphs.

3. **Strategic support.** The World Bank implementation support missions will meet with national and local authorities to: (a) review progress on the project's activities; (b) discuss strategic alignment of the project's different activities and those of relevant stakeholders, for example, around the formulation, validation, execution, and monitoring of the IWRM plans in the selected 10 river basins; and (c) evaluate progress on cross-cutting issues, such as M&E, gender, training, communication, dissemination of Project results and experiences, and coordination between relevant stakeholders.

4. **Technical.** Specialized technical inputs are required to revise the terms of reference and bid documents to ensure fair competition through proper technical specifications and a fair assessment of the technical aspects of the bids. High-quality supervision will be needed to ensure that contractual obligations and quality requirements are met, as well as to review any requested change in the selected technical method or design. The team comprising highly qualified national and international specialists in IWRM, hydrometeorology, institutional and legal frameworks, dam safety, groundwater management, finance, and social and environmental management, will conduct regular implementation support missions as needed.

5. **Fiduciary.** Periodic supervision of procurement and FM aspects will be carried out by the World Bank semi-annually to: (a) perform desk reviews of project IFRs and audit reports, following up on any issues raised by auditors, as appropriate; (b) assess the performance of control systems and arrangements; (c) update the FM rating in the FM Implementation Status and Results Report as needed; (d) provide training and guidance on carrying out the procurement processes in compliance with the Procurement and Anticorruption Guidelines and the POM; (e) work with the PIU to enhance its capacity in procurement and FM to facilitate project implementation; (f) review procurement documents and provide timely feedback to the PIU; (g) carry out the post review of one out of every ten procurement actions; and (g) help monitor Project progress against the Procurement Plan.

6. **Safeguards.** Close supervision of safeguards implementation and compliance will be carried out, at least twice a year, throughout Project implementation.

7. **Thematic support.** The scope, nature, and objectives of the Project indicate that there will be a continuous need

for implementation support, particularly in the areas of planning, institutional arrangements, meteorological and hydrological services, dam safety, groundwater management, and legal and financial mechanisms for the execution of the IWRM plans, among others.

Table 3.1. Implementation Requirements

Time	Focus	Skills Needed	Resource Estimate	Partner Role
First 12 months	Procurement and FM training; Safeguards training; Revision of technical specifications and bidding documents for contracting of monitoring equipment under Subcomponent 1a; Technical assistance to review the terms of reference for the contracting of consultancies for Subcomponent 1b and Component 2	Procurement and FM; Safeguards; Experience in the design of hydrometeorological networks, groundwater monitoring, dam safety, and water quality; Experience in the design and financing of the IWRM plans	Supervision budget	Provide support, national expertise, and technical advice
12–48 months	Supervision of the installation and use of the monitoring networks and decision-making tools under Component 1; Supervision of the capacity-strengthening activities under Subcomponent 1b and Component 2	Experience in the design and use of integrated water resources information systems; Experience in the technical and institutional aspects of IWRM; Procurement and FM; Safeguards	Supervision budget	Provide support, national expertise, and technical advice
Other	Drawing lessons learned and mainstreaming best practices	M&E Technical	Supervision budget	n.a.

Table 3.2. Skills Mix Required

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Task Team leaders (2)	20	4	Based in HQ and CO
IWRM specialist	10	4	Based in HQ and CO
Dam safety specialist	4	1	Based in HQ
Environmental specialist	8	4	Based in CO
Social specialist	8	4	Based in CO
Procurement specialist	6	0	Based in CO
FM specialist	6	0	Based in CO
M&E specialist	6	2	Based in HQ
Communications specialist	4	2	Based in CO
Technical experts	—	—	Consist of several World Bank staff/consultants of different technical disciplines (for example, NWRIS, groundwater, climate change, institutional, legal, and so on)

Note: CO = Country office; HQ = Headquarters.

ANNEX 4: DETAILED SECTOR CONTEXT

COUNTRY: Peru
Peru Integrated Water Resources Management in Ten Basins

1. This Annex provides a more detailed description of the main issues and needs identified to achieve participatory IWRM in Peru.

2. Based on analysis of issues and trends in water resources in Peru, as well as findings from the previous engagement of the WRMMP, there is strong evidence that variations in rainfall and hydrological parameters, as well as use of surface and groundwater and impact on water quality necessitate robust and reliable monitoring networks. Monitoring of different aspects of water resources is dispersed among various national and local agencies. ANA as the regulator of water resources has the mandate to monitor these parameters of water resources and enhance coordination between pertinent entities. Through a partnership with the meteorological agency, SENAMHI, ANA has installed and transferred 68 automatic hydrometeorological stations across the six basins in the Pacific watershed prioritized under the WRMMP.[28]

3. Considering the growing and changing information demands within ANA and from external users, this component will strengthen the existing monitoring systems that will enhance data quality and quantity for the NWRIS that are critical for development of analytical tools and products relevant for WRM and development. Water resources information is needed to orient planning and operation of various productive sectors that drive the Peruvian economy, safeguard environmental standards, and reduce water-related conflicts. The NWRIS is a comprehensive Water Information System that covers hydrological information and spatial data (Geographical Information System). Automated climatological, hydrological data has been directly linked to the NWRIS, as well as water use from selected irrigation abstraction points and collated water quality data from the six selected basins in the Pacific watershed. Despite notable advances in the design and development of the NWRIS, the challenges discussed in the following paragraphs persist.

4. **A dire need to upgrade and expand the information system related to surface water availability.** Before the creation of the NWRIS in 2013, water resources information was dispersed throughout various public and private entities. With the creation of the NWRIS, ANA was mandated to (a) deepen analysis and functions to design and articulate geographic locations of hydrometeorological stations, considering hydraulics, sediment transport behavior, economic activities, and urban settlements (to determine demands); (b) establish a methodology to prioritize national monitoring network standards to be implemented; and (c) coordinate with MINAM, SENAMHI, and regional governments to articulate efforts to monitor water resources.

5. A detailed analysis of existing hydrometeorological monitoring networks indicated that at the national level, there are 235 automatic stations under the purview of public and private entities, 68 of which were installed through the previous WRMMP in six targeted basins in the Pacific watershed. Of these automatic stations, 15 are currently nonfunctional. In addition, there are 1,519 manual stations, of which 860 are currently nonfunctional. Considering the demands for water and the complex hydrology of the country's water resources, there is a dire need to update the information system related to surface water availability. The presence of these stations is also geographically disproportionate, with the majority of stations located in the Pacific watershed, while relatively little real-time information exists about surface water hydrology in the Atlantic and Lake Titicaca watersheds. This is of particular

28 Tumbes, Chira-Piura, Chancay-Lambayeque, Chancay-Huaral, Quilca-Chili, and Caplina-Locumba.

concern, considering the increasing amount of hydrologic variability and the investment in large hydraulic infrastructure in place to transfer water from the 'water-rich' Atlantic and Lake Titicaca watersheds across the Andes to the Pacific watersheds, where the majority of the country's population and economic activities are located.

6. Based on this analysis, new stations will be acquired and installed in basins or interbasins where relatively little hydrological and meteorological information exists in real time that responds to information needs such as:

(i) Operation of large hydraulic infrastructure, to locate stations upstream and downstream depending on the monitoring needs and types of economic activities;

(ii) Areas where there are multiple and intensive water resources usage and require real time information to support planning and management of competing uses;

(iii) Areas where large hydraulic infrastructure or potential large-scale water use is envisioned to guide design and minimize impacts of downstream uses;

(iv) Monitoring and analysis of the volume of water in lakes, ponds, and hydraulic reservoirs;

(v) In areas prone to extreme hydrometeorological events such as droughts, storms, riverine flooding, flash floods, avalanches, and landslides;

(vi) Areas that require assessment of sediment transport; and

(vii) Areas where hydrometeorological information is required to develop a water balance and optimize the National Water Resources Management Plan.

7. Based on a detailed analysis and updated inventory of hydrometeorological information, ANA has established a program to gradually expand and modernize the national network, starting with prioritized areas[29] to fill in data gaps.

8. **Overexploited aquifers requiring urgent measures to combat the increasing groundwater table decline.** In the Pacific watershed, groundwater is an important resource due to its volume (2,883.13 million m^3/year) equivalent to 7.51 percent of the total rivers flow, which represents 15 percent of the multisectoral water consumption. These resources are naturally regulated, allowing their exploitation throughout the year, especially when and where surface water is scarce. Annual groundwater withdrawal in the 40 valleys in the Pacific watershed is estimated at 1,694.07 million m^3/year of groundwater; this volume represents 319.18 million m^3/year that is overexploited from nine aquifers.

9. As with surface water, ANA has the mandate to regulate groundwater resources through the formalization of water rights and monitoring of water quantity and quality. Increased economic activities, particularly irrigated agriculture, and rapid growth of major urban areas have increased groundwater exploitation, particularly in the arid coastal areas of the country. Exploitation of these aquifers has greatly exceeded natural recharge, and in the case of some aquifers, where there is evidence of recharge, mining of groundwater has increased. The proliferation of unregulated groundwater usage in various sectors has begun to put a strain on economic activities and livelihoods.

29 This includes the 10 river basins prioritized by the project and additional river basins (Pisco, Moche, Rio Grande-Palpa-Ingenio-Nazca, Santa, Ica, San Juan [chincha], Casma, Tambo, Chicama, Viru, Olmos, Motupe, Huarmey, Napeña, Moquegua, Acarí, Cañete, Yauca, Pativilca, Ocoña, Jequetepeque, Chillíon, Ricmac, Lurín, Pampa Majes, Perene, Inambari, Alto Madre de Dios, Chamaya, Chinicipe, Alto Apurimac, Llave, Llpa, Coata, Ramis, Azángaro, Huancané, and Uchusuma).

10. ANA has begun the procedure to prepare the exploitation plans (or Management Plans) by evaluating the water balance and controlling inputs and abstractions closely, to achieve IWRM for the 'groundwater' resource.

11. Forty-eight prioritized aquifers were studied with a certain degree of detail and declared overexploited. The most affected are Chancay, Lambayeque, Chicama, Rimac, Ica, Villacurí, Lanchas, Nazca, and Caplina (La Yarada).

12. As part of this project, it is intended to implement urgent measures and instruments in four aquifer systems with a serious overexploitation situation: Caplina (La Yarada), close to Tacna City, and Ica, Villacurí, and Lanchas, within the Ica Valley. These valleys have been selected as 'pilot areas' to design and improve IWRM and highlighted as aquifers requiring urgent measures to combat the increasing groundwater table decline: Ica, Villacurí-Lanchas, and La Yarada-Los Palos in Caplina aquifer (in accordance with IX Title of the Water Resources Law and the IX title of its Regulation and Development Document). These valleys present the most severe water crisis in the Pacific watershed currently. The overexploitation rates have been rated up to 396.0 million m^3/year, equivalent to 76.33 percent of the whole Pacific watershed deficit.

13. Ica and Caplina Valleys are very important for the Peruvian economy due to their agro-industry, a fundamental sector for job creation and important contribution to GDP. The continuous expansion of the groundwater-dependent farmland has led to water scarcity, which has also worsened with the increasing quality deterioration of the groundwater resources, causing, to a certain extent, serious problems and conflicts between users. In all these cases, agriculture is severely threatened due to intense extractions of groundwater and embedded salinization problems.

14. ANA has banned the construction of new boreholes in Ica, Pampas de Villacurí, and Lanchas, as well as in La Yarada-Los Palos (coastal area of Tacna). Despite this ban, endorsed by the DS 007/2015, the number and depth of the wells in use has been increasing steadily in a significant and illegal manner in these areas until today. The overexploitation of the aquifer has worsened accordingly, bringing conflicts between formal users (both small and large scale), informal users, and water authorities.

Table 4.3. Brief Description of Targeted Aquifers

Parameter	Ica	Villacurí	Lanchas	Caplina
General condition	Ica Valley aquifer is integrated by unconsolidated quaternary deposits from the Ica River (fluvial-alluvial sediments). The surface of the valley is about 335 km^2. The bedrock is between 60 and 600 m deep, with permeable materials down to 240 m and a saturated thickness between 20 and 190 m. In isolated sectors—for example, Ocucaje—the groundwater table is about 5 m deep.	In Villacurí, the aquifer has an unsaturated behavior, with isolated semiconfined or confined areas. Lateral groundwater transfers from Ica Valley, rated at 76 million m^3/year, are their main source. Groundwater table ranges between 5 and 104 m.	Lanchas Valley aquifer is recharged, almost exclusively, by underground lateral transfers from Río Seco. Groundwater table ranges between 5 and 32 m. The water table decline has been estimated at 1.00 m/year since 2005. The salinization process by natural causes (gypsum and salt outcrops interbedded in the unsaturated zone) impedes any artificial recharge project for this area unless in isolated and well-studied sectors.	Caplina Valley has a flat bottom and steep sidewalls, over an aquifer integrated by quaternary gravel, grit, sand, and pebbles, with typical alluvial deposits of clay and mud. The deepest geophysical prospecting reached 650 m without presence of the substrate, which calls for direct exploratory drilling. Water balances in the aquifer ranges from 62 to 204 million m^3/year (2015), thus requiring a more accurate water balance for this aquifer. The aquifer suffers from saline water intrusion, reaching up to 6 km inland.
State of overexploitation	From 1974 to 2005, the water table declined from 0.10 to 0.60 m/year. Since 2005, the registered decline is between 0.25 and 0.8 m/year. The accumulated decrease is about 18 m average. Aquifer overexploitation (ANA, 2008): 56.08 million m^3/y (1.78 m^3/s)	(ANA, 2008): 97 million m^3/year (3.07 m^3/s)	(ANA, 2008): 25 million m^3/year (0.79 m^3/s)	According to references, hydrogeological sustainability would require an exploitation of groundwater similar to that in the 1990s.

Parameter	Ica	Villacurí	Lanchas	Caplina
Hydrological parameters	(a) **Permeability:** 0.98 x 10^{-3} to 2.70 x 10^{-3} m/s (b) **Transmissivity:** 0.4 x 10^{-2} m^2/s until 13.60 x 10^{-2} m^2/s (c) **Storage coefficient:** 0.1 to 10% (d) **Electric conductivity** ranges between 0.8 mmhos/cm a+25ºC to 1,0 mmhos/cm a 25ºC	(e) **Permeability**: 0.81 x 10^{-3} to 5.89 x 10^{-3} m/s (f) **Transmissivity** in Villacurí ranges between 1.45 x 10^{-2} and 4.28 x 10^{-2} m^2/s. (g) **Storage coefficient:** 0.1 to 9% (h) **Sustainable mean extractions rate**: 2 m^3/s in Villacurí (i) **Electric conductivity** is about 0.8 mmhos/cm, increasing by the middle of the valley to 1 until 2 mmhos/cm and even 5 to 7 mmhos/cm at the final part (next to the seaside).	(j) **Permeability:** 0.19 x 10-2 to 1.63 x 10-2 m/s (k) **Transmissivity** in Lanchas ranges between 1.151 x 10-4 and 9.39 x 10-4 m^2/s (Paracas zone). (l) -**Storage coefficient:** 4.0 to 6.3%. (m) **Sustainable mean extractions rate:** 0.5 m^3/s (n) **Electric conductivity** ranges between 0.39 and 6.61 mmhos/cm, maximum for the whole Ica Valley	Not available

15. **Need to show progress on implementation of the National Water Quality Strategy.** A national water quality assessment was carried out by ANA in 59 basins between 2000 and 2012, to determine water quality based on the following parameters: thermotolerant coliforms, arsenic, cadmium, and lead associated to discharges of wastewater; environmental mining liabilities, informal mining (where appropriate), and natural characteristics by geology; and quality of the water resources of irrigation drainage (Pacific and Atlantic watersheds) to determine water quality standards for domestic water supply and protection of ecosystems. In addition, biochemical oxygen demand and pH readings were collected. Information collated through this analysis supported the development of the National Water Quality Strategy.

16. This analysis highlighted the deterioration of water quality and identified 879 varying sources of contamination in a total of 25 hydrographic regions in the Pacific watershed. The majority confirmed contamination due to discharge of untreated wastewater, followed by dumping of solid waste and mining discharges. Likewise, in nine hydrographic regions of the Atlantic watershed, 470 sources of pollution were identified; 350 of these sources were identified as discharges of untreated wastewater, followed by dumping of solid waste and acid mine drainage from informal mining activities. Further, evaluation of three hydrographic regions of Lake Titicaca identified 24 sources of contamination, with 16 identified as discharge of untreated wastewater.

17. The National Water Quality Strategy, led by ANA, calls for the participation of all productive sectors and users of water resources to reduce sources of pollution. ANA's mandate is to interface with various entities that regulate discharge from specific sectors and monitor water quality of surface and groundwater resources. Pertinent entities who share the responsibility of monitoring discharges into water bodies are (a) the Ministry of Energy and Mining, which is responsible for the control of mining discharges, environmental supervision, and oversight for the development of mining; (b) the environmental regulator, the Agency for Environmental Assessment and Enforcement (*Organismo de Evaluación y Fiscalización Ambiental*), which is responsible for controlling discharge standard of pollutants for various productive sectors; and (c) MINAGRI, which is responsible for the management of agricultural waste control. The Water Supply and Sanitation regulator (*Superintendencia Nacional de Servicios de Saneamiento)* regulates efficiency of wastewater treatment and discharges. At the watershed level, the activities related to the final disposal of wastewater and solid waste is under the purview of the district and provincial municipalities, and regional governments control small-scale mining activities.

18. Activities to improve the quality of water resources are based on available information on their status, identification of causes, and management of final disposal and reuse of wastewater by the population and productive uses.

19. The deteriorating water quality has led to adverse impacts on quality of agro-exports, potable water supplies, and environmental health, to name a few. The deterioration of water quality not only restricts its use but also increases treatment costs to enable provision of potable water and ensure quality of irrigated agriculture. As these additional costs would result in the decline in indicators of economic capacity and life expectancy of the population settled in the prioritized basins, ANA, as part of its core functions, seeks to safeguard the quality of water resources.

20. The proposed actions through this project are based on the results of the evaluations carried out by ANA. It is necessary to scale up water quality monitoring efforts through the installation of 33 water quality control equipment and validate the results in the 10 prioritized basins. In addition to permanent stations, it is necessary to carry out mobile water quality campaigns in 30 hotspots identified through the diagnostic of the National Water Strategy to increase monitoring stations and systematization of results at the national level, formalize discharge licenses, and integrate data with the NWRIS.

21. **Inadequate legal, regulatory, and institutional framework to manage and ensure the safety of communities downstream of dams.** In Peru, dams and water reservoirs are constructed and used for the following purposes: irrigation for agricultural purposes, hydroelectric power production, drinking and industrial water supply, for multiple purposes (a combination of the abovementioned and can include drought and flood management), as well as to contain contaminated discharges from mining activities (mine tailings). Hydraulic infrastructure that has been implemented in Peru for many years is aimed at increasing the guarantee of water supply to populations and for all activities that depend on the availability of the resource for its economic and other purposes, as well as the security of the populations to critical situations of meteorological origin as are the floods and droughts. Currently, there are 743 large and small dams and reservoirs, as well as mine tailings dams.

22. There is lack of standardization and regulation of water infrastructure construction and operation for both public (for energy, water supply, and so on) and private sectors, including mining. With the exception of a few dams, the bulk of the hydraulic infrastructure has been decentralized to regional governments or managed by private entities. In many instances where water infrastructure was designed with monitoring instrumentation in accordance with best practices, regional governments lack the financial and human capacities to continue monitoring efforts. As such, the country's civil defense system does not have emergency protocols for water infrastructure nor early warning mechanisms. Due to the importance of dams and reservoirs for the country's welfare and economy, such as those selected in this project, their sustainability and safety has been a matter of continuous concern by authorities.

23. The need for legislation on dam safety has been identified for many years. Several initiatives have been developed since 1972, but they have not achieved the expected success due to different institutional and technical factors. The first normative instrument developed was the Standards of Inspection of Dams and Reservoirs, elaborated by the General Directorate of Water and Irrigation of the Ministry of Agriculture and approved by the Supreme Decree No. 253-72-AG of March 19, 1972. This entity no longer exists and its functions have been transferred to various government entities, including ANA.

24. Since then, proposals for strengthening institutions in charge of dam safety have been presented, including the creation of a Multisectoral Committee on Dam Safety, composed of government and private sector representatives, and a Dam Safety Regulation applicable throughout the country. The purpose of the regulation would be to regulate the safety of dams to make it possible to control their structural, hydraulic, and functional safety. Such proposals have been discussed in different opportunities from which a solid conceptual and consensual basis on the subject arose among the technical community. However, attempts to implement a dam safety policy have not progressed, mainly due to the lack of a legal and institutional framework at adequate levels of past administrations, and human and financial resources.

25. Currently there is no regulation nor any entity dedicated to monitoring the safety of dams and their proper O&M. The result is that operators of hydraulic infrastructure, with few exceptions, have neglected the monitoring, maintenance, and supervision of the safety actions of dams in Peru, in such a way that even the existing safety instrumentation is outdated or not operating at all, increasing their level of risk

26. According to the Water Resources Law No. 29338, ANA was given the responsibility for developing, controlling, and supervising the application of safety standards for the major hydraulic infrastructure in the country. The law establishes that it is the function of ANA to issue regulations and establish procedures to ensure the integral and sustainable management of water resources, issues in which dams are necessary to ensure the supply of water for multiple purposes, and the sustainability of the use and the benefits they provide.

27. The Water Resources Law establishes that license holders of water use have the obligation to maintain, in good

condition, the hydraulic infrastructure necessary for the use of water that was granted, on the terms and conditions established by the law and the regulation, and to allow inspections to be carried out or arranged by ANA, in fulfillment of its functions.

28. For this purpose, in the case of dams, ANA has to issue technical standards for the adequate management of potential risks associated with them and supervise its application. Standards are related to O&M of such structures, including monitoring, auscultation, inspections and reporting, to detect, correct, and avoid possible failures that may jeopardize their stability and, consequently, the life of the people, the continuity of the essential services, and the preservation of the assets of both the state and individuals.

29. In 2015, under the provisions of the law, ANA reviewed past proposals and prepared a new proposal for an Institutional Framework for the Safety of Dams with the characteristics of a system composed of an administrative structure, regulations, and risk management tools aimed at promoting public or private dam operators to internalize safety procedures in their O&M practices. This proposal was revised and consolidated in 2016 and is currently ready to be submitted for the approval process in the different administrative areas.

30. It comprises the creation of a Multisectoral Commission, in accordance with governmental rules, and a technical unit within ANA, to serve as technical secretariat of the Commission, each one with its respective competences.

31. The main tasks of the Multisectoral Commission would be to promote a culture of dam safety and to assess the implementation of the Regulation on Dam Safety by the owners[30] or operators, by periodically assessing the situation of the dams and reporting the results to the decision-making levels of the corresponding sectors. Also, the Commission would coordinate, promote, and establish plans, programs, and projects and follow up on the actions to be implemented by the sectoral entities according to their duties.

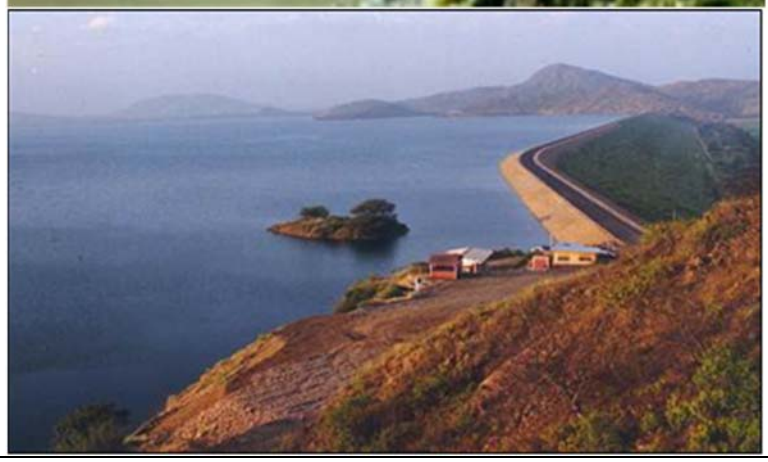
32. The regulation proposed by ANA still depends on its approval within the Authority and on adequate resources allocation for its implementation and enforcement, mainly human and financial resources. Also, training on dam safety principles and tools is needed for the technical unit staff and for the technical teams of dam owners and operators.

33. The proposed regulation establishes that the owner or operator of any dam will be responsible for its safety in each phase of its life cycle (planning, design, construction and operation, and decommissioning). The owner or operator must have the human, material, and economic resources necessary to ensure proper compliance with the regulation, starting by designating and keeping a person responsible for the operation and training his team on the procedures and actions required to maintain the safety of the dam.

34. The project aims to implement the abovementioned regulation on a pilot basis to a selected number of dams, limited in scope, based on their importance for storage and regulation of flows for irrigation and consequently for their economic importance for the country. The selected dams deserve special attention with regard to their monitoring and maintenance. International experience shows that the peaks in the number of incidents in this class of dams are high. Although ANA is not bound to regulate the safety of small dams, it is looking at strategic options for managing risks and playing a protagonist role in this matter. Six large dams are included: Poechos and San Lorenzo in Piura, Tinajones Dam in Lambayeque, Gallito Ciego Dam in La Libertad, and Condoroma Dam and El Frayle in Arequipa. These are representative of the diversity of the universe of dams in the country, thus ensuring that the results of this pilot program would apply to other dams, later on.

30 The reference to owners and/or operators is because some dams were transferred by the Government to local governments or water users' entities.

Table 4.4. Brief Description of the Selected Dams

San Lorenzo dam: Compacted earth, completed in 1958, 57 m high, 797 m crest length, useful volume of 259 million m^3. It is located in the district of Las Lomas, Sullana province, Department of Piura. It regulates the flows of the river Quiroz and supplies water to the San Lorenzo Irrigation district (41,590 ha).	
El Frayle dam: Concrete double curvature arch, completed in 1958, 74 m high, and 78 m long. It is located 78 km from the city of Arequipa. Its reservoir has a capacity of 200 million m^3 and irrigates the Pampas of La Joya. It was filled up in 1959, but on April 13, 1961, a chunk of the left bank suddenly collapsed. In spite of having been reinforced, its operation was limited to a useful volume of 130 million m^3.	
Tinajones dam: Compacted soil, completed in 1968, 40 m high and 2,400 m crest length, useful volume 320 million m^3. It regulates waters coming from the Conchano and Chotano Basins, which are drained into the Chancay river basin. The water is used for the irrigation of 111,000 ha on the coast of the Department of Lambayeque and to supply the population of Chiclayo, Lambayeque, Monsefú, Ferreñafe, Chongoyape, Reque, Pimentel, and Eten.	

Poechos dam: Compacted earth, completed in 1976, maximum height 48 m, crest length 11,170 m. It is located in the district of Lancones, in the channel of the river Chira, 30 km upstream of the city of Sullana, Department of Piura. It supplies water for irrigation in the Chira, Medio, and Bajo Piura Valleys (70,700 ha in total) and to the population of Sullana, Piura, and nearby towns. Its reservoir capacity of 1,000 million m^3 has been reduced to an estimated 500 hm^3 due to high sedimentation.

Gallito Ciego dam: Compacted earth, completed in 1987, maximum height 112 m, crest length 800 m. It regulates the surface waters of the Jequetepeque Basin. It has a capacity of 400 million m^3 and a useful volume of 372 hm^3, of which 95.5 percent is used to irrigate 42,000 ha of the Jequetepeque-Zaña agricultural valley, 4.4 percent for household use, and 0.1 percent for mining and industry.

Condoroma dam: Earth and rockfill, completed in 1985, 101 m high, 503 m long, located in the high Andean area, in the Colca/Chivay Basin. Its reservoir of 260 million m^3 is used to irrigate the Majes pampas (14,000 ha).

Huascacocha dam: (Earth dam)
Located in the Department of Junin, in the province of Yauli and part of the Mantaro River Basin. It has a height of 20 m and storage capacity of 45 million m^3. It is part of a series of dams that are operated jointly by EDGEL (energy production) and *Servicio de Agua Potable y Alcantarillado de Lima* for water supply to Lima.

Sutunta: (Earth and rockfill dam)
Located in the Department of Cusco, province of Espinar. It is a concrete dam with a height of 19.75 m and a storage capacity of 35 million m^3. It is primarily used for agriculture (irrigates an area of 5,000 ha), livestock rearing, and domestic water supply.

35. **Low water use efficiency in irrigated agriculture related to lack of measurement and control.** Approximately 80 percent of the available water is used in the agricultural sector. However, it is estimated that the average efficiency of water use is less than 40 percent. In 2004, more than 95 percent of agricultural users were informal. The Formalization of Water Use Rights for Agricultural Purposes Program was implemented, which introduced the concept of a block that essentially is a unit of water demand or organization that will use water in a set of plots or productive units, which have in common a water source and an irrigation canal—a hydraulic structure of capture, conduction, and distribution and/or regulation. The block allows the allocation of water and the granting of the rights and use of water for agricultural purposes to a water user association. At the same time, a water control and measurement structure in a block allows the quantification of water deliveries to the block and the control of the water use rights granted. Knowing the amount of water delivered to the block and the water consumed by the crops will allow for monitoring and enforcement of efficient of water use.

36. During 2004–2015, 6,389 blocks have been formed at a national level with an area of 992,890 ha supporting 511,210 users. With the objective of quantifying the amount of water delivered to the blocks, at the request of the ANA Subsectorial Program of Irrigation, projects were prioritized to install 627 water control and measurement structures in blocks in 19 water user associations of the Peruvian coast.

37. Through the WRMMP, 148 automated measurement and control structures and equipment were installed in six pilot basins: Locumba-Sana-Caplina, Quilca-Chili, Chancay-Huaral, Chancay-Lambayeque, Chira-Piura, and Tumbes, with the objective of continuously monitoring the delivery of water to the blocks and enforcing water rights. These structures have been put into operation for the generation of hydrological information.

38. **Limited water resources information to better inform planning and management of water resources**. The Water Resources Law (Law No. 29338) created and defined the NWRIS, identifying its purpose and members. The law stipulates that ANA is the governing body of the integrated system and is responsible for implementing and managing the NWRIS.

39. The NWRIS was developed under the previous World Bank engagement, the WRMMP, and is supported by a robust technological platform composed of high-caliber hardware and software, with a framework to safeguard availability, confidentiality, and information integrity.

40. This technological platform allows the flow of information on which the daily operations are developed and utilized by ANA at the central, regional, and basin levels and also offers availability to various stakeholder and end users. Despite notable advances in development of the architecture of the NWRIS and integration of data collected from monitoring systems established in six pilot basins in the Pacific watershed, the NWRIS has many weaknesses and requires strengthening to integrate years of old historical records that are only available in paper format. In addition to capturing historic data, efforts are needed to standardize data quality and control to ensure that data captured from numerous manual monitoring systems conform to the standard format and can be easily integrated into the NWRIS.

41. The current NWRIS is hosted at the national level at ANA with connections to Decision-making Rooms or nodes established in the 14 hydrographic regions (AAA) and six at the basin level in the Pacific watersheds. All decentralized rooms rely on a single-server architecture that is precarious and requires backup and strengthening to ensure that it can cope with increased amounts of data that will be entered into the system from the expansion and modernization of monitoring systems, increase in use by the various Decision-making Rooms, and the establishment of new ones in the four targeted basins in the Atlantic watershed. There are no technological mechanisms to safeguard the availability of databases and disaster recovery features.

Characteristics of Targeted Basins in the Pacific Watershed

42. **Puyango Tumbes Basin (5,285 km^2).** The Puyango-Tumbes basin is located in northern Peru. It is a binational basin, composed by neighboring territories of the Department of Tumbes in Peru and Loja and El Oro in the southeastern provinces of Ecuador. The main rivers of the basin are the Tumbes and the Zarumilla. The water balance that was carried out as part of the river basin plan is positive for the Tumbes River and negative for the Zarumilla River. That same diagnostic identifies water quality problems during the rainy season. The mining activity to the north of the Calera and Amarillo Rivers, which is part of the Puyango River catchment, generates a series of environmental issues due to tailings discharged without adequate treatment, with severe ecological effects downstream: the Calera River is a dead river in more than 20 km. Cyanide levels exceed 5 mg/liter, which eliminates any form of aquatic life and limits its use for irrigation. The basin has 20 water quality measurement points of which only 1 is automatic. The river

basin plan diagnostic has identified a high flooding vulnerability during El Niño, affecting the lower part of the basin; despite the installation of an information node in the AAA of Jequetepeque-Zarumilla, as part of the IDB Project, there is still no early warning system in place.

43. The Tumbes CC, through its river basin plan, has identified 187 activities in six main topics: improvement of water availability, preservation of water quality, reduction risks, institutional improvement, improvement of water culture, and improvement of water financing. These activities amount to an estimated investment of US$193 million in five years.

44. **Chira-Piura Basin (9,987 km^2).** The Chira-Piura Basin is located in the northern part of Peru in the Department of Piura. The Chira-Piura Basin is an artificial basin formed by two naturally independent river basins that have been hydraulically connected by the Chira-Piura Special Project that transfers water from the Chira River Basin (regulated by the Poechos dam) to the Piura River Basin. The river basin plan that was prepared by the Chira-Piura CC, with the support of the AAA of Jequetepeque-Zarumilla and the local water authority of the Chira-Piura Special Project, provided a good assessment of water resources and the existing hydraulic infrastructure but there is still not enough available information that allows detailed hydrogeological characterization of groundwater aquifers nor reliable information of volumes used. Regarding water quality, deterioration is mainly caused by untreated domestic discharges and the lack of maintenance to existing oxidation lagoons for municipal wastewater treatment. Soil drainage and salinity problems are a serious problem in the basin due to low irrigation efficiency, permanent flooding irrigation, inefficient maintenance of the drainage network, ignorance of best practices in saline soil washing, and lack of drainage works at the parcel level. At the national level, the Piura River Basin is one of the areas with the highest risk of flooding. The existing defense system (188 km of dikes and piers/breakwaters) needs to be rehabilitated.

45. The Chira-Piura CC, through its river basin plan has identified 32 main activities in six main topics: improvement of water availability, preservation of water quality, reduction risks, institutional improvement, improvement of water culture, and improvement of water financing. These activities amount to an estimated investment of US$635 million for 2015–2020. This investment includes hard (infrastructure) and soft (O&M and technical assistance) investments.

46. **Chancay-Lambayeque Basin (5,555 km^2).** The Chancay-Lambayeque river basin is located in northern Peru. The basin encompasses the Department of Lambayeque and the Department of Cajamarca in the upper part. The basin hosts the Tinajones Project, one of the oldest and most important hydraulic projects of Peru, which derives water from the Conchano and Chotano River Basins to the Chancay River Basin and regulates and distributes water to 111,000 ha of agricultural land located on the Department of Lambayeque. The river basin plan that was prepared by the Chancay-Lambayeque CC, with the support of the AAA of Jequetepeque-Zarumilla and the local water authority of the Olmos-Tinajones Special Project, identified the main issues pertaining the management of water resources in the basin. Around 43.02 percent of the potentially arable area (46,760 ha) has from slight to severe drainage and salinity problems due to a lack of maintenance and inadequate irrigation practices; part of this land is no longer cultivated because of its severity. Regarding water quality, the sources of water pollution in the basin are urban, industrial, agricultural, and mining discharges. The river basin plan also identified that 84,642 houses and 109,660 ha are at risks from flooding and droughts, respectively. The previous World Bank project has contributed to the installation of hydrometeorological stations and an information node with basic hydrometeorological data but the implementation of an early warning system for flooding and a drought monitoring system are still lacking.

47. The Chancay-Lambayeque CC, through its river basin plan, has identified the need to invest a total of US$860 million for the planning horizon of 2014–2028 in six main topics: improvement of water availability, preservation of water quality, reduction risks, institutional improvement, improvement of water culture, and improvement of water financing. The main focus of these planned investments focuses on the improvement of hydraulic infrastructure to

increase water availability in the basin.

48. **Chancay-Huaral basin (3,480 km^2).** The Chancay-Huaral River Basin, located to the north of the Department of Lima, covers the province of Huaral, the province of Canta, and a part of the province of Lima. Surface water resources consist of the natural drainage of the basin, complemented by the contributions of snowmelt and water regulated by upstream lakes, including water transfers from the Mantaro River Basin lakes. The river basin plan that was prepared by the Chancay-Hural CC, with the support of the AAA of Cañete-Fortaleza and the local water authority of Chancay-Huaral, identified an annual water demand in the basin of 374 million m^3 per year. Despite apparent availability of water resources, there is a water deficit in the period of droughts in mid sub-basins; four projects of small dams are being analyzed. The diagnostic performed as part of the river basin plan also identified water quality deterioration in many areas of the basin due to domestic and agricultural discharges. The Chancay-Huaral Basin is also very vulnerable to floods and landslides (*huaycos*), for which a risk characterization is yet to be made.

49. The Chancay-Huaral CC, through its river basin plan, has identified 48 interventions that amount to a total of PEN 200 million for the planning horizon of 2014–2035 in six main topics: improvement of water availability, preservation of water quality, reduction risks, institutional improvement, improvement of water culture, and improvement of water financing. Around 60 percent of the investment corresponds to hydraulic infrastructure for the regulation of water resources in the basin and the improvement of water quality (wastewater treatment plants and sewerage systems).

50. **Quilca-Chili Basin (13,817 km^2).** The Quilca-Chili Basin is located in the southwest of Peru and encompasses most of the Arequipa Province. The Quilca-Chili Basin is made from 15 hydrological sub-basins. In the Andamayo, Mollebaya, and Yarabamba sub-basins, water resources are mainly groundwater (springs, leaks, and return waters). The main characteristics of the Quilca-Chili Basin are its biological, ecological, and cultural diversity. There are five natural protected areas: Salinas and Aguada Blanca, which are national reserves, and El Rayo, El Nevado del Pichu-Pichu, and the Colca Valley, which are regional reserves. The main water users of the basin are agricultural, mining (the main user is the Mining Society of Cerro Verde), water supply for Arequipa (700,000 inhabitants, with an estimated demand of 3.5 m^3/s) and hydropower (the hydroenergetic system installed in the basin has a capacity of 175 MW, using a maximum flow of 24 m^3/s). The river basin plan that was prepared by the Quilca-Chili CC, with the support of the AAA of Caplina Ocoña and the local water authority of Chili and Colca-Siguas-Chivay, provided a good assessment of water resources identifying the following issues: the Quilca Valley is affected by poor drainage and salinity problems in agricultural lands; the untreated water from Arequipa is derived for irrigation; and for domestic use in rural areas posing health threats, the hydrological balance scenarios performed in the basin show a water deficit, which especially affects agriculture.

51. To address these issues, the Quilca-Chili CC, through its river basin plan, has identified the need to invest a total of US$1,000 million for the planning horizon of 2014–2021 in six main topics: improvement of water availability, preservation of water quality, reduction risks, institutional improvement, improvement of water culture, and improvement of water financing. Over 50 percent of this investment is targeted to activities to improve water quality (improvement of monitoring points and monitoring devices and improvement of sewerages services and wastewater treatment plants).

52. **Locumba-Sama-Caplica Basin (14,389 km^2).** The Locumba-Sama-Caplica Basin is located in the south of Peru, north of Chile, southeast of the Moquegua region, and southwest of the Department of Puno. The Locumba-Sama-Caplica basin covers the Department of Tacna and part of the Department of Moquegua. The river basin plan that was prepared by the Quilca-Chili CC, with the support of the AAA of Caplina Ocoña, provided a good assessment of water resources identifying the following issues: limited water availability (yearly water balance deficit of 8.6 m^3/s), rapid

deterioration of water quality (the main causes are domestic discharges and the excessive use of nitrogen and phosphatic agrochemicals in agricultural activities), and poor information on actual water use and its geographical distribution. The main issues on the basin relate to the use of groundwater.

53. Groundwater resources have not yet been fully investigated. The Pampas de la Yarada aquifer, the most important aquifer in the area, consists of a great reservoir of groundwater of an extension of 844 km^2 and several hundreds of meters of depth. The basin has an estimated potential of 100 m between Calientes and Tacna, more than 200 m in the Tacna-Magollo sector, between 700 and 900 m in Pampas de la Yarada, and between 800 and 1,000 m between Palos and Pampas de Hospicio and the border with Chile. The Yarada-Hospicio aquifer contains 18,706 million m^3 of groundwater. Groundwater moves from the northeast to the southwest toward the Pacific Ocean. In Yarada Antigua, due to overexploitation, the water table is below sea level, which causes problems of marine intrusion of more than 6 km. In this area, water levels fall by an average of 0.69 m/year. A total of 502 wells have been counted, of which 326 are used with a total exploitation volume of 116,654.04 m^3 per year; 397 wells have no water exploitation license. ANA has banned access to this aquifer and prohibits drilling new wells: works to improve existing infrastructure, storage and regulation systems, and a proposal to monitor and control exploitations in the Yarada aquifer.

54. To address the main issues of WRM, the Locumba-Sama-Caplica Basin CC, through its river basin plan, has identified the need to invest a total of US$817 million for the planning horizon of 2014–2029 in six main topics: improvement of water availability, preservation of water quality, reduction risks, institutional improvement, improvement of water culture, and improvement of water financing. Over 50 percent of this investment is targeted to activities to improve the service of water providers (mainly irrigation and water supply).

55. The development of the river basin plans has allowed to develop a more integrated diagnostic of the water resources situation in each basin and to develop and prioritize the investment needs. Despite these achievements, there is still a lack of defined mechanisms for the financing of the participatory IWRM Plans. Moreover, there are still areas in the WRM tools that need to be strengthened in these basins: the mechanisms to enforce water rights are still weak and ANA's control of water withdrawals is still insufficient; the monitoring of water quality is still manual and not frequently done; and water information products are still limited and only basic data is available (for example, floods have become recurrent events in these basins and there is still a lack of early warning systems). These activities are included in all of the river basin plans but have not been implemented. Additionally, the CCs still need to strengthen their technical capacities and knowledge for WRM to monitor and track the implementation of the river basin plans.

Characteristics of Selected River Basins in the Atlantic Watershed

56. **Mantaro Basin (34,547 km^2) is located in the central zone of Peru.** It encompasses the Departments of Ayacucho, Huancavelica, Junín, Lima, and Pasco. The main urban center in the basin is the city of Huancayo. The basin contains two major hydropower plants that supply 34 percent of the country's energy, contributing to the provision of energy in Lima, Ica, and the north of Peru. The Mantaro Basin also hosts an important water reserve (110 million m^3/year), being targeted for a water transfer to supply the increasing demand of Lima City (P*royecto de Trasvase* '*Obras de Cabecera y Conducción para el Abastecimiento de Agua Potable para Lima*', formerly *Proyecto Marca* II). The basin is a major agriculture contributor, considered an important breadbasket for Lima and other urban centers. It is also a major exporter of nontraditional products. Seventy percent of the agriculture in the basin is rainfed and highly vulnerable to climatic variability.[31] Growing mining activities and the increase of untreated waste water have contributed to the deterioration of water quality in the basin, leading to several water-related conflicts (for example,

31 Vergara, Walter, Alejandro Deeb, Irene Leino, Akio Kitoh, and Marisa Escobar. 2011. *Assessment of the Impacts of Climate Change on Mountain Hydrology*. Washington DC: The World Bank.

Junin Lake). The main water conflicts have occurred between farmers and fish-farms in the canal Quichuay-Santa Rosa-Huanchor; conflicts between ANA and farmers refusing to be monitored for water consumption have also been recorded.

57. **Alto Mayo Basin (7,940 km^2) is located in the north of the San Martin Department, in the Andean-Amazon transitional zone in the north of Peru.** It belongs to the Rio Mayo Basin, a tributary of the Huallaga River part of the Amazon River Basin. The basin contains virgin rainforests that are known to be some of the most biodiverse forests in the world and home to many endangered species. The Alto Mayo Protected Forest spans 182,000 ha geared at preserving these natural resources. Despite its protected status, the forest has some of the country's highest deforestation rates.[32] Increased migration and settlement in the area, coupled with poor land use practices, including deforestation through slash and burn mechanisms for coffee and cacao growth, have contributed to a deterioration of water resources in quantity and quality. As a result, landslides (*huaycos*) are common in the upper basin (in the tributaries of the main river), causing numerous road blockages and property loss. The use of water resources is still very informal (only 30 percent of agricultural users have formalized their water rights), leading to a lack of control on water resources use.

58. **Urubamba basin (58,735 km^2) is part of the Amazon River Basin, located in southeastern Peru.** This basin is fed by glaciers from the Vilcanota Andean Cordillera, augmented by runoff from nearby glaciers and ultimately drains into Lake Titicaca, a major tributary of the Amazon River.[33] The information on water use from both the agricultural and the urban sector is still very limited, ANA's water rights formalization program has not been implemented in this basin, the monitoring of urban water uses is still weak, and groundwater abstractions have not yet been accounted. Pressure on water resources comes mainly from urban water supply (the basin hosts the city of Cuzco, one of the country's most densely populated cities) and agriculture (9 irrigations projects for an estimated total of 20,000 ha are planned for this basin, which would lead to an additional demand of 245.82 hm^3/year). Conflicts over water resources are frequent (16 conflicts registered in the *Defensoría del Pueblo*). Some of the main conflicts recorded are against the development of hydropower projects (Sallca Dam) and the increasing development of mining activities with impacts on water quality (Kallpa mining affecting Qoriqocha lagoon). The main impacts on water quality are untreated urban water discharges, agricultural runoff, and mining (tail dams in the upper sub-basins of Vilcanota and Yavero). Particularly, the impact of mining on water resources is growing in the basin as a result of the increase of illegal mining activities. The main climatic risks in the Urubamba basin are droughts, cold spells, and the occurrence of hail in the upper basin, affecting the agricultural activities in the Andean highlands zones (above 3,000 meters above sea level).

59. **Pampas Basin (23,236 km^2) is located in the eastern Andes in southeastern Peru.** This river belongs to the Atlantic hydrographic system.[34] Part of the water resources of the upper Alto Pampas Basin (110 hm^3/year) are transferred to the Ica Basin in the Pacific region, for agricultural and urban water supply, through a series of hydraulic infrastructure works to improve the regulation capacity of the Orcococha, Choclococha, and Caracocha lake system. The main water conflict is linked to this water transfer, opposing inhabitants of the Department of Huancavelica to the Regional Government of Ica. The rural community of Carhuancho in Huancavelica demands to be part of the CC of Ica arguing that the hydraulic basin has been artificially opened and should now include the basin where the transfer originates. Since 2015, ANA, with the support of the WRMMP, has promoted the development of dialogue workshops bringing together water users from the river basins of Ica and Huancavelica. The main agreements that have been reached are (a) the creation of a bi-regional commission with the participation of the national government, (b) the creation of a technical board to support the management of water resources, (c) acknowledgement of the water rights

32 MINAM. 2013. *Mecanismos De Retribución Por Servicios Hídricos Para La Cuenca Del Alto Mayo. Departamento De San Martín, Perú.*
33 Leavell, Daniel, and Cesar Portocarrero. *Sustainability of Peruvian Water Resources in Light of Climate Change*. Ohio State University. http://www.iwra.org/congress/resource/MADRID2003_DANIEL_LEAVELL_EN.pdf
34 ANA. 2010. *Evaluación de Recursos Hídricos Superficiales en la Cuenca del Río Pampas.* Lima.

of the communities of Alto Pampas and Tambo-Ica-Santiago, and (d) the requirement of previous consultation for the development of new water projects. Additionally, flooding events are common in the Pampas Basin, recurrently threatening lives and property. Quality of available water resources have deteriorated due to uncontrolled discharge of effluents from wastewater, industry (livestock), and mining. This affects agricultural activities and ecosystems because the water supply for human consumption mainly comes from natural springs.

ANNEX 5: ECONOMIC ANALYSIS

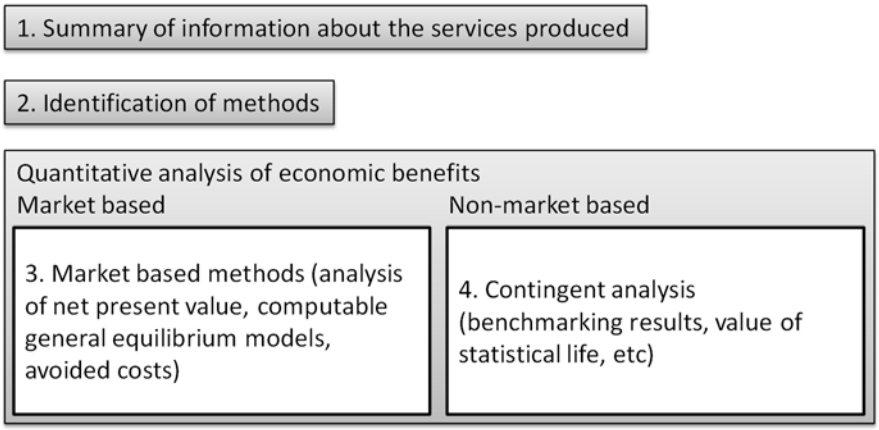
COUNTRY: Peru
Peru Integrated Water Resources Management in Ten Basins

I. Introduction to Economic Evaluation

1. Improving WRM includes a range of co-benefits in several sectors and for the general public, making the economic analysis of potential impacts a complex task. Instead of trying to be an exhaustive compendium of all the expected impacts, the present analysis aims to evaluate some of these for which quantitative information can be obtained and to establish conservative assumptions with the intention of considering only the impacts attributable to the Project. In this way, this valuation can be understood as a lower limit of the benefits, which will undoubtedly be broader.

2. On one hand, there are direct economic effects affecting productive sectors such as agriculture or energy that can be measured with market information. But on the other hand, there are many other indirect effects derived from the improvement on decisions resulting from a better information system, the reduction of conflicts related to water, and so on, that also generate economic value, although they are not considered in market mechanisms (that is, reductions of mortality rates, environment protection, reduction of conflicts, and so on). Therefore, a combination of market and non-market methods are necessary for carrying out the economic assessment of this kind of water-related project. Figure 5.1 outlines the steps followed for this process.

Figure 5.1. Steps in the Methodology



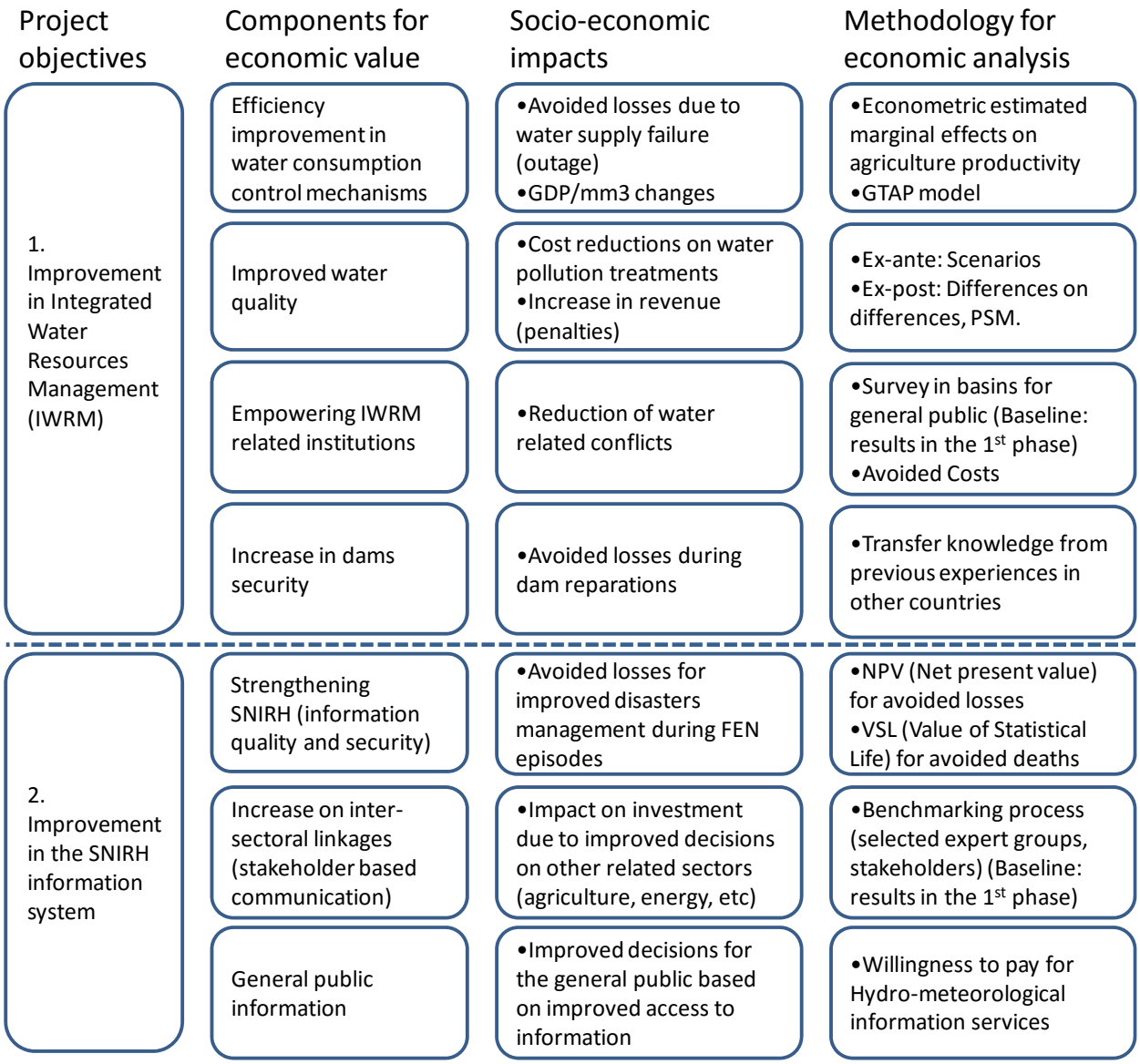
Source: Own elaboration based on Lazo (2008).[35]

II. Methodological Framework for the Analysis

3. Figure 5.2 shows the main objectives of the Project and the specific components that have been considered for the economic evaluation.

35 Lazo, J. K., R. S. Raucher, T. J. Teisberg, and R. F. Weiher. 2008. *Manual de economía para los servicios meteorológicos e hidrológicos nacionales*. http://www.sip.ucar.edu/pdf/Manual_de_economia_para_SMHN.pdf

Figure 5.2. Methodological Framework for the Cost-benefit Analysis



Note: FEN = Extreme Weather Events related to *El Niño* Southern Oscillation; PSM = Propensity Score Matching; SNIRH = National Water Resources Information System.

4. This analysis is based on the main objectives of the Project: (a) improvement in IWRM, and (b) improvement in the NWRIS. The socioeconomic impacts identified as a response to these two main objectives and the main components of the Project are also presented in Figure 5.2, jointly with the proposed methodology for the analysis. In the methodological framework, it is important to point out that the economic impacts are responding to changes in decision-making processes improved by a better information system, empowered institutions, or more efficient management mechanisms. The Project will be implemented by the IWRM-related institutions, but the consequences of that will highly depend on the use that the stakeholders will make of these improved processes. This is why the economic value lies in the Project's ability to involve users in its implementation and therefore, some of the mechanisms proposed for evaluation are based on surveys to stakeholders.

III. Results: Cost-Benefit analysis

Improved Water Management: Averted Drought Agricultural Losses

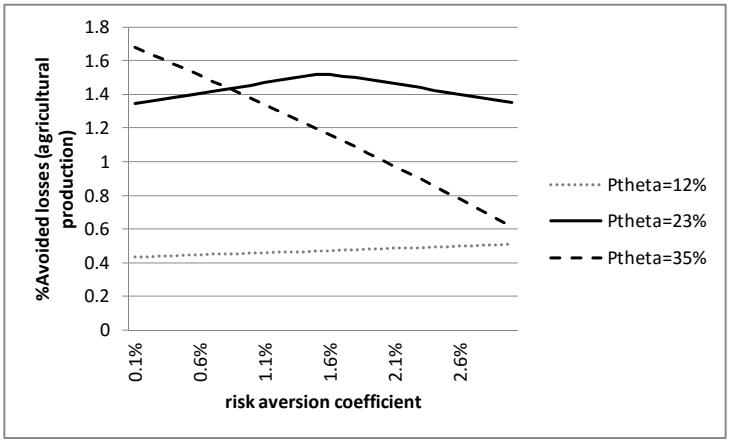
5. One of the objectives of the Project is to improve water allocation for farmers. Quiroga et al. (2011)[36] developed a model for the estimation of monetary gains due to improved water allocation for agriculture. The analysis uses this model calibrated for crop production in Peru to compute the averted losses for increased water reliability in drought periods as a result of the Project. Marginal effects on agriculture productivity during drought conditions have been estimated from time series of crop production and climate conditions data (30 years) for the agricultural-intensive region of Ica. Water and drought elasticities are estimated for a number of crops (see Table 5.1).

Table 5.1. Water and Drought Elasticity for Representative Crops (Representative Site: Ica Region)

Elasticity	Grapes	Potato	Maize	Avocado	Oranges	Cotton	Wheat	Olives	Barley	Average
Water	0.40	0.10	0.00	0.20	0.40	0.10	0.10	0.80	0.10	0.24
Drought	−7.00	−6.40	−0.40	−3.10	−5.40	−3.20	−20.80	−29.40	−3.20	−8.77

6. The average on these estimations is considered for the model calibration and the percentage of avoided losses was calculated for three drought probability scenarios (Pθ = 0.12; 0.23; 0.35) and considering risk aversion (sensitivity analysis from 0.1 to 3.0) (Quiroga et al. 2011). Results from the model are shown in Figure 5.3. The analysis follows a conservative approach; so for the estimation of total losses, the minimum value of 0.43 percent of agricultural production is computed.

Figure 5.3. Potential for Avoided Losses (% of Agricultural Production) for an Improved WRM in Drought



Source: Own elaboration.

7. The potential for averted losses have been calculated by applying the estimated percentage to the current agricultural added value in the intervened river basins. Figure 5.2 shows the results.

36 Quiroga, S., L. Garrote, A. Iglesias, Z. Fernández-Haddad, J. Schlickenrieder, B. De Lama, C. Mosso, and A. Sanchez-Arcilla. 2011. "The Economic Value of Drought Information for Water Management under Climate Change: A Case Study in the Ebro Basin." *Natural Hazards and Earth System Sciences* 11: 1–15.

Table 5.2. Potential for Averted Losses in the Agriculture Sector as a Result of Improved Water Management in Drought Conditions

River Basins	Crop	Production Averted Losses (potential) (Tons)	Current Price (perceived from farmers) (PEN/ton)	Avoided Losses (US$, millions)
Tumbes	Rice	52,921.9	1,198	18.7
	Lemon	9,026.4	1,415	3.8
	Banana	55,357.2	700	11.5
	Maize (duro)	702.3	1,297	0.3
Piura	Maize	30,732.7	975	8.9
	Rice	159,428.2	1,202	56.6
	Banana	104,034.6	683	21.0
	Mango	14,664.7	525	2.3
	Lemon	63,523.3	928	17.4
	Grapes	63,336.2	2,561	47.9
	Cotton	4,317.5	3,375	4.3
	Coffee	1,726.7	8,119	4.1
Chancay-Lambayeque	Maize	37,179.5	908	10.0
	Rice	142,739.5	1,177	49.6
	Lemon	22,829.2	928	6.3
	Beans	1,893.3	1,960	1.1
	Cotton	2,812.6	3,528	2.9
	Pallar	1,728.6	2,680	1.4
	Sugarcane	1,244,818.8	90	33.1
Chancay-Huaral-Lima	Maize	100,279.2	918	27.2
	Potato	63,856.8	553	10.4
	Aji	3,779.6	1,105	1.2
	Avocado	28,589.2	2,009	17.0
	Cotton	1,486.1	2,395	1.1
	Mandarin	91,676.0	1,429	38.7
	Apple	63,913.1	709	13.4
	Sugarcane	743,041.0	139	30.6
Quilca-Chili	Rice	114,780.3	1,128	38.3
	Onion	188,750.9	885	49.4
	Potato	137,491.6	694	28.2
	Quinua	13,199.6	6,919	27.0
	Beans	3,491.3	4,471	4.6
	Garlic	25,797.9	2,285	17.4
	Sugarcane	40,691.9	109	1.3
Caplina Locumba	Potato	3,152.2	694	0.6
	Onion	3,849.4	1,197	1.4
	Aji	3,257.6	1,497	1.4
	Grapes	2,892.6	1,980	1.7
	Origan	4,689.6	5,500	7.6
	Olives	49,612.6	1,770	25.9
Moyobamba (San Martin)	Maize	54,360.0	709	11.4

River Basins	Crop	Production Averted Losses (potential) (Tons)	Current Price (perceived from farmers) (PEN/ton)	Avoided Losses (US$, millions)
	Rice	278,630.7	1,002	82.5
	Banana	200,044.7	446	26.4
	Palm (oil)	68,092.7	406	8.2
	Coffee	25,718.5	6,591	50.1
	Cacao	15,668.1	6,920	32.0
Mantaro (Junin)	Wheat	5,841.1	1,256	2.2
	Maize (yellow)	7,580.5	820	1.8
	Maize (amilaceo)	8,150.3	2,179	5.2
	Barley	10,322.8	1,281	3.9
	Quinua	4,541.7	7,517	10.1
	Potato	176,657.8	440	23.0
	Banana	85,244.9	518	13.0
	Coffee	13,280.8	7,505	29.5
	Cacao	5,633.2	6,584	11.0
	Oranges	109,694.4	383	12.4
Vilcanota-Urubamba (Cuzco)	Wheat	9,582.1	1,596	4.5
	Maize(yellow)	2,083.4	1,527	0.9
	Maize (amilaceo)	31,458.3	2,862	26.6
	Barley	13,235.4	1,321	5.2
	Quinua	1,266.7	8,132	3.0
	Potato	164,717.5	838	40.8
	Beans	40,201.4	1,127	13.4
	Wheat	9,639.7	1,596	4.5
	Coffee	10,168.0	7,306	22.0
	Cacao	8,530.6	5,384	13.6
Huancavelica	Maize (amilaceo)	11,584.8	2,042	7.0
	Barley	11,065.6	884	2.9
	Quinua	383.6	5,047	0.6
	Beans	3,315.3	3,224	3.2
	Potato	101,360.5	540	16.2
	Broad bean	13,362.9	1,037	4.1
	Pea	7,389.6	1,568	3.4
	Alfalfa	58,850.0	163	2.8

8. The results from Table 5.2 show a total potential for averted losses of US$1,143 million in the 10 river basins in the Project. In this analysis, an averted losses reduction factor of 20 percent has been considered and only half of the averted losses have been considered as attributed to the Project (considering the possibility of other funding sources affecting the objectives too).

Indirect Impact on GDP through the Change in Land Productivity

9. Average changes in land productivity can have indirect effects in other sectors. Here, these effects have been computed through a Computable General Equilibrium (CGE) Model analysis. The CGE comprises a representation of most economic sectors, where countries are linked through the volume of trade, prices in international markets and financial flows. A change in relative prices induces effects on the general equilibrium that are transferred to the entire economy as a whole. The CGE considered for this analysis of the effects of the impacts of changes in productivity on GDP changes is the Global Trade Analysis Project (GTAP) model. The database has been aggregated, as shown in Table 5.3.

Table 5.3. GTAP Aggregation for this Analysis

Regions	Sectors	Factors
Peru Rest of the World	Agriculture Energy Manufactures and Services	Land and natural resources Labour Capital

10. Table 5.4 shows the results from the GTAP model for economic changes as a response to the increase in land productivity resulting from the improved water management in drought episodes. As can be observed, the impacts include the adjustment to other sectors in the economy, because the model considers the interactions between intermediate inputs and the markets for other goods and the links between factor remuneration and consumer income, among others.

Table 5.4. Economic Changes as a Response to the Increase in Land Productivity

	Added Value (% change)	Firms Price of Value Added (% change)	Market Price of Commodities (% change)	Value of Exports (% change)
Agriculture	0.1038	−0.1419	−0.0947	0.3076
Energy	0.0081	−0.0053	−0.0016	0.0177
Manufactures and services	0.0200	−0.0200	0.0106	−0.0439
GDP change (% change)	**0.0114**			
GDP (US$, millions)*	**189,100**			
Productivity effects (US$, millions)**	**1,293**			

Source: Own elaboration.
Legend: * 2015 World Bank database; ** Based on estimated % GDP changes avoiding double accounting for direct effects.

Cost Reductions on Water Pollution Treatments for Improved Water Quality

11. Table 5.5 shows the current operational costs for water treatment in the main river basins considered in the Project for water volume. For calculating the reduction rate, the World Health Organization (WHO) estimation of US$3.5 benefits per each US$1 invested in water quality was considered. Thus, a US$4.2 million of investment in water quality will result in US$14.7 million in reduction of cost, equivalent to 2.5 percent of the overall water treatment costs.

Table 5.5. Total Operational Cost for Water Treatment and Water Volume in Urban Areas

River Basins	Company	Volume (m^3)	Total Costs (US$, millions)
Six pilot basins			
Tumbes	Atusa (aguas de tumbes)	6,298,837	3.4
Chira-Piura	Eps grau s.a.	36,312,476	31.7
Chancay-Lambayeque	Epsel sa	30,982,193	22.7
Chancay-Huaral	Emapa cañete sa	6,037,837	2.3
	Emapa huaral sa	3,518,343	1.5
Quilca-Chili	Sedapar sa	44,531,839	30.2
Caplina-Locumba	Eps tacna sa	15,215,117	7.2
Four pilot basins			
Alto Mayo	Sedapar srl (rioja)	498,282	0.4
	Emapa moyobamba	2,019,738	1.4
	Emapa san martín sa	8,553,783	4.0
Pampas Apurimac	Emusap abancay sac	2,740,503	1.1
	Emsap chanka scrl	1,074,681	0.2
Mantaro	Epsasa	9,953,204	3.3
	Eps sierra central srl	1,789,555	0.5
	Eps selva central sa	6,592,142	1.2
	Eps mantaro sa	3,707,949	0.9
	Sedam huancayo sac	19,495,148	5.5
	Emapa huancavelica	1,946,554	0.9
	Emapa pasco sa	4,172,956	0.4
	Emsapa yauli srl	417,239	0.2
Urubamba	Sedacusco sa	13,049,789	10.1
Total (US$, millions)	**589.6**		
Potential reduction (US$, millions)*	**14.7**		

Source: ANA 2016; (* Based on OMS estimation of US$3.5 benefits per US$1 invested.

Avoided Losses through Reduction of Conflicts: Empowered Water Institutions

12. In this analysis, the baseline conditions are based on the survey collected in the final evaluation of the WRMMP. To minimize potential biases, the design of the survey was discussed with the water authorities, who improved the questionnaire considering local aspects. The initial values for the Willingness to Pay (WTP) were selected considering the recommendation in World Meteorological Organization (2015) and to limit the vehicle bias, the WTP needed to be asked as a percentage of incomes (instead of absolute values). In the survey, the percentage of income associated with the reduction of conflicts was 15 percent of averted benefits. Table 5.6 shows some data on averted benefits on mining projects that were paralyzed or delayed by social conflicts or administrative barriers.

Table 5.6. Averted Benefits on Mining Projects Paralyzed or Delayed by Social Conflicts or Administrative Barriers (in million US$)

Phase	Impacts	2008	2009	2010	2011	2012	2013	2014	Total	Yearly Average
Investment	**Direct impact**	26	877	2,385	5,678	6,340	4,832	1,377	21,515	3,073.6
	Total impact	37	1,263	3,435	8,176	9,130	6,958	1,983	30,982	4,426.0
	Taxes	4	137	372	886	989	754	215	3,357	479.6
	Employment (1,000)	4	152	414	986	1,101	839	239	3,735	533.6
Production	**Direct impact**	0	0	0	49	3,424	6,307	14,860	24,640	3,520.0
	Total impact	0	0	0	72	5,033	9,271	21,844	36,220	5,174.3
	Taxes	0	0	0	3	191	353	831	1,378	196.9
	Employment (1,000)	0	0	0	4	268	493	1,161	1,926	275.1
Total	**Direct impact**	26	877	2,385	5,727	9,764	11,138	16,237	46,154	6,593.4
	Total impact	37	1,263	3,435	8,248	14,164	16,229	23,828	67,204	9,600.6
	Taxes	4	137	372	888	1,180	1,106	1,046	4,733	676.1
	Employment (1,000)	4	152	414	990	1,368	1,332	1,401	5,661	808.7

Source: *Instituto Peruano de Economía* 2015.

13. The *Defensoría del Pueblo* (2016)[37] reports that 70.3 percent of the social conflicts are conflicts for environmental issues (including water management). Averted benefits have been computed on the basis of the 70.3 percent of the reported benefits in Table 5.6. Apart from the direct economic losses due to conflicts, a number of deaths have happened as a result of these conflicts too. Table 5.7 shows the reported deaths from 2006 to 2011 as a result of social conflicts.

Table 5.7. Number of Deaths due to Social Conflicts

Year	Number of Deaths due to Social Conflicts
2006	13
2007	41
2008	37
2009	52
2010	31
2011	21
Total	195
Yearly average	32.5

Source: Defensoría del Pueblo, 2016.

14. The Value of Statistical Life (VSL) methodology has been used to compute the economic value for the potential avoided deaths as a consequence of water conflicts. OECD (2012)[38] presents a detailed description of the method and a meta-analysis of values presented in different studies and different countries. There is no single study in Peru, but

37 Defensoría del Pueblo. 2016. Reporte de Conflictos Sociales no. 152.
38 OECD. 2012. "Mortality Risk Valuation in Environment, Health and Transport Policies." http://www.oecd.org/env/tools-evaluation/mortalityriskvaluationinenvironmenthealthandtransportpolicies.htm.

we have used the value presented for a study conducted in a group of studies in Chile for being the most similar context in this database (and the only ones in Latin America). This study uses an average value for VSL of US$0.69 million per person (yearly value). Table 5.8 shows the total values estimated for the potential economic losses (direct losses) and the VSL for avoided deaths. The resulting total potential averted losses are about US$1,028 million, as reported in Table 5.8.

Table 5.8. Total Potential Averted Losses for Avoided Water Conflicts

Average percentage of reduced losses from survey in the previous project (*)	15%
Potential economic losses (direct)	US$1,012.38 million
Potential economic losses (avoided deaths VSL)	US$15.68 million
Total potential losses	US$1,028.06 million

Source: Own elaboration; (*) Results of surveys in river basins for the economic evaluation of WRMMP.

Dam Safety Improvement: Computing Averted Benefits

15. In this analysis, only the averted benefits derived from dam safety improvements are considered, because of lack of information about remediation costs. The potential averted benefits considered are avoided irrigation benefit losses and hydropower benefits. Table 5.11 shows the data about irrigated land and hydro-power production. Crop intensity and prices are not available for this area, but Enriquez (2016)[39] estimated at US$3,000 /ha the agricultural value of irrigated land in the region (based on the return of organic banana). The analysis considers this value as a reference. Enriquez (2016) also estimated the value of hydro-power at US$40 per MW per year. On the basis of these values, the potential averted losses have been calculated. Table 5.9 shows the results. A total potential of US$115.3 million results from improvements in dam safety. This value is very low because of the limited information on some of the dams considered and also because only small part of the potential benefits (averted benefits) are considered.

Table 5.9. Potential Averted Losses due to Improved Dam Safety

Dams (districts)	Storage Capacity (Million m^3)	Irrigated Area (Ha)	Irrigation Benefit (US$, millions)	Hydropower (MW)	Hydropower Benefit	Potential Averted Losses (US$, millions)
Presas Poechos (Sullana/Lancones)	407.0	108,000.0	97.2	41.0	14.2	30.1
San Lorenzo (Las Lomas/Tambo Grande)	200.0	150,000.0	135.0	n.a.	n.a.	36.5
Presa Tinajones (Chongoyape)	308.0	85,000.0	76.5	95.0	32.8	29.5
Presa Limón (Pomahuaca)	44.0	n.a.	n.a.	n.a.	n.a.	n.a.
Presa Gallito Ciego (Yonan)	372.0	64,000.0	57.6	40.0	13.8	19.3
Presa El Frayle (San Juan de Tarucani)	127.0	n.a.	n.a.	n.a.	n.a.	n.a.
Total	1,458.0	407,000.0	366.3	176.0	60.8	**115.3**

Source: Own elaboration from ANA (2015) and Enriquez (2016).

39 Enríquez, J. 2016. Estado hidrológico, hidráulico y sedimentológico de los embalses en la Región Piura (Tesis de pregrado en Ingeniería Civil). Universidad de Piura. Facultad de Ingeniería. Programa Académico de Ingeniería Civil. Piura, Perú.

Benchmarking Process: Impacts of the NWRIS and Improvement in the Avoided Losses for better DRM

16. To calculate the impacts of an improved NWRIS in the avoided losses for better DRM episodes, a literature review of historical losses is presented in Table 5.10 for the FEN in the 1982–83 and 1997–98 periods. Average values for the potential avoided losses are calculated considering average losses for DRM episodes and the baseline results in the benchmarking process in the economic evaluation of WRMMP that computed a 40 percent of avoided losses due to the NWRIS contribution.

Table 5.10. Losses in the DRM Episodes in 1982 and 1997 in Peru and the Avoided Losses Computed for the Project Implementation (NWRIS Improvement)

DRM Period	Impact Considered	Losses (US$, millions)	Source of Data
1982–83	Agriculture and fishing (losses in exports)	71.00	Memorias BCP (1983)
1982–83	Social impact	147.00	Ferradas (2000)
1982–83	Impact in the mining sector	175.00	Memorias BCP (1983)
1982–83	Production losses	397.00	Ferradas (2000)
1982–83	Impacts in infrastructure	456.00	Ferradas (2000)
1982–83	Total direct losses	1,000.00	Ferradas (2000)
1982–83	Total losses	2,000.00	Rocha-Felices (2007)
1982–83	Total direct losses	3,283.00	CAF (2000)
1997–98	Economic losses in Tumbes, Piura, Lambayeque, and La Libertad (FEN extraordinary)	1.03	Investment Guarantee Fund (1998)
1997–98	Effect in trade balance	1,382.00	Memorias (1998)
1997–98	Total direct losses	1,612.00	CAF (2000)
1997–98	Total indirect losses	1,888.00	CAF (2000)
1997–98	Total losses	3,501.00	CAF (2000)
Average total direct economic impact		**US$2,129.67 million**	
Benchmarking baseline (based in the WRMMP)		**40%**	
Improved disasters management due to the NWRIS		**US$851.87 million**	

Source: Own elaboration from literature review.

WTP Methods for Valuation of Benefits of the NWRIS for General Public

17. To calculate the co-benefits that a potential improvement of the NWRIS service would have on households, this analysis considers the values found in the literature for the WTP for an improvement in those services. There is an important uncertainty associated to this value, so given the conservative nature proposed for this analysis, the lowest value of those reported has been used. It computes US$5 per year per household. This value has been estimated on the basis of a survey collected in households in Mozambique, whose economy is much less developed than the economy in Peru, so this value is considered as a lower limit that would greatly underestimate the value of the benefits to households. The total population in Peru is 31.1 million people, and the average number of persons per household is 3.8 (ENDES 2014), so the analysis considers a total of 8.2 million of households and this results in US$40.99 million as total WTP for general public for the potential improvement.

Development of Scenarios for Ex-ante Evaluation: Level of Implementation and Uncertainty

18. Once the potential benefits of the Project being calculated for each of the components are analyzed, it is necessary to estimate the effectiveness of the IWRM in 10 river basins with regard to achieving the potential benefits.

To tackle this task, the following steps have been followed: (a) definition of scenarios for ex-ante rates of implementation of the Project, (b) aggregation of the potential benefits estimated for each component, and (c) cost-benefit analysis of the Project for the proposed scenarios. To keep conservative assumptions, the Project effectiveness rate evolution in this report ranges from 0 to 50 percent during the implementation period. The maximum rate program effectiveness is not achieved in a linear trend but it has been defined as a path of accumulation of improvements based on the actions proposed in the Project. However, the benefits have been computed on the basis of a long term (15 years). This is due to the type of investment, oriented to produce durable effects in the economy of the country. As the intention is to keep the benefits in a conservative assumptions profile, an averted losses reduction factor of 20 percent has been considered, and computed only half of the averted losses as attributed to the Project. Additionally, sensitivity analyses for three different scenarios and for different discounted rates have been conducted.

(a) **Scenario 1 (estimated).** Considers the estimated benefits and accounted costs for the project.
(b) **Scenario 2 (lower bond).** Considers a sensitivity analysis of +20 of accounted costs and −20 percent of estimated benefits.
(c) **Scenario 3 (upper bond).** Considers a sensitivity analysis of −20 of accounted costs and +20 percent of estimated benefits.

NPV for the Cost-benefit Analysis

19. **Calculating the NPV consists of discounting future cash flows.** Table 5.11 shows the potential benefits attributed to the Project and Table 5.12 shows the results for the NPV of the Project for a range of discount rates (from 3.5 to 6.5). The Project shows high returns even in a conservative assumptions framework.

Table 5.11. Potential Benefits Attributed to the Project on a Yearly Basis

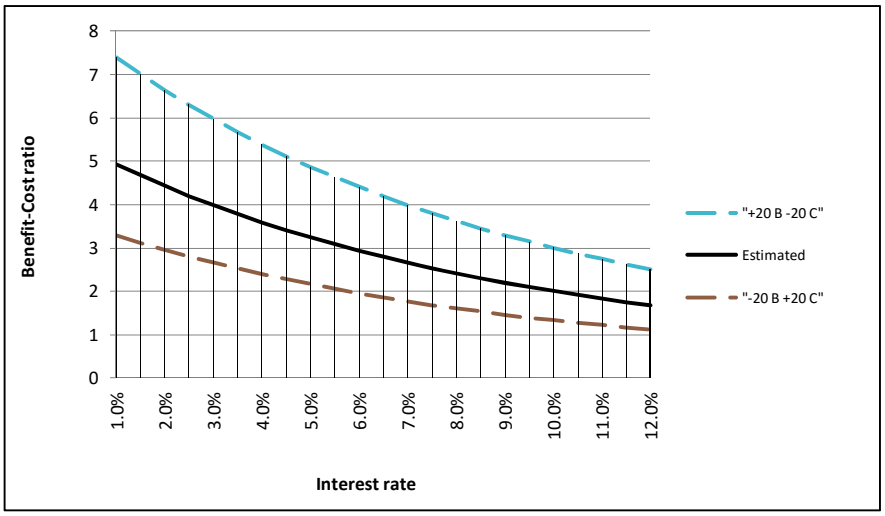
Drivers	Type of Impact	Benefits Attributed to the Project (yearly) (US$, millions)
Improved drought management	Direct economic losses avoided	114.30
Increased water productivity	Impact on GDP	129.34
Reduced costs of water treatment	Treatment cost reduction	1.47
Empowered institutions	Water conflicts losses avoided and avoided deaths	102.81
Improved dam safety	Averted losses from collapse	11.53
Improved NWRIS (institutional cooperation)	FEN economic losses avoided	85.19
Improved general public information (NWRIS)	WTP from households	4.10

Table 5.12. NPV of the Project Benefits for Different Discount Rates (3.5 to 6.5%)

Interest rate (%)	NPV (15 years)
3.50	1,053.71
4.00	1,000.70
4.50	950.82
5.00	903.86
5.50	859.63
6.00	817.95
6.50	778.66

20. The benefit-cost ratio has been computed for the three scenarios described earlier and the results are shown in Figure 5.4. The sensitivity analysis of the three scenarios is presented in Figure 5.4 in the face of significant variations in the discount rate (between 1 percent and 12 percent). It can be observed that in all cases, the Project shows benefits that exceed costs, because the benefit-cost ratio is greater than 1 for all scenarios and for any discount rate considered. For this reason and because the assumptions in this analysis are in the conservative lower bound, it is considered that the expected benefits of this Project are robust to the possible sources of uncertainty.

Figure 5.4. Cost-benefit Ratio for the Three Considered Scenarios with Sensitivity Analysis to Discount Rate



ANNEX 6: MAPS

COUNTRY: Peru
Peru Integrated Water Resources Management in Ten Basins


80°W
75°W
70°W
0°
5°S
10°S
15°S
COLOMBIA
ECUADOR
BRAZIL
BOLIVIA
CHILE
PACIFIC OCEAN
ATLANTIC
PACIFIC
LAKE TITICACA
PERU
Tumbes
Piura
Chiclayo
Chachapoyas
Moyobamba
Iquitos
Cajamarca
Trujillo
Pucallpa
Huaraz
Huánuco
Cerro de Pasco
Huacho
Callao
LIMA
Huancayo
Huancavelica
Ayacucho
Abancay
Cusco
Puerto Maldonado
Ica
Puno
Arequipa
Moquegua
Tacna
San Lorenzo Dam
Poechos Dam
Tinajones Dam
Gallito Ciego Dam
Huascacocha Dam
VILLACURÍ
LANCHAS
ICA
Sutunta Dam
Condoroma Dam
El Frayle Dam
CAPLINA
Lago Titicaca
Marañon
Ucayali
Huallaga
Pachitea
Urubamba
Madre de Dios
Yavari
Amazonas
Putumayo
Napo
Tigre
Corrientes
Santiago
Purús
Jamiri
0 100 200 Miles
0 100 200 Kilometers
PERU
INTEGRATED WATER RESOURCES MANAGEMENT PROJECT
PROJECT DAMS
PROJECT AQUIFERS
MAJOR RIVER BASINS
SUB-RIVER BASIN BOUNDARIES
REGION CAPITALS
NATIONAL CAPITAL
INTERNATIONAL BOUNDARIES
WORLD BANK GROUP
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