No.

REPUBLIC OF PERU

MINISTRY OF AGRICULTURE･AGRORURAL

PREPARATORY SURVEY
FOR
THE PROGRAM OF SMALL AND MEDIUM IRRIGATION INFRASTRUCTURE IN THE SIERRA, PERU

FINAL REPORT (Pre-F/S)

September 2009

JAPAN INTERNANATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.

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REPUBLIC OF PERU

MINISTRY OF AGRICULTURE･AGRORURAL

PREPARATORY SURVEY
FOR
THE PROGRAM OF SMALL AND MEDIUM IRRIGATION INFRASTRUCTURE IN THE SIERRA, PERU

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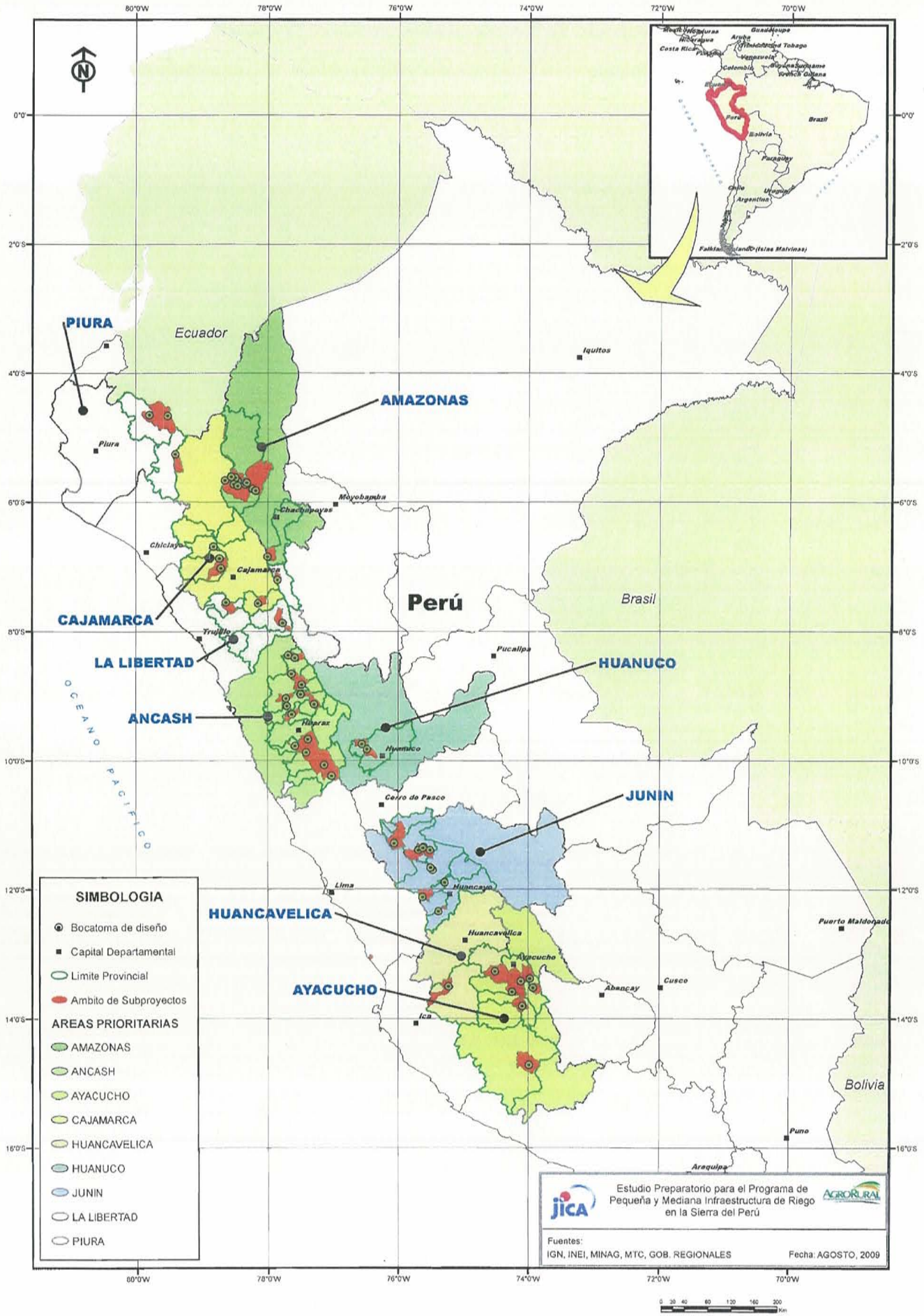
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AMAZONAS
CAJAMARCA
LA LIBERTAD
ANCASH
HUANUCO
JUNIN
HUANCAVELICA
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Perú
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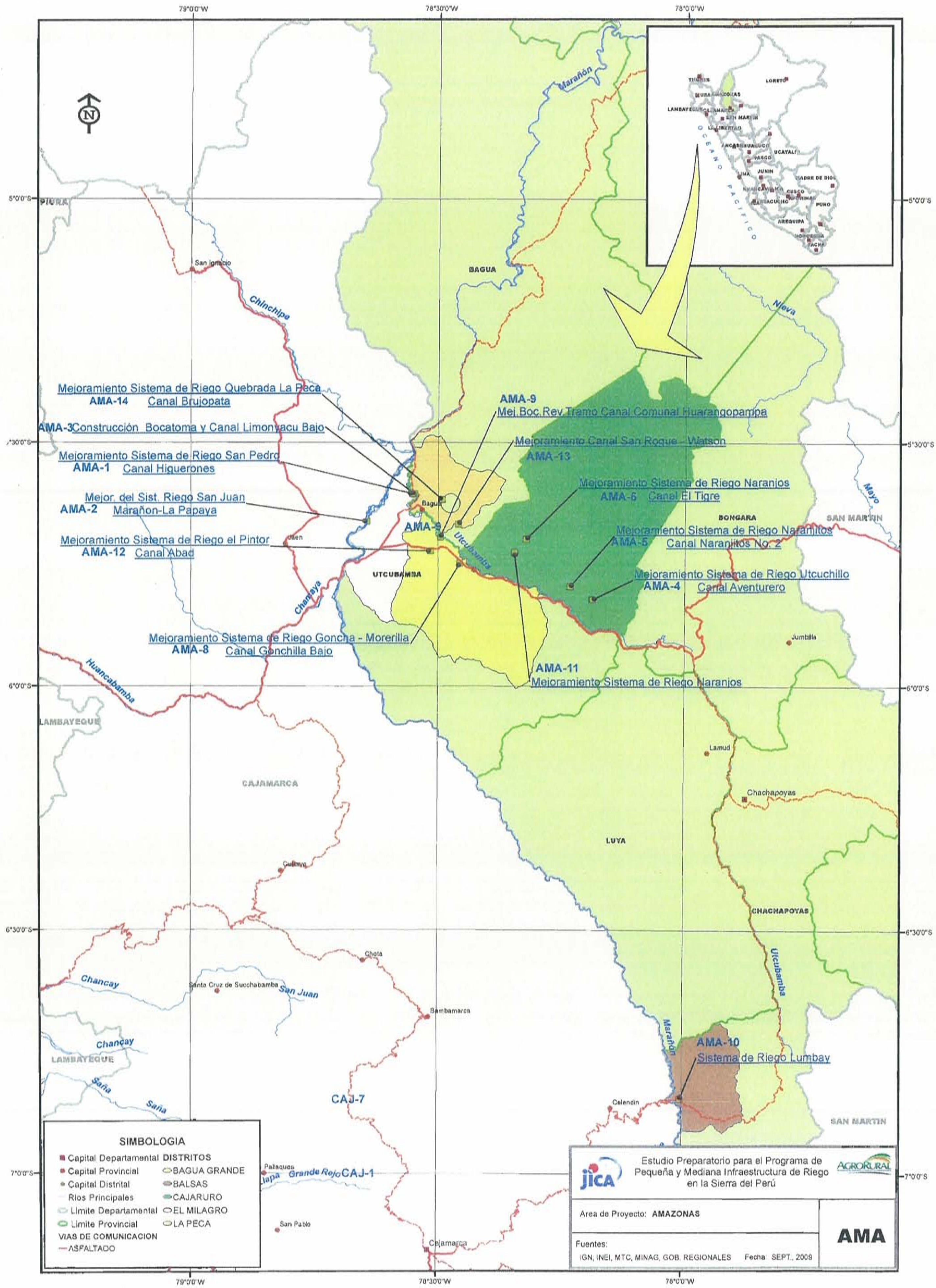
Bolivia
Iquitos
Piura
Moyobamba
Chachapoyas
Chiclayo
Cajamarca
Trujillo
Pucallpa
Huaraz
Huanuco
Cerro de Pasco
Lima
Huancayo
Huancavelica
Ayacucho
Abancay
Cusco
Ica
Puerto Maldonado
Puno
Arequipa
OCEANO PACIFICO
SIMBOLOGIA
Bocatoma de diseño
Capital Departamental
Limite Provincial
Ambito de Subproyectos
AREAS PRIORITARIAS
AMAZONAS
ANCASH
AYACUCHO
CAJAMARCA
HUANCAVELICA
HUANUCO
JUNIN
LA LIBERTAD
PIURA
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
Fuentes:
IGN, INEI, MINAG, MTC, GOB. REGIONALES
Fecha: AGOSTO, 2009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Chinchipe
Marañon
BAGUA
Nieva
OCEANO PACIFICO
LORETO
AMAZONAS
LAMBAYEQUE
CAJAMARCA
SAN MARTIN
LA LIBERTAD
ANCASH
HUANUCO
UCAYALI
PASCO
JUNIN
LIMA
MADRE DE DIOS
CUSCO
AYACUCHO
APURIMAC
PUNO
AREQUIPA
MOQUEGUA
TACNA
Mejoramiento Sistema de Riego Quebrada La Peca
AMA-14 Canal Brujopata
AMA-9
Mej.Boc.Rev.Tramo Canal Comunal Huarangopampa
AMA-3 Construcción Bocatoma y Canal Limonyacu Bajo
Mejoramiento Canal San Roque - Watson
AMA-13
Mejoramiento Sistema de Riego San Pedro
AMA-1 Canal Higuerones
Mejoramiento Sistema de Riego Naranjos
AMA-6 Canal El Tigre
Mejor. del Sist. Riego San Juan
AMA-2 Marañon-La Papaya
Bagua
BONGARA
SAN MARTIN
Mayo
AMA-9
Mejoramiento Sistema de Riego Naranjitos
AMA-5 Canal Naranjitos No. 2
Mejoramiento Sistema de Riego el Pintor
AMA-12 Canal Abad
Jaen
Utcubamba
UTCUBAMBA
Mejoramiento Sistema de Riego Utcuchillo
AMA-4 Canal Aventurero
Chamaya
Mejoramiento Sistema de Riego Goncha - Morerilla
AMA-8 Canal Gonchilla Bajo
Jumbilla
Huancabamba
AMA-11
Mejoramiento Sistema de Riego Naranjos
LAMBAYEQUE
Lamud
CAJAMARCA
Chachapoyas
LUYA
Cutervo
CHACHAPOYAS
Chota
Chancay
Santa Cruz de Succhabamba
San Juan
Bambamarca
Utcubamba
Marañon
Chancay
LAMBAYEQUE
AMA-10
Sistema de Riego Lumbay
Saña
Saña
CAJ-7
Celendin
SAN MARTIN
SIMBOLOGIA
Capital Departamental
Capital Provincial
Capital Distrital
Rios Principales
Limite Departamental
Limite Provincial
VIAS DE COMUNICACION
ASFALTADO
DISTRITOS
BAGUA GRANDE
BALSAS
CAJARURO
EL MILAGRO
LA PECA
Pallaques
Jequetepeque
Grande Rejo CAJ-1
San Pablo
Cajamarca
JICA
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
AGRORURAL
Area de Proyecto: AMAZONAS
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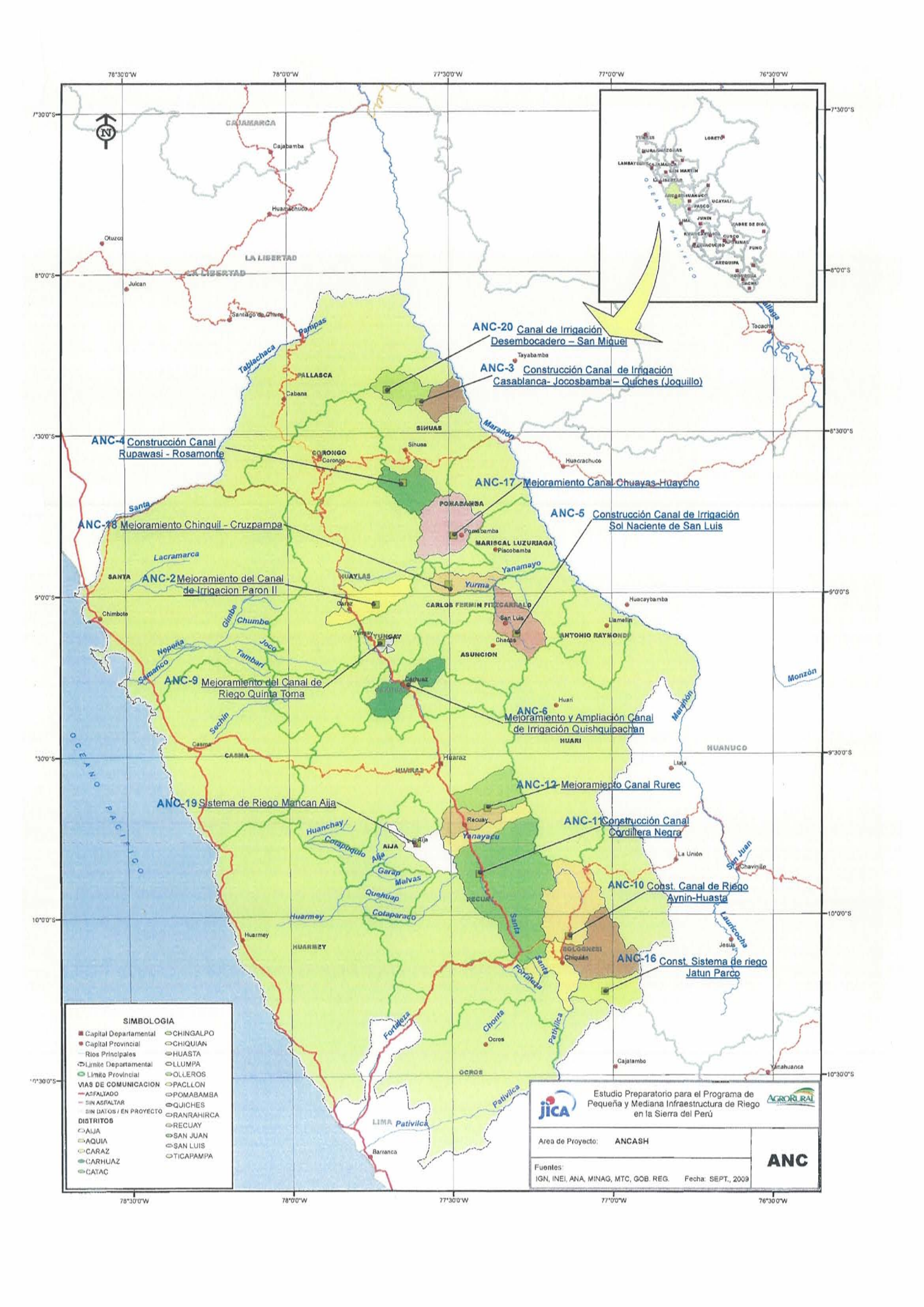
Fuentes:
IGN, INEI, MTC, MINAG, GOB. REGIONALES
Fecha: SEPT., 2009


ANC-20 Canal de Irrigación Desembocadero – San Miguel
ANC-3 Construcción Canal de Irrigación Casablanca- Jocosbamba – Quiches (Joquillo)
ANC-4 Construcción Canal Rupawasi - Rosamonte
ANC-17 Mejoramiento Canal Chuayas-Huaycho
ANC-5 Construcción Canal de Irrigación Sol Naciente de San Luis
ANC-18 Mejoramiento Chinquil - Cruzpampa
ANC-2 Mejoramiento del Canal de Irrigacion Paron II
ANC-9 Mejoramiento del Canal de Riego Quinta Toma
ANC-6 Mejoramiento y Ampliación Canal de Irrigación Quishquipachan
ANC-12 Mejoramiento Canal Rurec
ANC-19 Sistema de Riego Mancan Aija
ANC-11 Construcción Canal Cordillera Negra
ANC-10 Const. Canal de Riego Aynin-Huasta
ANC-16 Const. Sistema de riego Jatun Parco
SIMBOLOGIA
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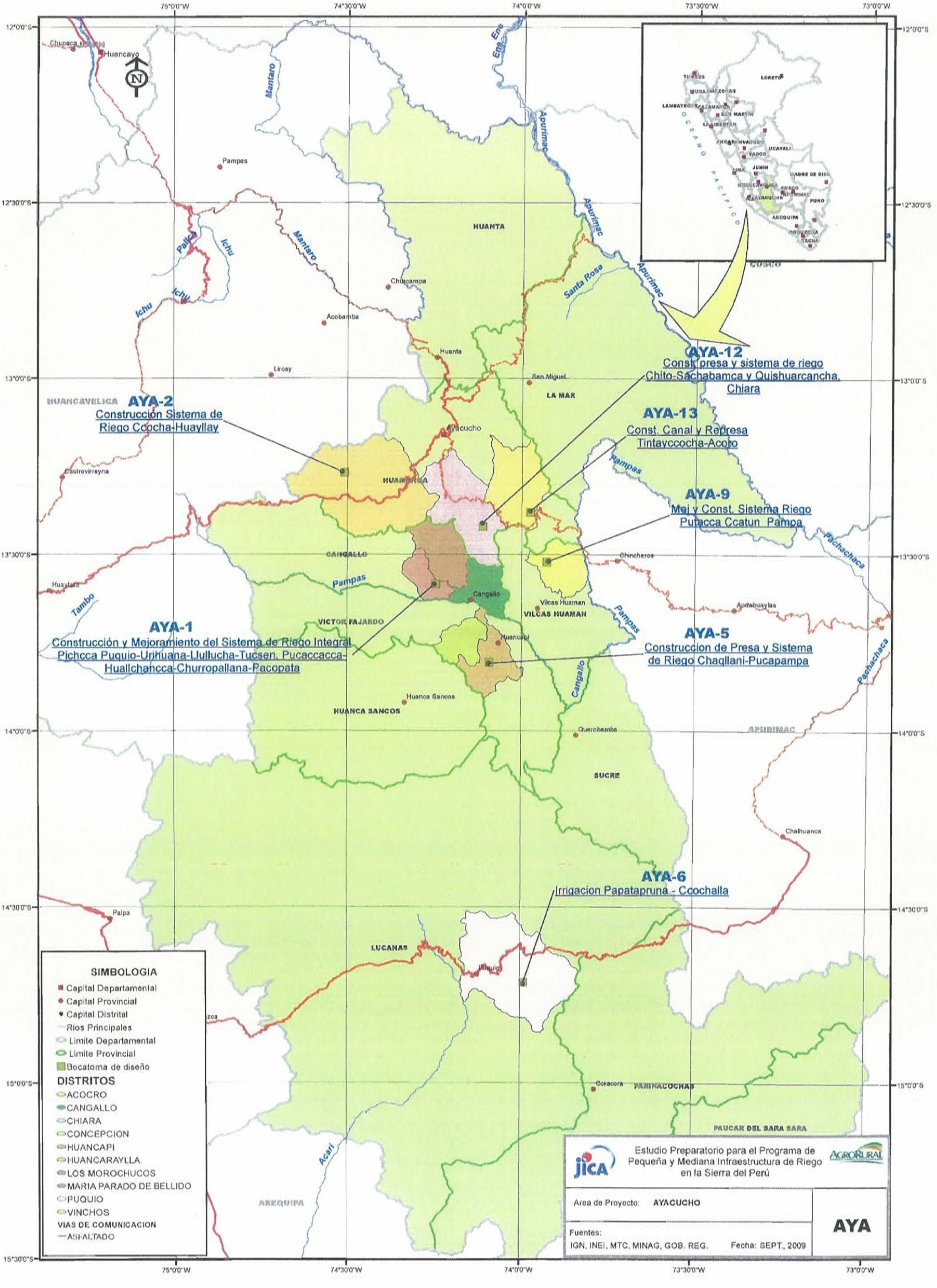
Capital Provincial
Rios Principales
Limite Departamental
Limite Provincial
VIAS DE COMUNICACION
ASFALTADO
SIN ASFALTAR
SIN DATOS / EN PROYECTO
DISTRITOS
AIJA
AQUIA
CARAZ
CARHUAZ
CATAC
CHINGALPO
CHIQUIAN
HUASTA
LLUMPA
OLLEROS
PACLLON
POMABAMBA
QUICHES
RANRAHIRCA
RECUAY
SAN JUAN
SAN LUIS
TICAPAMPA
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
Area de Proyecto: ANCASH
ANC
Fuentes:
IGN, INEI, ANA, MINAG, MTC, GOB. REG. Fecha: SEPT., 2009



AYA-12
Const. presa y sistema de riego Chito-Sachabamca y Quishuarcancha, Chiara
AYA-2
Construccion Sistema de Riego Ccocha-Huayllay
AYA-13
Const. Canal y Represa Tintayccocha-Acoro
AYA-9
Mej y Const. Sistema Riego Putacca Ccatun Pampa
AYA-1
Construcción y Mejoramiento del Sistema de Riego Integral Pichcca Puquio-Urihuana-Llullucha-Tucsen, Pucaccacca-Huallchancca-Churropallana-Pacopata
AYA-5
Construccion de Presa y Sistema de Riego Chaqllani-Pucapampa
AYA-6
Irrigacion Papatapruna - Ccochalla
SIMBOLOGIA
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Capital Provincial
Capital Distrital
Rios Principales
Limite Departamental
Limite Provincial
Bocatoma de diseño
DISTRITOS
ACOCRO
CANGALLO
CHIARA
CONCEPCION
HUANCAPI
HUANCARAYLLA
LOS MOROCHUCOS
MARIA PARADO DE BELLIDO
PUQUIO
VINCHOS
VIAS DE COMUNICACION
ASFALTADO
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
Area de Proyecto: AYACUCHO
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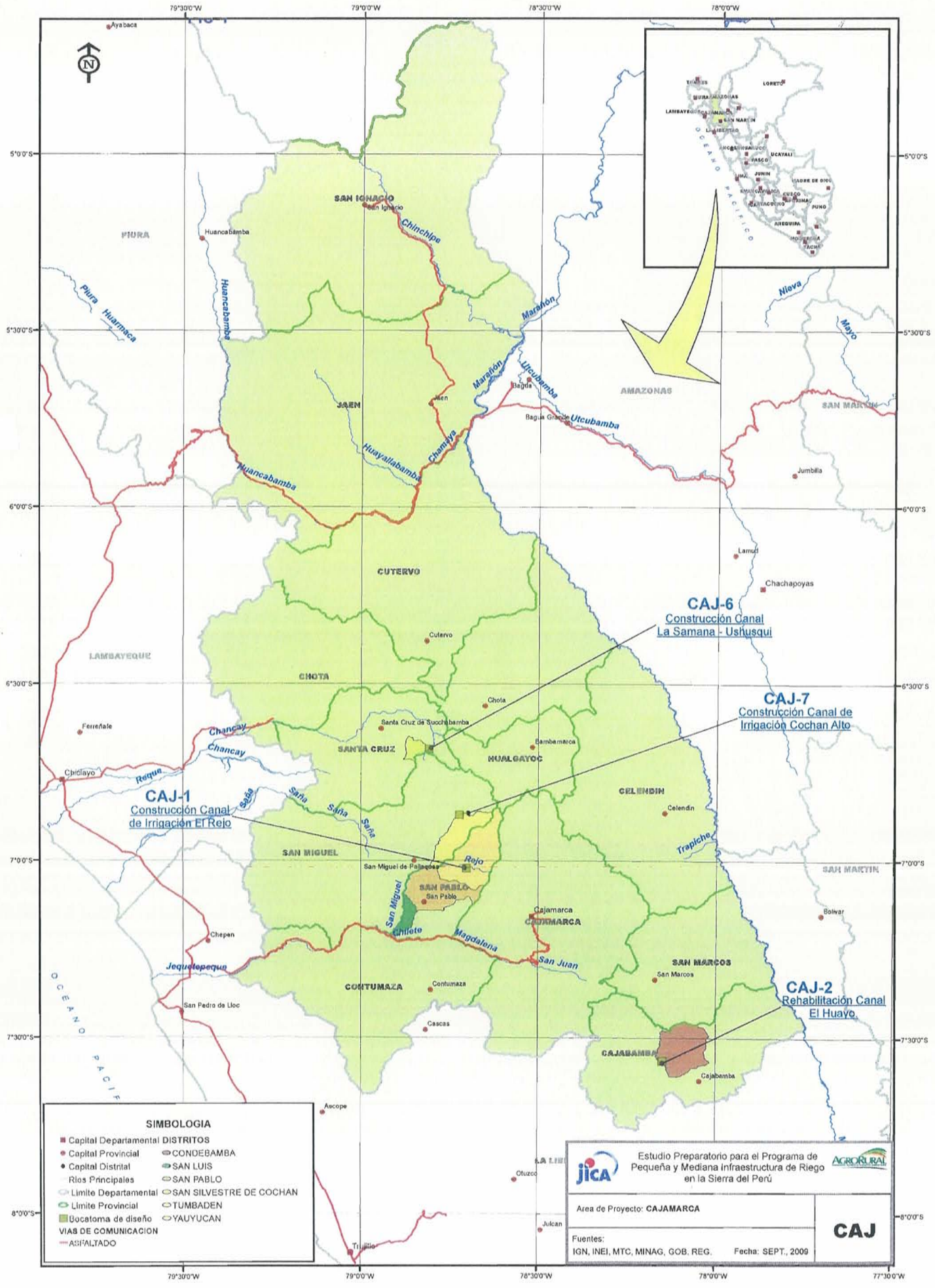
Fuentes:
IGN, INEI, MTC, MINAG, GOB. REG.
Fecha: SEPT., 2009


CAJ-6
Construcción Canal
La Samana - Ushusqui
CAJ-7
Construcción Canal de
Irrigación Cochan Alto
CAJ-1
Construcción Canal
de Irrigación El Rejo
CAJ-2
Rehabilitación Canal
El Huayo
SIMBOLOGIA
Capital Departamental
Capital Provincial
Capital Distrital
Rios Principales
Limite Departamental
Limite Provincial
Bocatoma de diseño
VIAS DE COMUNICACION
ASFALTADO
DISTRITOS
CONDEBAMBA
SAN LUIS
SAN PABLO
SAN SILVESTRE DE COCHAN
TUMBADEN
YAUYUCAN
Estudio Preparatorio para el Programa de
Pequeña y Mediana Infraestructura de Riego
en la Sierra del Perú
Area de Proyecto: CAJAMARCA
Fuentes:
IGN, INEI, MTC, MINAG, GOB. REG.
Fecha: SEPT., 2009
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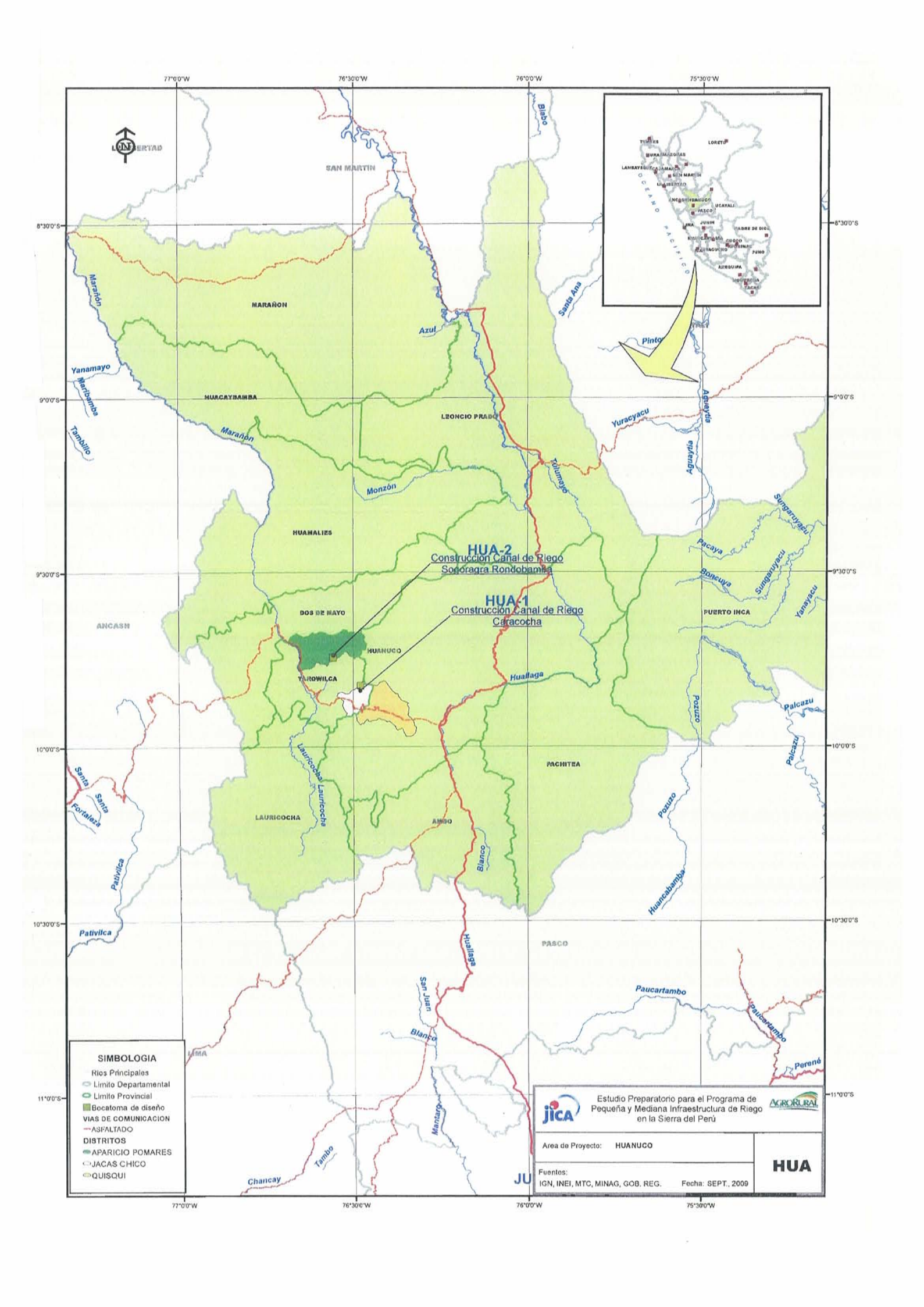
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SAN MARTIN
MARAÑON
HUAMALIES
DOS DE MAYO
HUANUCO
YAROWILCA
LAURICOCHA
PACHITEA
PUERTO INCA
LEONCIO PRADO
HUACAYBAMBA
ANCASH
PASCO
LIMA
Blabo
Marañón
Azul
Yanamayo
Maribamba
Tambillo
Monzón
Santa Ana
Pinto
Yuracyacu
Aguaytia
Tulumayo
Sungaruyacu
Pacaya
Boncuya
Yanayacu
Huallaga
Pozuzo
Palcazu
Laurichocha
Santa
Fortaleza
Pativilca
Blanco
Huancabamba
Paucartambo
San Juan
Mantaro
Tambo
Chancay
HUA-2
Construccion Canal de Riego
Sogoragra Rondobamba
HUA-1
Construccion Canal de Riego
Caracocha
SIMBOLOGIA
Rios Principales
Limite Departamental
Limite Provincial
Bocatoma de diseño
VIAS DE COMUNICACION
ASFALTADO
DISTRITOS
APARICIO POMARES
JACAS CHICO
QUISQUI
JICA
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
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Area de Proyecto: HUANUCO
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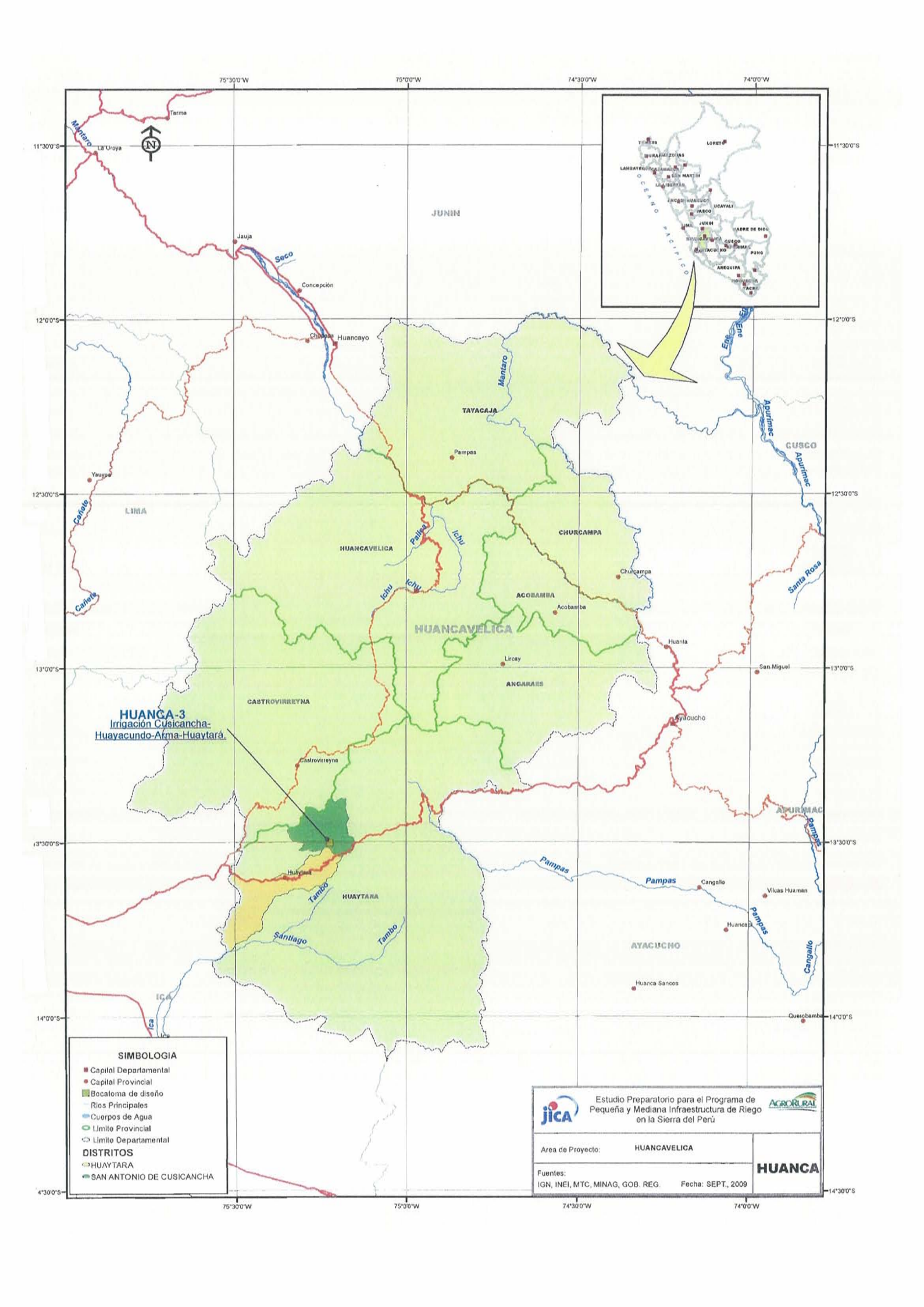
Fuentes:
IGN, INEI, MTC, MINAG, GOB. REG.
Fecha: SEPT., 2009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La Oroya
Jauja
Concepción
Chilca
Huancayo
Yauyos
Pampas
Lircay
Huanta
San Miguel
Acobamba
Churcampa
Castrovirreyna
Huaytará
Cangallo
Vilcas Huaman
Huanca Sancos
Querobamba
Ayacucho
JUNIN
TAYACAJA
HUANCAVELICA
CHURCAMPA
ACOBAMBA
ANGARAES
CASTROVIRREYNA
HUAYTARA
AYACUCHO
APURIMAC
CUSCO
LIMA
ICA
Mantaro
Seco
Pallca
Ichu
Cañete
Apurímac
Ene
Santa Rosa
Pampas
Tambo
Santiago
Cangallo
HUANCA-3
Irrigación Cusicancha-
Huayacundo-Arma-Huaytará.
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Capital Departamental
Capital Provincial
Bocatoma de diseño
Rios Principales
Cuerpos de Agua
Limite Provincial
Limite Departamental
DISTRITOS
HUAYTARA
SAN ANTONIO DE CUSICANCHA
JICA
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
AGRORURAL
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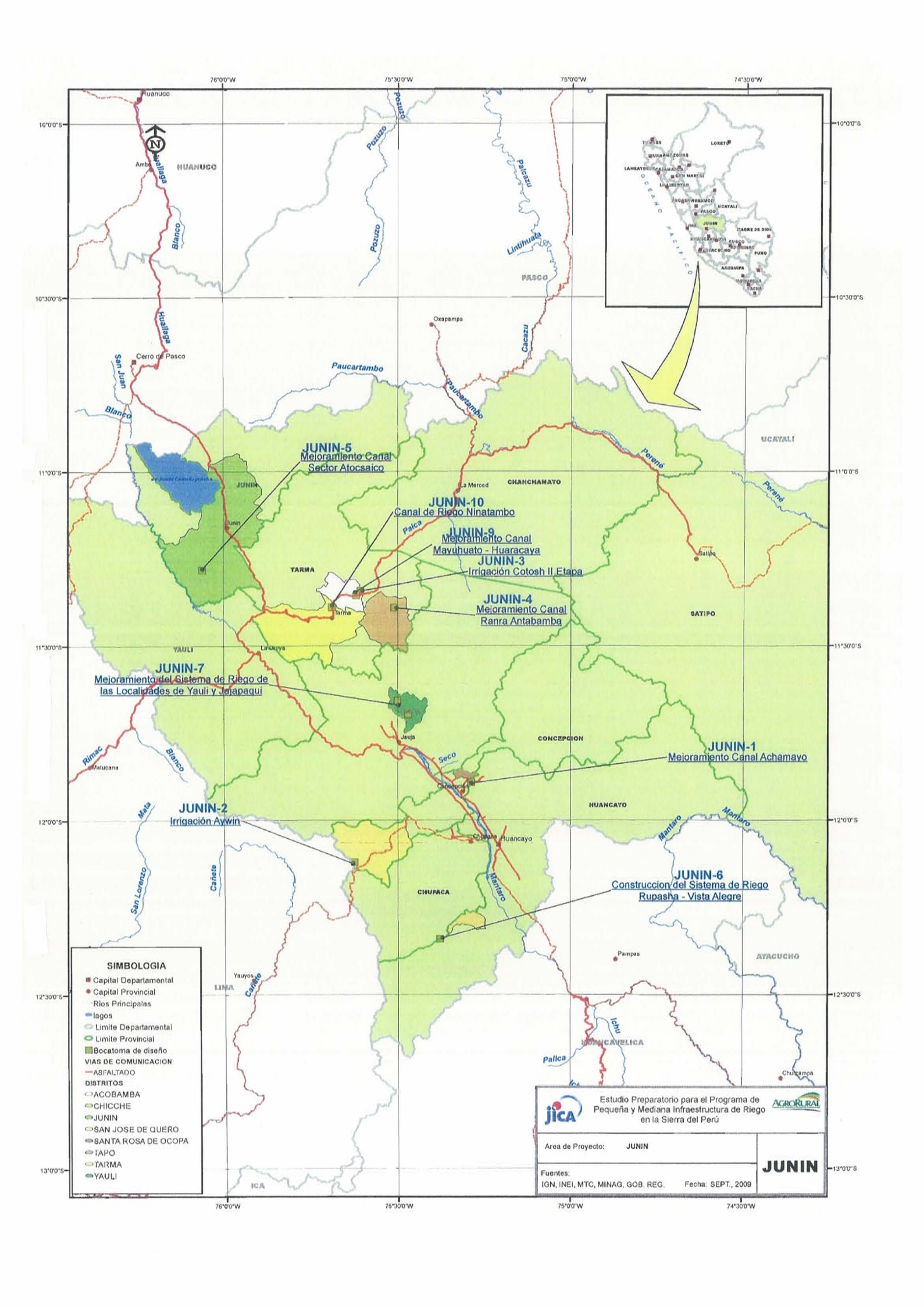
IGN, INEI, MTC, MINAG, GOB. REG.
Fecha: SEPT., 2009
HUANCA


JUNIN-5
Mejoramiento Canal
Sector Atocsaico
JUNIN-10
Canal de Riego Ninatambo
JUNIN-9
Mejoramiento Canal
Mayuhuato - Huaracaya
JUNIN-3
Irrigación Cotosh II Etapa
JUNIN-4
Mejoramiento Canal
Ranra Antabamba
JUNIN-7
Mejoramiento del Sistema de Riego de
las Localidades de Yauli y Jajapaqui
JUNIN-1
Mejoramiento Canal Achamayo
JUNIN-2
Irrigación Aywin
JUNIN-6
Construccion del Sistema de Riego
Rupasha - Vista Alegre
SIMBOLOGIA
Capital Departamental
Capital Provincial
Rios Principales
lagos
Limite Departamental
Limite Provincial
Bocatoma de diseño
VIAS DE COMUNICACION
ASFALTADO
DISTRITOS
ACOBAMBA
CHICCHE
JUNIN
SAN JOSE DE QUERO
SANTA ROSA DE OCOPA
TAPO
TARMA
YAULI
Estudio Preparatorio para el Programa de
Pequeña y Mediana Infraestructura de Riego
en la Sierra del Perú
Area de Proyecto: JUNIN
Fuentes:
IGN, INEI, MTC, MINAG, GOB. REG.
Fecha: SEPT., 2009
JUNIN
HUANUCO
PASCO
UCAYALI
CHANCHAMAYO
SATIPO
TARMA
YAULI
CONCEPCION
HUANCAYO
CHUPACA
AYACUCHO
HUANCAVELICA
LIMA
ICA
Huanuco
Cerro de Pasco
Oxapampa
La Merced
Satipo
Tarma
Jauja
Huancayo
Chupaca
Paimpas
Churcampa
Malucana
Yauyos
Pozuzo
Palcazu
Lintihuata
Paucartambo
Cacazu
Perené
Palca
Rimac
Blanco
Seco
Mantaro
Cañete
Mata
San Lorenzo
Ichu
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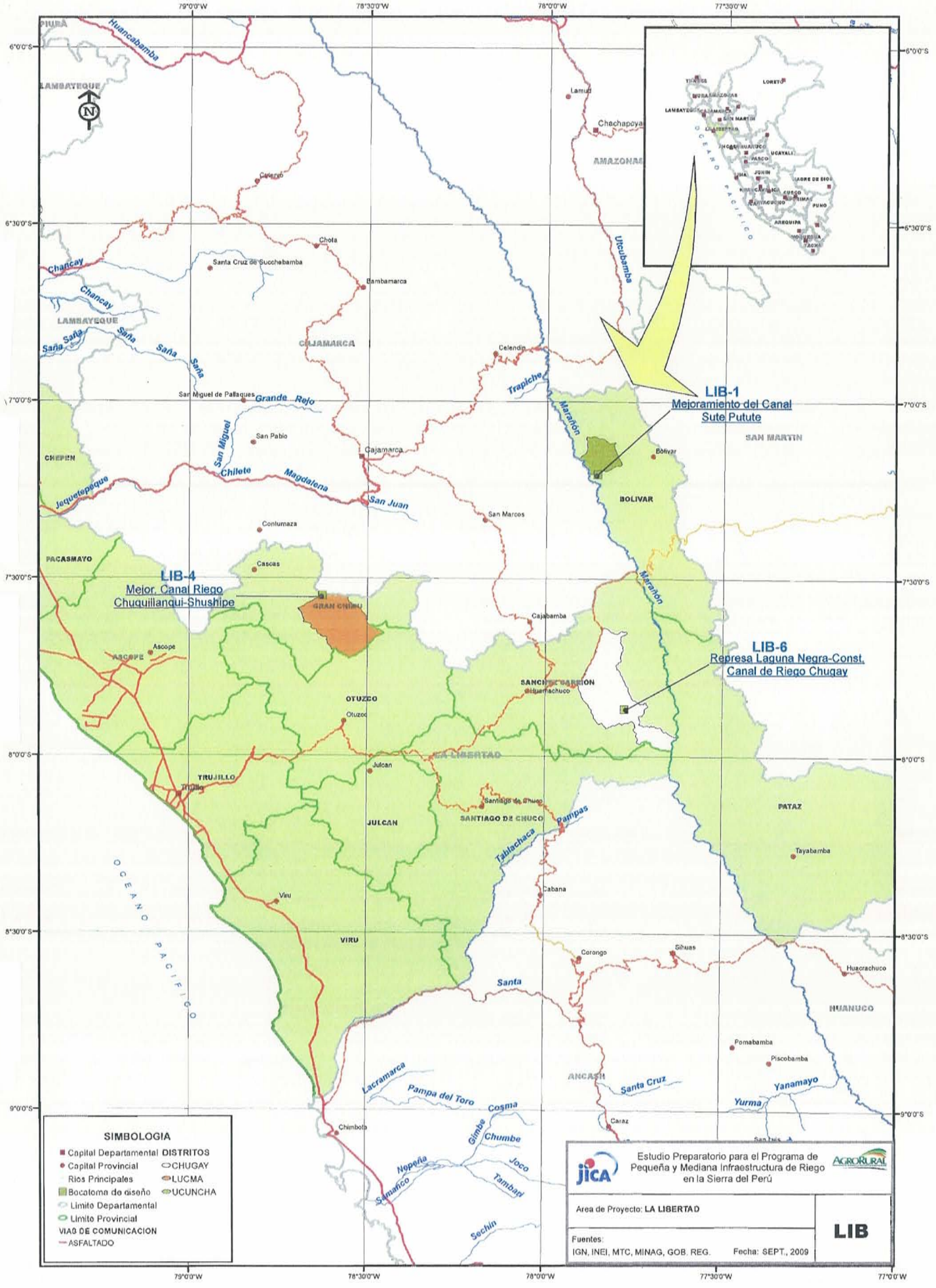
LIB-1
Mejoramiento del Canal
Sute Pututе
LIB-4
Mejor. Canal Riego
Chuquillanqui-Shushipe
LIB-6
Represa Laguna Negra-Const.
Canal de Riego Chugay
SIMBOLOGIA
Capital Departamental
Capital Provincial
Rios Principales
Bocatoma de diseño
Limite Departamental
Limite Provincial
VIAS DE COMUNICACION
ASFALTADO
DISTRITOS
CHUGAY
LUCMA
UCUNCHA
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
Area de Proyecto: LA LIBERTAD
Fuentes:
IGN, INEI, MTC, MINAG, GOB. REG.
Fecha: SEPT., 2009
LIB
OCEANO PACIFICO
AMAZONAS
CAJAMARCA
LAMBAYEQUE
PIURA
SAN MARTIN
BOLIVAR
CHEPEN
PACASMAYO
GRAN CHIMU
ASCOPE
OTUZCO
LA LIBERTAD
TRUJILLO
JULCAN
SANTIAGO DE CHUCO
SANCHEZ CARRION
PATAZ
VIRU
ANCASH
HUANUCO
Huancabamba
Chancay
Saña
Grande
Rejo
San Miguel
Chilete
Magdalena
Jequetepeque
San Juan
Trapiche
Marañon
Utcubamba
Pampas
Tablachaca
Santa
Lacramarca
Pampa del Toro
Cosma
Nepeña
Samanco
Chimbote
Gimbe
Chumbe
Joco
Tambarí
Sechin
Santa Cruz
Yanamayo
Yurma
Lamud
Chachapoyas
Celendin
Bambamarca
Chota
Santa Cruz de Succhabamba
Cutervo
San Miguel de Pallaques
San Pablo
Cajamarca
Bolivar
San Marcos
Contumaza
Cascas
Ascope
Cajabamba
Otuzco
Huamachuco
Julcan
Trujillo
Santiago de Chuco
Tayabamba
Cabana
Viru
Corongo
Sihuas
Huacrachuco
Pomabamba
Piscobamba
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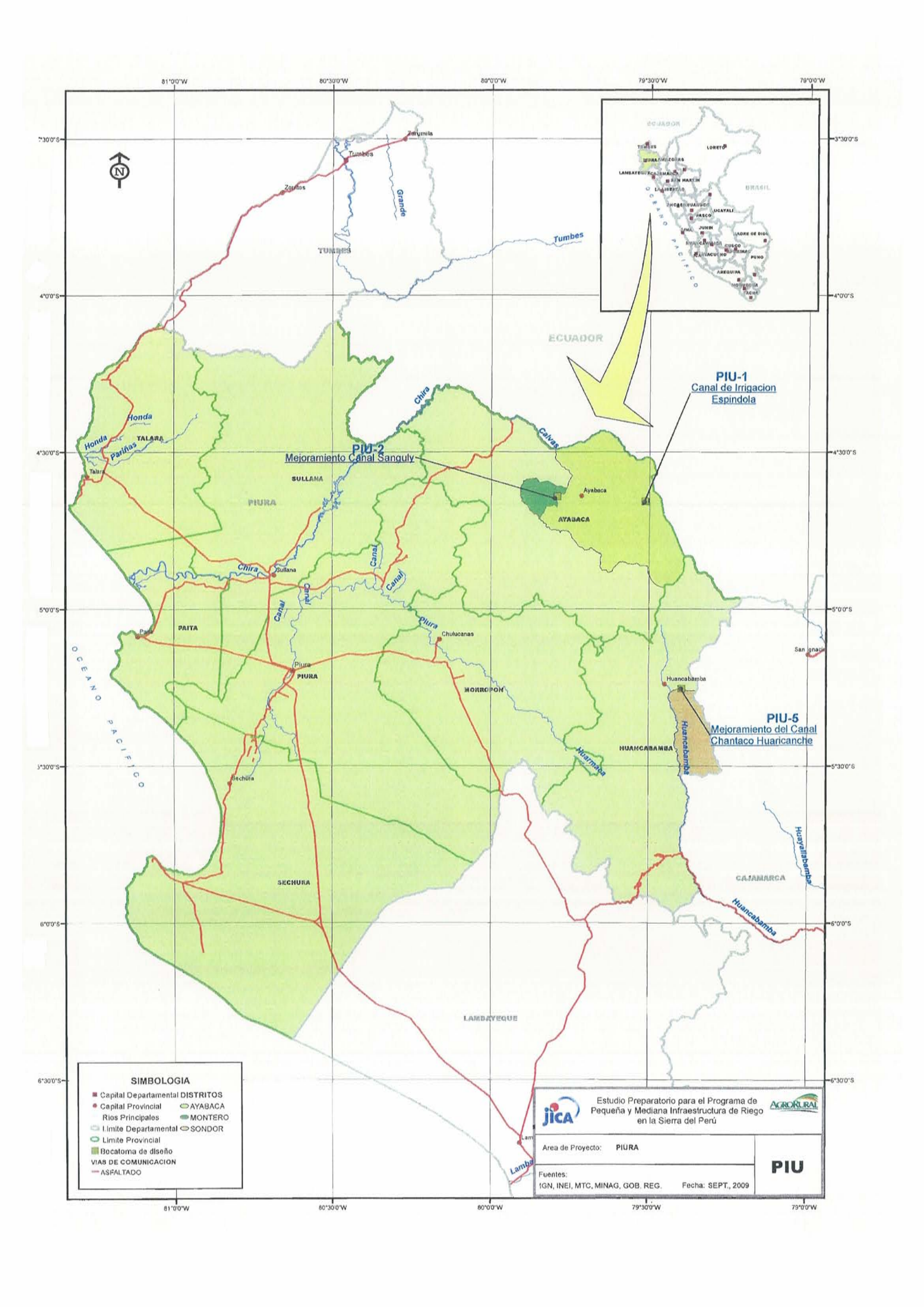
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Zarumilla
Tumbes
Zorritos
Grande
Tumbes
TUMBES
ECUADOR
PIU-1
Canal de Irrigacion
Espindola
PIU-2
Mejoramiento Canal Sanguly
Chira
Honda
Honda
Pariñas
TALARA
Talara
SULLANA
PIURA
Ayabaca
AYABACA
Calvas
Chira
Sullana
Canal
Canal
Canal
Canal
Piura
Paita
PAITA
Chulucanas
Piura
PIURA
MORROPON
San Ignacio
Huancabamba
PIU-5
Mejoramiento del Canal
Chantaco Huaricanche
HUANCABAMBA
Huancabamba
Huarmaca
Sechura
SECHURA
CAJAMARCA
Huancabamba
Huayllabamba
LAMBAYEQUE
Lamb
OCEANO PACIFICO
OCEANO PACIFICO
ECUADOR
BRASIL
TUMBES
LORETO
AMAZONAS
LAMBAYEQUE
CAJAMARCA
SAN MARTIN
LA LIBERTAD
ANCASH
HUANUCO
UCAYALI
PASCO
JUNIN
LIMA
MADRE DE DIOS
AYACUCHO
CUSCO
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AREQUIPA
MOQUEGUA
TACNA
SIMBOLOGIA
Capital Departamental
Capital Provincial
Rios Principales
Limite Departamental
Limite Provincial
Bocatoma de diseño
VIAS DE COMUNICACION
ASFALTADO
DISTRITOS
AYABACA
MONTERO
SONDOR
JICA
Estudio Preparatorio para el Programa de Pequeña y Mediana Infraestructura de Riego en la Sierra del Perú
AGRORURAL
Area de Proyecto: PIURA
PIU
Fuentes:
IGN, INEI, MTC, MINAG, GOB. REG.
Fecha: SEPT., 2009

ABBREVIATIONS/ABREVIATURA

Abreviatura/ Abbreviations		Inglés/ English	Español/ Spanish
Inglés/ English	Español/ Spanish		
	ADEX	The Exporters Association	Asociación de Exportadores del Perú
	ANP	Natural Protection Area	Áreas Naturales Protegidas
	ANPE	National Association of Ecological Producers of Peru	Asociación Nacional de Productores Ecológicos del Perú
	ANA	National Authorization of Water	Autoridad Nacional del Agua
	ALADI	Latin American Integration Association	Asociación Latinoamericana de Integración
	ALIADOS	Support Program for Rural Alliance and Producers in Sierra	Programa de Apoyo a las Alianzas Rurales y Productivas del a Sierra
	ATDR	Technical Administration of Irrigation District	Administración Técnica de Distrito de Riego
CBO		Community Based Organization	Organización de Base comunitaria
	CENAGRO	National Agricultural Census	Censo Nacional Agrario
	DIR	Irrigation Infrastructure Management	Dirección de Infraestructura de Riego
	DGAA	Directorate General of Environmental Affai	Dirección General de Asuntos Ambientales
	DGPM	General Management of Multi-Annual Programming of Public Sector	Dirección General de Programación Multianual del Sector Publico
	DGR	Irrigation Management Caucus	Dirección de Gestión de Riego
	DPIH/PERDEC	Directorate General of Hydraulic Infrastructure/River Channeling and Catchment's Structure Protection Program	Dirección General de Infraestructura Hidráulica / Programa de Encauzamiento de Ríos y Protección de Estructura de Captación
	DRA	Management of Regional Agricultural	Dirección Regional Agricultura
EIA	EIA	Environmental Impact Assessment	Evaluación de Impacto Ambiental
EI	INEI	National Institute of Statistics and Information	Instituto Nacional de Estadística e Informática
	INCAGRO	Competitive Innovation for Peruvian Agro	Innovación y Competitividad para el Agro Peruano
	FAO	Food and Agricultural Organization of the United Nations	Organización de las Naciones Unidas para la agricultura y la alimentación
	FONCODES	Cooperation Fund for Social Development	Fondo de Cooperación para el Desarrollo Social
GIS	SIG	Geographic Information System	Sistema de Información Geográfica
	GL	Local Government	Gobierno Local
	GP	Peruvian Government	Gobierno Peruano
	GR	Regional Government	Gobierno Regional
IBRD	BIRF	International Bank for Reconstruction and Development	Banco Internacional de Reconstrucción y Fomento
IDB	BID	Inter-American Development Bank	Banco Interamericano de Desarrollo
	INCAGRO	Agricultural Extension, Information and Research Project	Proyecto de Información, Investigación y Extensión Agrícola
	INADE	National Institute of Development	Instituto Nacional de Desarrollo
	INGEMMET	Geological Mining and Metallurgical Institute	Instituto Geológico Minero y Metalúrgico

	INIA	National Institute of Agricultural Innovation	Instituto Nacional de Innovación Agraria
	IPROGA	Institute of Water Management Promotion	Instituto de Promoción de Gestión del Agua
	INRENA	National Institute of Natural Resources	Instituto Nacional de Recursos Naturales
	IRH	Management of Water Resources	Intendencia de Recursos Hídricos
JBIC		Japan Bank for International Cooperation	
JICA		Japan International Cooperation Agency	Agencia de Cooperación Internacional del Japón
HDI	IDH	Human Developmental Index	Índice de Desarrollo Humano
	JNUDRP	National board for district irrigation users in Peru	Junta Nacional de Usuarios de los Distritos de Riego del Perú
KfW	KfW	Kreditanstalt fur Wiederaufbau	Instituto de Crédito para la Reconstrucción o Banco de Crédito para la Reconstrucción.
	MARENASS	Project of Natural Resources management in the Southern Sierra	Proyecto de Manejo de los Recursos Naturales en la Sierra Sur
MDGs		United Nations Millennium Development Goals	Objetivos de Desarrollo del Milenio de la ONU
	MEF	Ministry of Economy and Finance	Ministerio de Economía y Finanzas
	MERISS	Improvement of Irrigation in Sierra and Selva	Mejoramiento de Riego en Sierra y Selva
	MIMDES	Ministry of Women and Social Development	Ministerio de la Mujer y Desarrollo Social
	MINAG	Ministry of Agriculture	Ministerio de Agricultura
	MIMA	Intensive Management of Small Watershed	Manejo Intensivo de Microcuencas Altoandinas
	MINAM	Ministry of Envirnement	Ministerio del Ambiente
	MMC	Millon Cubic Meter	Millones de metros cúbicos
	MMM	Multinational Macroeconomic Framework	Marco Macroeconómico Multianual
	MSNM	Meters above Sea Water Level	Metro Sobre Nivel de Mar
NGO	ONG	Non- Governmental Organization	Organización No-Gubernamental
ODA		Official Development Assistance	Asistencia oficial para el Desarrollo
	OGPA	General Office for Agricultural Planning	Oficina General de Planificación Agraria
	OPI	Programming and Investment Office	Oficina de Programación e inversiones
WUA	OUAs	Water Users' Association	Organización de Usuarios de Agua de Riego
GDP	PBI	Gross Domestic Product	Producto Bruto Interno
	PCM	Presidency of the Council of Ministry	Presidencia de Consejo de Ministros
	PEAA	Economically Active Agricultural Population	Población Económicamente Activa Agropecuaria
	PEE	Economic Stimulus Plan	Plan de Estímulo Económico
	PEPMI	Special Project for Plan Meris-Inka	Proyecto Especial Plan Meris-Inka
	PIA	Opening Initial proposal	Presupuesto Inicial de Apertura
	PIM	Institutional Modified Porposal	Presupuesto Institucional Modificado
	PIP	Public Investment Program	Programa Inversión Pública
UNDP	PNUD	United Nations Development Programme	Programa de las Naciones Unidas para el Desarrollo

	PROABONOS	Special Project for Promotion of Utilization of Fertilizers from Seabird	Proyecto Especial de Promoción del Aprovechamiento de Abonos provenientes de Aves Marinas
	PROFODUA	Formalization Program of Water Use' Right	Programa de Formalización del Derecho de Uso de Agua
	PRONAMACHCS	National Program for Watershed Management and Soil Conservation	Programa Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos
	PROSAAMER	Assistant Service Program for Access to Rural Market	Programa de Servicios de Apoyo para Acceso a los Mercado Rurales
	PROVIAS	Special Project of Infrastructure of Decentralized Transport	Proyecto Especial de Infraestructura de Transporte Descentralizado
	PSI	Sub-sectorial Program of Irrigation	Programa Subsectorial de Irrigación
PVC		Polyvinyl Chloride	Polivinilo Chloride
	SINANPE	National System of Natural Protected Areas by the State	Sistema Nacional de Áreas Naturales Protegidas por el Estado
	SMGRH	National System of Water Resources Management	Sistema Nacional de Gestión de Recursos Hídricos
	SNIP	National System of Public Investment	Sistema Nacional de Inversión Pública
	SENAMHI	National Service of Meteorology and Hydrology in Peru	Servicio Nacional de Meteorología e Hidrología del Perú
TA		Technical Assistance	Asistencia Técnica
	UIT	Revenue Tax Unit	Unidad Impositiva Tributaria
USAID		United States Agency for International Development	Agencia de los Estados Unidos para el Desarrollo Internacional
WTP		Willing to Pay	Disposición de pago
WUA	JU	Water Users' Association	Junta de usuarios del agua.

PREFEASIBILITY STUDY REPORT

ON

THE PROGRAM

OF

SMALL AND MEDIUM IRRIGATION INFRASTRUCTURE

IN

THE SIERRA, PERU

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EXECUTIVE SUMMARY

CHAPTER 1 EXECUTIVE SUMMARY

1.1 Name of the Project

PREPARATORY SURVEY FOR THE PROGRAM OF SMALL AND MEDIUM IRRIGATION INFRASTRUCTURE IN THE PERUVIAN SIERRA

1.2 Objective of the Project

The objective of the Program is to increase agriculture and livestock production of farmers in situation in poverty and extreme poverty at the Sierra.

In order to obtain this objective, the 38,732 ha of irrigation system, being 37,620 ha with gravity and 1,120 ha with technical irrigation system, will be constructed and will be strengthen the rural residents' capacities for the management and conservation of the water resources in 50 micro watersheds, benefiting to 24,849 families.

The Program has been structured in four main components. The specific contents and objectives of each Component are;

Component A; to achieve the adequate supply/distribution of irrigation water and to improve technical level in the use of irrigation water in order to increase agriculture production.

Component B; to achieve upgrading of water use efficiency and distribution of irrigation water at the farm level in order to introduce high valued crop

Component C; to strengthen the management capacity of the micro-watershed actors in order to sustain the water resources at the micro watershed zones where the irrigation subprojects will be constructed.

Component D; Program Management

To develop and to make control the activities for the implementation of the actions of the Program, through the monitoring, supervision, follow-up and evaluation of the Program.

1.3 Balance of Offer/Demand of Goods and Services of Program

Relating to Program

<table>
<tr><th>Demand</th><th>Offer</th></tr>
<tr><td>Frame of the Program

Poverty condition in Peru is heterogeneous: (2008)

<table><tr><td>National</td><td>Urban</td><td>Rural</td></tr><tr><td>36.2%</td><td>23.5%</td><td>59.8%</td></tr></table>Source : Mapa de Pobreza 2007

The present Government intends to reduce poverty to 30% by 2011. The policy of AGRO RURAL is to “Attend farmers in poverty and extreme poverty of Andean highlands”. In consequence, the objective area of the Program is the rural sierra where agriculture is main activity and most of population suffers in extreme poverty with low Human Development Index.

9 Departments targeted upon the program are the Andean zones of Amazonas, Ancash, Ayacucho, Cajamarca, Huancavelica, Huánuco, Junín, La Libertad and Piura.</td><td>To face the magnitude of poverty in a hard economic and social situation, the State implements the following programs, among others:

▪ Program JUNTOS
▪ Program for poverty reduction and alleviation, USAID
▪ ALIADOS. Program for the support of productive rural alliances in the Sierra
▪ FONCODES. Fund for social cooperation and development

According to AGRO RURAL Budgetary Capacity

During the year 2008, the budget of PRONAMACHCS was 194 million nuevos soles. The highest expenditure item was “Promotion of Agricultural Production” where 47% of the budget was assigned. For the “Conservation of Renewable Natural Resources”, item that includes Irrigation, only 31 % of the budget was applied.</td></tr>
<tr><td>According to Land and Irrigation Needs: At the 9 departments there are 1,658,431 ha of cultivated land, from which only 27% have irrigation system. 73% is rainfed land in demand for irrigation

According to irrigation project in the SNIP. There exist 1,556 projects of irrigation registered in the SNIP by April 2009 at the 9 departments at the Program area. AGRO RURAL has received 158 requests of irrigation projects at the 9 departments, with an investment amount of 462 million soles to irrigate 102 thousand ha.</td><td>Program of Economic Incentive; In the framework of this Program (PEE), which amounts 3.2% of the GNP, the government has assigned 153 million of soles, for the Program of Irrigation Infrastructure Maintenance (PMIR). It is handled by the Ministry of Agriculture and it aims to finance the maintenance of the irrigation infrastructure in the country. This Program is being executed directly by the district municipalities, as part of the anti-crisis action plan under implementation by the Central Government.</td></tr>
<tr><td colspan="2">BALANCE

Geographic, economic and social balance.

Poverty Statistics show a higher necessity in rural poverty reduction as a priority policy. In consequence, the State takes this poverty problem up to focus solutions upon this issue. Recovery and increase of installed capacity to improve Andean agriculture production should be attended through small and medium irrigation infrastructure, where poverty is deeper and less elastic to the programs of assistance aid.

Program of Small and Medium Irrigation Infrastructure in the Sierra (PMIR).

The Program consists on incorporating in total irrigated area of 38,732 ha, (37,612 has with gravity irrigation and 1,120 ha with technical irrigation system), also the conformation of 50 committees of Water Resources Management Committee in Micro Watershed, with an investment amount approximately of 243 million Nuevo soles, to satisfy the demand of irrigation infrastructure in the countryside, like means to improve life conditions of Andean farmers.</td></tr>
</table>

Component A; Irrigation Infrastructure

<table>
<tr><th>Demand</th><th>Offer</th></tr>
<tr><td>Irrigation Infrastructure:

There are 5,947 irrigation systems in the 9 departments. Most of these scheme are deteriorated. It is estimated that 90% of system has no lining canal.</td><td>Irrigation Improvement.

Availability by the projects:
▪ Project of Irrigation Infrastructure – AGRO RURAL.
▪ Project of rehabilitation and improvement of irrigation systems.</td></tr>
<tr><td>Incorporation of irrigation in rainfed lands

At the 9 departments, there are 1,658,431 ha of crop land, being only 27% irrigated. 73% is rainfed area that requires the irrigation system, indicating high demand for irrigation program. Farmers average monthly income at the project area shows in the following table (2009), requiring to improve the incomes through the increase of production.

<table>
<tr><th>Acocro Ayacucho</th><th>Tumbadem Cajamarca</th><th>Sondor Piura</th><th>San Luis Ancash</th><th>Condebamba Cajamarca</th></tr>
<tr><td>106.7</td><td>143.0</td><td>101.4</td><td>91.1</td><td>161.8</td></tr>
</table>
Source: Agricultural survey results by the survey team

Alternative way to increase the production is to introduce irrigation practices. In the field's survey realized by Study Team, the lack of irrigation infrastructure was pointed out as the main problem, causing low productivity and production. In some area, 35% pointed out that the shortage of water is the origin of social conflicts.</td><td>Increase in availability of water resources.

The Program of small and medium infrastructure in the sierra will be conducted at the sierra of 9 departments, covering 50 macro watersheds.</td></tr>
<tr><td>Infrastructure conditions.

The present situation of irrigation infrastructure is in deteriorated, causing loss of water resources.</td><td>The Program includes improvement of efficiencies of conveyance, distribution and water supply.

An appraisal of the agricultural situation in the 9 departments indicates an insufficient supply of water.</td></tr>
<tr><td>Training.

The predominant irrigation method is by surface irrigation, with low efficiency.

<table>
<tr><th></th><th>Acocro %</th><th>Tumbaden %</th><th>Sondor %</th><th>San Luis %</th><th>Conde-bamba%</th></tr>
<tr><td>Furrow Flooding</td><td>51.1</td><td>41.6</td><td>65.6</td><td>2.2</td><td>37.5</td></tr>
<tr><td>Gravity by ditch</td><td>20.7</td><td>9.5</td><td>34.4</td><td>66.8</td><td>62.5</td></tr>
<tr><td>Dripping</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.0</td></tr>
<tr><td>Aspersion</td><td>0.0</td><td>11.1</td><td>0.0</td><td>31.0</td><td>0.0</td></tr>
<tr><td>Others</td><td>28.1</td><td>37.8</td><td>0.0</td><td>0.0</td><td>0.0</td></tr>
</table>
Source: Agricultural survey results by the survey team

The survey identified that 90% of the farmers have interest in preserving water sources. Also, more than 59% is willing to pay charge for the use of water.</td><td>Training in irrigation system management is one of the contents of the Program, but it is small compared to the existing demand.

There is no opportunity to carry out the training for water management.</td></tr>
<tr><td colspan="2">Balance

• The balance indicates an insufficient supply of irrigation system compared to the demand for the Andean farmers.
• Considering the large area of rainfed land, the program availability covers a marginal magnitude. The Program includes 56 subprojects with incorporation of 37,612 ha., meaning approximately the 3.2% of rainfed land surface. The government expects to reduce poverty to 30% in average to the whole country by year 2011.
• There is not enough irrigation infrastructure supply by the Ministry of Agriculture and its decentralized entities side. The same for local and regional governments
• Training is part of technological change and transference. There is a demand for it at the Program area, according to survey results.</td></tr>
</table>

Component B; Technical Irrigation.

<table>
<tr><th>Demand</th><th>Offer</th></tr>
<tr><td>

Introducing Technical Irrigation, saves between 40 to 60 % of water use. Demand of farmers for this technology is reflected in the answers to the questions concerning their interest upon this type of irrigation, obtained from the survey conducted at three districts at the Program area.

	Acocro(%)	Tumbaden(%)	Sondor(%)
No	33.3	28.1	40.5
Yes	66.7	71.9	59.5

Source: Agricultural survey results by the survey team

The interest to change from traditional irrigation to technical irrigation is shown in the following table.

	Acocro(%)	Tumbaden(%)	Sondor(%)
No	3.0	7.3	11.9
Yes	97.0	92.7	88.1

Source: Agricultural survey results by the survey team

The willingness to pay for 20% of the technical irrigation cost as a contribution by beneficiaries was affirmatively answered by the 82% (Tumbaden) to 100 (Sondor) % of the farmers interviewed at the 3districts.

</td><td>

National Institute of Agriculture Innovation– INIA plans to create a fund to finance technical irrigation in 100 thousand ha/year. The goal is to achieve 1 million de ha. in 10 years.

Project of Irrigation Sub-sector has a Program in process of approval with two components for:

a) Rehabilitation and maintenance works of irrigation systems: 14,600ha.
b) Technical irrigation for farm lots: (for) 3,500ha.

Program of Small and Medium Irrigation Infrastructure in the Sierra (AGRO RURAL)

PRONAMACHCS had executed 297 projects of technical irrigation in the rural area. Based on this experience today RURAL AGRICULTURE plan to implement technical irrigation systems utilized natural water pressure, taking advantage of the difference of the source and the land to irrigate, for each one of the 56 projects in the 9 Sierra departments.

</td></tr>
<tr><td>

Technological training. Producers are aware of the technical irrigation advantages but have a limited knowledge, implicating a demand for training.

</td><td>

INIA conducts training in technical irrigation. It is not conducted at program level yet.

There is still deficit supply in this item

</td></tr>
<tr><td colspan="2">

Balance

Farmers are interested in technical irrigation, but high costs of installation make the access to technical irrigation system difficult. The inefficient use of water with the present technology causes increasingly seasonal shortage, determining an increase in the number and frequency of conflicts for water. Introduction of technical irrigation is necessary but it is required to be accompanied by technical, economic and technological innovation measures. The Program proposes to construct one module of technical irrigation for each subproject (total technical irrigation target area of 1,120 ha), using water resources produced by Component A, on where it will be realized the field day, demonstration of methods, technical seminars, field visits for evaluation-recommendation and demonstration of technical and economic results.

Deficit in this aspect goes together with the previous. The system and process of introduction has to be ordained and systematic, meaning planning the training, technical assistance and agriculture extension, following the tendencies of the market.

Needs to avoid future social conflicts; As water and land resources in the sierra are not sufficient for the farmers, there is a need to elevate the potential of soils. The introduction of technical irrigation systems would allow the increase of production and to reach a larger number of producers, alleviating future social conflicts due to “shortage of water”.

</td></tr>
</table>

Component C; Institutional Strengthening for the Management of Water Resources at Micro-watershed

<table>
<tr><th>Demand</th><th>Offer</th></tr>
<tr><td><u>Studies and practices for watershed management</u>

Fragility of ecosystems predominant in the Project ambit is the base of this component, requiring preservation measure. Moreover, each watershed has different type of conformation and characteristics of the ecosystem, requiring with particular measure to solve.

The land fragmentation, over exploitation of pasture and demand for firewood trees determine deforestation and the inappropriate farming practices and improper land use cause erosion, and all these elements combined determine distinct realities for each micro watershed. For that, there is a demand of knowledge by the social entities concerned.</td><td><u>Studies and practices for watershed management</u>

Main institutions concerned with the issue are:
▪ AGRO RURAL that has conducted studies for the Pilot Watershed Vilcanota (Cusco), Muylo-Tarma Watershed, etc.
▪ National Authority of Water ANA.
▪ Regional and Local Governments
▪ Institute of Geology, Mining and Metallurgy. INGEMMET
▪ NGOs
▪ Agrarian Universities</td></tr>
<tr><td>Promote the formation and strengthening of the Watershed Management Committee. Question: Are you interested in participate in the Watershed Management Committee?, the following answers were obtained:

Interest to participate in the Watershed management committee
<table><tr><th></th><th>Frequency</th><th>%</th></tr><tr><td>No</td><td>4</td><td>9.5</td></tr><tr><td>Yes</td><td>38</td><td>90.5</td></tr></table>Source: Agricultural survey results by the survey team</td><td>This experience is developed by AGRO RURAL.

AGRO RURAL has been working in 5 pilot watersheds: San Juan (Chincha, Huancavelica-Ica); Chancay-Huaral (Lima); Vilcanota (Cusco) and Casma (Ancash). All have a Watershed Management Committee.

ANA is empowered by law to conform the Watershed Councils by initiative of regional Governments that are multi-sector commissions depending on ANA, at each watershed or group of watersheds.</td></tr>
<tr><td colspan="2">Balance

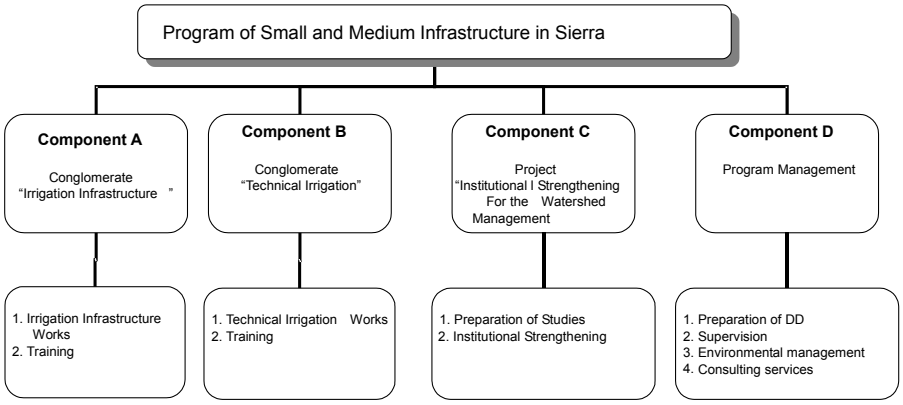
The capacities to support the problem in a participative way are available. Available financial resources are not enough ,as well as a deficit in the interest shown by some local and regional governments exists.

There are various institutions with the respective knowledge to the watershed conservation. Also there is evidence that farmers are interested in participation in the Watershed Management Committees. In this case, there is luck of fund. Besides, a very strong awareness raising and motivation campaign directed to the communities and the watershed actors about the problems of water, rain water filtration at the upper micro watershed , the meaning of handling and management of a micro watershed and the role of the Watershed Management Committee has to be conducted.

It is necessary to indicate that this Committees of watershed Management will coordinate with the Central Governments, Regional government, NGOs and Private Companies, to give the presentation of projects and their recognition. This Program intends that the Irrigation Committees play a very important role in the fulfillment of the Management Committee functions, due to their capacity to invite the population, mainly in activities connected to the watershed water load.</td></tr>
</table>

1.4 Description of Alternatives Proposed

Considering the existing conditions and limitations of the Program area, the following structure is proposed:



Component A "Conglomerate of Irrigation Infrastructure" will be applied to construct and rehabilitate the Irrigation system of 37.162 ha for increase the agricultural production.

Component B "Technical Irrigation" is applied for the construction of technical irrigation modules of 1,120 ha in order to disseminate technical irrigation technology in the Andean sierra for the benefit of a larger number of beneficiaries, saving water resources.

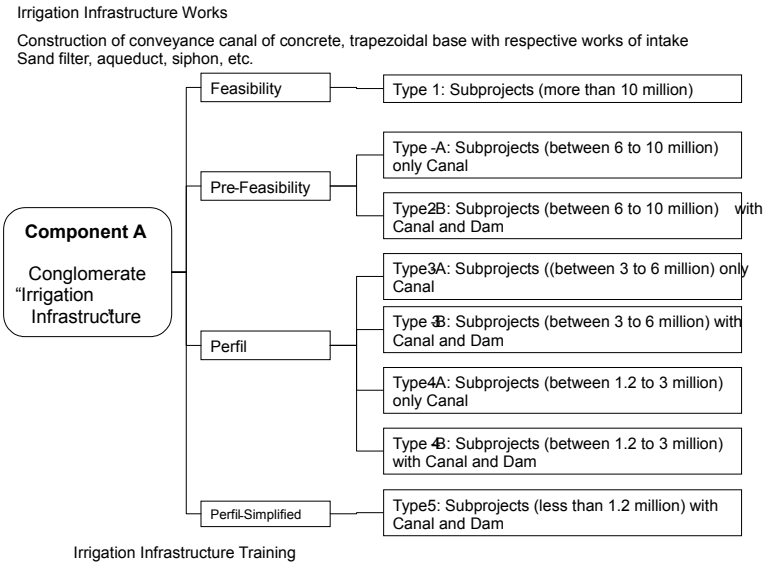
Component C is developed to construct the basis of watershed conservation and management through the necessary studies to identify the needed actions of the watershed conservation and management and empower communities for the purpose of water conservation.

Component D is directed to conduct all procedures to implement Components A, B and C of the Program. The Program is integrated by 4 components, the Components A and B have been structured as conglomerates that include the Works.

(1) Component A: Irrigation Infrastructure

Component A: Considering the similarity of the subprojects and requirements of SNIP they were typified and grouped as follows:

Structure of Component A



Group of Type 1: conformed by subprojects that requires Feasibility Studies according to SNIP due to investment amount.

Group Type 2-A: conformed by subprojects that require Pre-Feasibility Studies and main works are canal construction.

Group Type 2-B: conformed by subprojects that require Pre-Feasibility Studies and main works are construction of dam and irrigation system.

Group Type 3-A: conformed by subprojects with budgets between 3 to 6 million soles and approval requirement at SNIP is Perfil level and the main works are: rehabilitation and construction of canals.

Group 3-B: conformed by subprojects with budget between 3 to 6 million soles; SNIP requirements at Perfil level and considers the construction of canal and dam.

Group 4-A: conformed by subprojects with budget between 1.2 to 3 million of soles; SNIP requirements at Perfil level and main works are: rehabilitation and construction of canals.

Group 4-B: conformed by subprojects with budget between 1.2 to 3 million of soles; SNIP requirements at Perfil level and considers construction of canal and dam.

Group 5 conformed by subprojects less than 1.2 million soles. SNIP requirements for this group is only a simplified Perfil and can include canal.

The quantity of proposed subprojects for each type by department in the Component A are the following;

Type and number of Subprojects by Department

Category	Type 1	Type 2-A	Type 2-B	Type 3-A	Type 3-B	Type 4-A	Type 4-B	Type 5	**Total**
Amazonas				2		10		1	**13**
Cajamarca	1			2				1	**4**
Piura						2	1		**3**
La Libertad						2	1		**3**
Ancash	1	1		6		1	1	4	**14**
Huánuco						2			**2**
Junín					3	1	1	4	**9**
Huancavelica						1			**1**
Ayacucho			2		2	2	1		**7**
Total	**2**	**1**	**2**	**10**	**5**	**21**	**5**	**10**	**56**

Source : Survey Team

(2) Component B: Technical Irrigation

In this component, in order to implement technical irrigation in the Sierra, the installation of one technical irrigation module for each subproject of Component A is proposed. The proposed location is that where a group of farmers interested in changing the traditional method for a modern irrigation system exists. The technical Irrigation system to be installed in the project is: installation of a technical irrigation system by sprinkler.

The Program consists, in a preliminary list, of 56 subprojects of irrigation infrastructure, each subproject conformed by one technical irrigation module of 20 ha. Each subproject of technical irrigation takes water from a new or improved concrete canal. These canals are part of the irrigation infrastructure subprojects and are located in nine departments. The quantity of objective subprojects of this component and the technical irrigation modules are the following;

Distribution of Irrigation Area with Technical irrigation practices

Department	Area (ha)
Amazonas	260
Cajamarca	80
Piura	60
La Libertad	60
Ancash	280
Huánuco	40
Junín	180
Huancavelica	20
Ayacucho	140
Total	**1,120**

Source : Survey Team

(3) Component C: Institutional Strengthening for the Water Resources Management at Micro Watershed

The objective planned consists of strengthening of the management capacity of the micro watershed actors to improve the over-load of water to micro watersheds where the subprojects are to executed, through the institutional strengthening for management.

The Program intends to strengthen the institutionalization of the watershed management process and to incorporate conservation practices at the water load zones to assure quantity and quality of water for irrigation. The following activities will be conducted:

a) Elaboration of Studies for the micro watershed collecting area management.

1. Characterization of the micro watershed (including Inventory and Planning of Water Resources (IPRH), Focused Diagnosis in Silvo-Pastoral (DES-P).

b) Institutional strengthening of the Farmers Communities and the Board of Irrigation and Management of the Micro watershed.

1. Events of awareness raising and motivation to the farmer's communities.
2. Events of training about micro watersheds management and technical assistance for the institutional strengthening to the Committees of Irrigation and Management of the Micro watershed.
3. Legalization of the Irrigation Committees.
4. Conformation of the Micro watersheds Management Committees.
5. Legalization of the Micro watersheds Management Committees.

(4) Proposed Alternatives of the Program

With the purpose of implementing the program, it intends two alternatives as follows;

- Alternative 1 intend to irrigate 38,732 ha of which 37,612 ha. with gravity irrigation and 1,120 ha with technical irrigation, the conformation of irrigation committees, committee of technical irrigation and Committees of water resources Management in Micro watershed, benefiting to 24,849 families, located in 9 departments, 35 counties and 56 districts.
- Alternative 2 Intend to irrigate 38,732 ha with gravity irrigation benefiting to 24,804 families located in 9 departments, 35 counties and 56 districts.

Contents of the Program are the following;

Content of the Program

	Item		Alternative 1	Alternative 2
A	Conglomerate "Irrigation Infrastructure"			
	Type 1: Subprojects (more than 10 million) only Canal	Subprojects	2	2
	Type 2-A: Subprojects (between 6 to 10 million) only Canal	Subprojects	1	1
	Type 2-B: Subprojects (between 6 to 10 million) with canal & Dam	Subprojects	2	2
	Type 3-A: Subprojects (between 3 to 6 million) only Canal	Subprojects	10	10
	Type 3-B: Subprojects (between 3 to 6 million) with Canal & Dam	Subprojects	5	5
	Type 4-A: Subprojects (between 1.2 to 3 million) only Canal	Subprojects	21	21
	Type 4-B: Subproject (between 1.2 to 3 million) with Canal & Dam	Subprojects	4	4
	Type 5: Subprojects (less than 1.2 million) only Canal	Subprojects	11	11
	Total	Subprojects	56	56
B	Conglomerate "Technical Irrigation"			
	Works of technical irrigation	Modules	56	-
	Training	Modules	56	1
C	Project "Institutional Strengthening for Watershed Management"			
	Study	Micro watershed	50	50
	Promotion of the Watershed Committee	Micro watershed	50	50
	Total			

D Management of the Program			
Administration and National Supervision	Unit	1	1
Total of the Component D			
TOTAL	Program	1	1

Note: Conglomerates A and B include Technical Training

1.5 Costs of Alternatives

(1) Alternative 1

The estimated costs for the Program amount to S./ 243.11 million in market prices. The following table shows a summary of the cost breakdown by components:

GENERAL BUDGET OF THE PROGRAM Unit: ($x10^3$) S/.

COMPONENTS / ITEMS	QUANTITY	UNIT	BASE COST S/.	IGV (19%)	TOTAL S/.
			a	b=a x 0.19	f=a+b
1. Construction and Acquisition			187,726	35,669	223,395
Component A: INFRASTRUCTURE OF IRRIGATION			155,860	29,614	185,474
Studies	56	Studies	2,077	395	2,472
Irrigation Infrastructure (CD+GG+GS+MA+Ut)	56	Projects	134,142	25,487	159,629
Training, Technical Assistance and Conformation of the Irrigation Committees	56	Various	664	126	790
Administrative Expenses	1	Glob	18,977	3,606	22,583
Component B: TECHNICAL IRRIGATION			14,582	2,771	17,353
Studies	56	Studies	758	144	902
Technical Irrigation	56	Subprojects	8,587	1,632	10,219
Training, Technical Assistance and Conformation of the Irrigation Committees	56	Committees	4,183	795	4,978
Administrative Expenses	1	Glob	1,054	200	1,254
Component C: INSTITUTIONAL STRENGTHENING FOR THE WATERSHED MANAGEMENT			17,283	3,284	20,567
Elaboration of Studies	50	Studies	4,456	847	5,303
Institutional Strengthening	50	Committees	11,773	2,237	14,010
Administrative Expenses	1	Glob	1,054	200	1,254
2. Administrative Cost					
Component D: MANAGEMENT OF THE PROGRAM			12,560	2,386	14,946
Cost of Administration National Supervision	1	Glb	12,560	2,386	14,946
SUB TOTAL (S./)			200,286	38,055	238,341
3. Price Escalation					
2% of the Sub Total		2%	4,006	761	4,767
GRAND TOTAL (S./)			204,292	38,816	243,108
GRAND TOTAL (US$)			64,243	12,206	76,449

Exchange Rate: 1.0 US$ = S./ 3.18 (End of March 2009, Central Bank of Reserve, Peru)
Source: Study Team

1) Cost of Component A: Infrastructure of Irrigation

Costs estimated at market and economic prices for each subproject, adding the corresponding management expenses are shown in the following table:

Cost of the Program Component A: Conglomerate Infrastructure of Irrigation (Unit: Thousand S./)

Category	Study	Direct Cost	Environmental Management	General Expenses	International Technical Assistance	Supervision	Profit	Training	Conformation of Watershed	Sub-total	IGV	Market Price	Economic Price
Type 1	195	17,772	10	710	2,804	299	709	17	7	22,524	4,280	26,804	22,524
Type 2-A	43	5,074	4	183	800	85	152	4	3	6,348	1,206	7,555	6,348
Type 2-B	329	11,547	64	773	1,822	266	405	258	5	15,469	2,939	18,409	15,469
Type 3-A	375	28,610	57	1,289	4,515	614	1,390	68	13	36,931	7,017	43,949	36,931

Type 3-B	445	16,630	30	840	2,624	277	676	59	6	21.587	4,102	25,689	21.587
Type 4-A	427	27,485	69	1,299	4,338	543	1,197	102	13	35,473	6,740	42,213	35,473
Type 4-B	160	7,530	19	493	1,188	152	376	29	6	9,953	1,891	11,845	9,953
Type 5	103	5,588	14	425	882	145	340	71	3	7570.96	1,438	9,009	7570.96
Sub Total	2,077	120,236	267	6,012	**18,977**	2,381	5,246	608	56	**155,859**	**29,613**	**185,472**	**155,859**

Source: Study Team

2) Cost of Component B: Technical Irrigation

Costs calculated for the component of Technical irrigation amounts to a total of S./16.03 million. The following table is a summary of the cost breakdown by items:

Composition of Cost (Unit: Thousand S./)

Department	PROJECTS	Studies	Technical Irrigation	Expenses of Supervision	Training and Technical Assistance	COMMITTEÉ OF IRRIGATION	Administrative Expenses	TOTAL WITHOUT IGV	IGV	Total
Amazonas	13	176	1,890	103	958	13	245	3,385	643	4,028
Cajamarca	4	54	582	32	295	4	75	1,042	198	1,240
Piura	3	41	436	24	221	3	56	781	148	929
La Libertad	3	41	436	24	221	3	56	781	148	929
Ancash	14	190	2,036	111	1,032	14	264	3,647	693	4,340
Huánuco	2	27	291	16	147	2	38	521	99	620
Junín	9	122	1,309	71	663	9	169	2,343	445	2,788
Huancavelica	1	14	145	8	74	1	19	261	49	310
Ayacucho	7	95	1,018	55	516	7	132	1,823	346	2,169
Total	**56**	760	8,143	444	4,127	56	1,054	14,584	2,769	17,353

Source: Study Team

3) Cost of Component C: Institutional Strengthening of Water Resources Management at Micro Watershed

The cost composition is the following:

Composition of Cost (Unit: Thousand S./)

Item	Base Cost	IGV	Market Price	Economic Price
1) Elaboration of Studies	4,456	847	5,303	4,825
2) Organizational Strengthening	11,773	2,237	14,010	12,749
3) Administrative Expenses	1,054	200	1,254	1,141
Total	17,283	3,284	20,567	17,696

Source: Study Team

4) Cost of Component D: Program Management

The cost composition is the following:

Composition of cost (Unit: Thousand S./)

Items	Base Cost	IGV	Market Price	Economic Price
Cost of Administrative National Supervision	12,560	2,386	14,946	13,601
Total	12,560	2,386	14,946	13,601

Source: Study Team

(2) Alternative 2

The estimated costs for the Program amount to S./ 225.4 million in market prices. The following table shows a summary of the cost breakdown by components:

GENERAL BUDGET OF THE PROGRAM

COMPONENTS / ITEMS	QUANTITY	UNIT	BASE COST S/	IGV (19%)	TOTAL
			a	b=a x 0.19	f=a+b
1. Construction and Acquisition			173,143	32,898	206,041
Component A: INFRASTRUCTURE OF IRRIGATION			155,860	29,614	185,474
Studies	56	Studies	2,077	395	2,472
Irrigation Infrastructure (CD+GG+GS+MA+Ut)	56	project	134,142	25,487	159,629
Training, Technical Assistance and Conformation of the Irrigation Committees	56	Committees	664	126	790
Administrative Expenses	1	Glb	18,977	3,606	22,583
Component C: INSTITUTIONAL STRENGTHENING FOR THE WATERSHED MANAGEMENT			17,283	3,284	20,567
Elaboration of Studies	50	Est	4,456	847	5,303
Institutional Strengthening	50	Committees	11,773	2,237	14,010
Administrative Expenses	1	Glb	1,054	200	1,254
2. Administrative Cost					
Component D: MANAGEMENT OF THE PROGRAM			12,560	2,386	14,946
Cost of Administration National Supervision	1	GLB	12,560	2,386	14,946
SUB TOTAL (S./)			185,703	35,284	220,987
3. Price Escalation					
2% of Sub Total	2	%	3,714	706	4,420
GRAN TOTAL (S./)			189,417	35,990	225,407
GRAN TOTAL (US$)			59,565	11,318	70,883

Tasa de Cambio : 1.0 US$ = S./ 3.18 (Fin de Marso 2009 de Banco Central de Reserva del Perú)

1) Cost of Component A: Irrigation Infrastructure

The Estimated costs at private and social prices for this component are similar to the one considered in the alternative 1 with the amount of S/. 185.47 millions.

2) Cost of Component C: Institutional Strengthening for the Water Resources Managements at Micro Watershed

The Estimated cost at social and private price for this components are similar to the Alternative 1 with the amount of S/. 20.57 millions of soles.

3) Cost of Component D: Program Managements

In a similar way to the alternative 1, the estimated cost for the Management of the Programs is of 14.9 million.

1.6 Benefits

The Program allows to increase cultivated areas and productivity, achieving the following benefits:

Area of Direct Benefit of the Program

Component	Direct Benefit	Alt 1	Alt 2
Comp. A: Conglomerate of "Infrastructure of Irrigation"	Total: Irrigation Improvement Total: Irrigation Increase	18,103 ha 20,629 ha	18,103 ha 20,629 ha
Comp. B: Conglomerate "Technical irrigation"	Increase by Technical irrigation;	1,120 ha	-
Comp. C: Conglomerate " Institutional Strengthening for Watershed Management"	Institutionality of watershed management and program for the watershed conservation and management.	50 micro watershed	50 micro watershed

Source: Study Team

In the present condition "without project", the Program will generate the following benefits:

Existing benefits

Type of Cultivation Area	Existing benefit
Level 1 (50% of rainfed land area and 50% irrigation area)	Harvest area (50% of dry land and 50% of irrigation cultivated area) Number of crops (1 crop) Productivity (Level 1)
Level 2 (50% irrigation area)	Harvest area (50% irrigation cultivation area) Number of crops (1 crop) Productivity (Level 2)

Source: Study Team

By improving irrigation conditions in the situation "With Project", the Program will generate the following benefits:

Expected Benefit

Type of Cultivation Area	Expected Benefit (Increase of Production)
Level 2 Improving Area (Existing Irrigation Area)	By improving irrigation conditions (stable), the following is to be achieved; Number or crops (1 crop→ 2 crops in 50% of the improvement area except areas of alfalfa, manioc and coffee) Productivity (Level 1 and Level 2→Level 2)
Level 2 Incorporation Area (Area of Rainfed Land)	By improving up to stable irrigation conditions; Number or crops (1 crop → 2 crops in 50% of the incorporation area, except areas of alfalfa, manioc and coffee) Productivity (Level 2→ Level 2)

Source: Study Team

(1) Benefit of Alternative 1

The following benefits are expected within the scope of the Irrigation Infrastructure for Alternative 1;

Item	Net Value of Production	Gross Value of Production	Cost of Production
Component A	S./ 65,542,000	S./ 143,789,000	S./ 78,247,000
Component B	S./ 5,029,000	S./ 11,337,000	S./ 6,308,000

Source : Survey Team

(2) Benefit of Alternative 2

The following benefits are expected within the scope of the Irrigation Infrastructure for Alternative 2;

Item	Net Value of Production	Gross Value of Production	Cost of Production
Component A	S./ 65,542,000	S./ 143,789,000	S./ 78,247,000
Component B	-	-	-

Source : Survey Team

1.7 Results of the Economic Evaluation

(1) Program and Component of the Alternative 1

Evaluation results of each component are as shown below;

Item	Market Prices			Economic Prices		
	B/C	IRR_{10}	NPV_{10} (1000 S./)	B/C	IRR_{10}	NPV_{10} (1000 S./)
Program	1.76	29.4 %	169,414	2.05	36.6 %	200,887
Component A	1.87	31.9 %	168,243	2.16	38.3 %	191,254
Component B	1.38	18.1 %	6,414	1.63	22.3 %	9,020

Source: Study Team

The results of the evaluation for the Subprojects of Component A are the following;

Subprojects		Market Prices		Economic Prices	
		TIR_{10}	B/C	TIR_{10}	B/C
1	CAJ-1 Const. Canal of Irrigation "El Rejo"	11.6%	1.03	15.2%	1.20
	ANC-11 Const. Canal "Cordillera Negra"	15.3%	1.21	19.2%	1.42
2A	ANC-3 Const. Canal of Irrigation "Sol Naciente de San Luis"	32.6%	2.26	38.1%	2.64
2B	AYA-1: Const. And Improv. Of Irrigation System "Cangallo"	11.0%	1.00	14.4%	1.17
	AYA-13: Const. Canal and Dam "Tintayccocha"-Acoro	13.9%	1.14	17.8%	1.34
3A	AMA-2: Improvement Irrigation System "San Juan" Marañón-La Papaya	36.3%	2.34	42.1%	2.67
	AMA-6: Impr. Irrigation "Naranjos" - Canal El Tigre	34.0%	2.22	39.6%	2.54
	CAJ-2: Rehabilitation Canal "El Huayo"	21.8%	1.51	26.1%	1.72
	CAJ-7: Irrigation "Cochan Alto"	11.1%	1.00	14.7%	1.17
	ANC-3: Const. Canal "Casablanca"/Ocosbamba/Quiches	17.8%	1.34	22.0%	1.57
	ANC-4: Const. Canal "Rupawasi" – Rosamonte	26.7%	1.86	31.6%	2.16
	ANC-10: Const. Canal of Irrigation "Aynin-Huasta"	17.3%	1.32	21.4%	1.54
	ANC-16: Const. Irrigation system "Jatun Parco"	15.5%	1.22	19.5%	1.43
	ANC-17: Impr. Canal "Chuayas"-Huaycho	14.9%	1.19	18.8%	1.39
	ANC-18: Impr. "Chinguil" – Cruzpampa	24.8%	1.73	29.5%	2.02
3B	JUN-3: Irrigation "Cotosh" II Stage	35.5%	2.38	41.1%	2.75
	JUN-6: Const. Irrigation system "Rupasha" - Vista Alegre	39.4%	2.59	45.5%	2.96
	JUN-7: Impr. Irrigation system "Yauli" and "Jajapaqui"	10.4%	0.97	13.9%	1.14
	AYA-5: Const. Dam "Chaqllani"-Pucapampa	21.8%	1.55	26.2%	1.81
	AYA-12: Const. Dam "Chito"-Sachabamca/Quish., Chiara	37.4%	2.48	43.3%	2.85
Subprojects Type 4A (21 Subprojects)		41.6%	2.61	48.7%	3.00
Subprojects Type 4B (4 Subprojects)		33.1%	2.19	39.1%	2.55
Subprojects 5 (11 Subprojects)		33.8%	2.11	39.9%	2.42

Source: Study Team

These results obtained show that the subprojects are favorable, showing a positive NPV and B/C.

(2) Program and Component of the Alternative 2

Evaluation results of each component are as shown below;

Item	Market Prices			Economic Prices		
	B/C	IRR_{10}	NVP_{10} (1000 S./)	B/C	IRR_{10}	NVP_{10} (1000 S./)
Program	1.75	29.0%	155,574	2.03	36.1%	184,957
Component A	1.87	31.9%	168,243	2.16	38.3%	191,254
Component B						

The results of the evaluation for the Subprojects of Component A are similar to the results of the Alternative 1. These results obtained show that the subprojects are favorable, showing a positive NPV and B/C.

1.8 Sensitivity Analysis of the Program

The results of the sensitivity analysis are as shown below;

Sensitivity Analysis of the Program. Case I: Increase of the Program Cost

Increase of the Program Cost	Alternative 1						Alternative 2					
	IRR		B/C		NPV (1,000 S/.)		TIR		B/C		VAN (1,000 S/.)	
	Market	Economic	Market	Economic	Market	Economic	Market	Economic	Market	Economic	Market	Economic
0%	29.4%	36.6%	1.76	2.05	169,414	200,887	29.0%	36.1%	1.75	2.03	155,574	184,957
10%	25.9%	32.4%	1.61	1.88	149,282	183,903	25.6%	32.0%	1.60	1.87	136,853	169,175
20%	22.9%	28.9%	1.49	1.74	129,151	166,918	22.6%	28.6%	1.48	1.73	118,133	153,393
30%	20.4%	26.0%	1.38	1.62	109,019	149,934	20.1%	25.7%	1.38	1.61	99,413	137,611

Source: Study Team

The Program supports to increases over 30% in the investment costs, maintaining positive Internal Rates of Return and Benefit-Cost relations majors to the unit. It means that, still before a possible increase of

the project until a 30%, the economic yield of the Program continues being high.

Sensitivity Analysis of the Program. Case II: Decrease of the Production

Decrease of the Production	Alternative 1						Alternative 2					
	IRR		B/C		NPV (1,000 S/.)		TIR		B/C		VAN (1,000 S/.)	
	Market	Economic	Market	Economic	Market	Economic	Market	Economic	Market	Economic	Market	Economic
0%	29.4%	36.6%	1.76	2.05	169,414	200,887	29.0%	36.1%	1.75	2.03	155,574	184,957
10%	21.5%	27.3%	1.43	1.66	94,839	126,312	21.4%	27.2%	1.42	1.65	87,934	117,318
20%	13.3%	17.9%	1.09	1.27	20,275	51,748	13.5%	18.1%	1.10	1.28	20,299	49,682
30%	4.3%	7.7%	0.76	0.88	-54,289	-22,817	4.7%	8.3%	0.77	0.90	-47,336	-17,953

Source: Survey Team

With regard to the variable production, the results show that the Program maintains its viability before diminutions of production until of 20%, situation in which continues being profitable.

1.9 Private Evaluation

(1) Irrigation Infrastructure

The investment by hectare of sub-projects is ranged between S/. 2,000 to 8.400 and the investment by beneficiary between S/. 3,000 to 10.000 nuevos soles.

With the implementation of the project, the agricultural net income by beneficiary would be improving of S/. 132 monthly (S/. 33 monthly per capita) to S/. 351 monthly (S/. 88 monthly per capita).

The results of the Private Evaluation become favorable, showing high rates of economic return. However the results of the economic calculation analysis of the possibility of a beneficiary's contribution amounting 20% of the investment demonstrate that, to assume this assumption, is non realist for the small producers due to the following reasons;

- The farmers agricultural Income is of approximately S/. 1580 yearly. With this Income, it is not possible to pay S/. 1311 (20% of the investment), according to the results of farmer's income analysis.
- In order to pay 20%, the farmer should take a credit in the Market, in which the interest rate is of approximately 3.5 monthly (51.1% of annual interest rate)%.
- In case of demanding the contribution by the beneficiaries, it would be necessary to create a credit line at a reasonable interest rate (less than 12% annual). If this type of credit line does not exist, the contribution would harm the producers instead of to help them.
- Also, the farmers require to buy the agricultural inputs to increase agricultural productivity. This Financial cost does not considered in this calculation.
- If the farmers does not acquire and use agricultural inputs to increase their production, the productivity would not get targeted yield and income, resulting probable situation of risk of default.
- It is Necessary to mention that this economical assumption was done in the average situation, meaning that that most of the farmers don't have this type of financial capacity. It can stand out that this budget is estimated upon value average. It exists the risk of that the majority of the producers does not have any financial capacity.
- Since financial Market becomes expensive, the producer would not be benefited by the investment in irrigation infrastructure.
- It is important to mention that the net income includes other revenues, such as those coming from works outside of the place and received remittances. Most of the beneficiaries are in situation of poverty, being the average of 92.2% (Estimate)

(2) Technical Irrigation

20% of the contribution by the beneficiaries is extremely difficult, even though it shows favorable IRR values. Between the reasons, the following can be mentioned:

- It will bring about a default, if the mechanism to canalize a quite favorable credit does not exist.
- In the case of technical irrigation, it exists a quite high risk arising from the fact that the producers require financial credit to purchase agricultural consumptions for production uses.
- Nevertheless, in the Sierra, the introduction of technical irrigation is necessary due to the fact of limited water and soil resources.
- The conflicts by water use are frequent in the Sierra.

It is recommendable to implement technical irrigation system as a model to save water resources as a mean to reach a major number of users.

1.10 Risk Analysis

The risk analysis was realized to identify and to evaluate the probable type and level of damages and losses that could affect an investment from the point of view of the expected benefit. The awaited benefits are able to be obtained from the following achievements:

- Stable supplying of water resources
- Stable productivity (level of average productivity of the irrigation area).

The degrees of vulnerability for each risk can be classified into high, medium and low:

Degree of vulnerability for each risk

	Factor of Vulnerability	Degree of Vulnerability		
		Low	Medium	High
Program	Construction cost escalation		X	
	Possible damages in the construction stage (rain, earthquakes, etc.)	X		
	The availability of participation of the Community and Regional/Local Government does not exist	X		
	Not offering the required Technical Assistance to the producers or it not being implemented by the Regional/Local Government		X	
	Lack of credit for the purchase of farming consumptions to increase the productivity			**X**
	Price of Products does not cover the production costs	X		
Component A	Not to realize the efficient maintenance of the channel by the beneficiaries		X	
	Existence of possible climatologic damages in the Stage of Operation (Frozen, Droughts, etc)		X	
	Not to be able to commercialize the product surpluses		X	
	Lack of will of participation of the beneficiaries for the improvement of the irrigation system (improvement of lateral channels)		X	
	Inefficient exploitation of the water by the beneficiaries determines shortage of the resource			**X**
Component B	Non existence of disposition of the communities to conform groups for the installation of technical irrigation		X	
	The contestable funds are not realized		X	
	Lack of disposition for the contribution of the irrigation installation (20%)			**X**
	Nonexistence of high value product to cover the investment cost with the technical irrigation			**X**
	Not to learn the techniques of technical irrigation to save the water use and to increase its productivity			**X**
	Lack of disposition of the beneficiaries to improve agricultural practices	X		
Component C	Lack of disposition of the Community farmer to sensitize and to motivate themselves for the conservation of the micro river basin		X	
	Not to be able to institutionalize the committees for conservation of the micro river basin		X	
	Unwillingness of organizations to strengthen themselves		X	
	Nonexistence of financial support of Regional/Local Government		X	
	The community farmers do not initiate the activities of conservation of the river basin			**X**

Source: Survey Team

The major's risks of the Program are in the following points;

- Not to find high profitability cultures to cover the investments due to the lack of research or study market
- Not to find the credit system that makes viable the investments of the producers.

It is necessary to accelerate the investigation upon introduction of technical irrigation and products of high value with a stable market taking advantage of a unit of technical irrigation to be installed for each sub-project. With this proposal, it will be possible to mitigate at least the following risks;

- Inefficient use of water by the beneficiaries
- Non disposition to the contribution of the irrigation installation (20%)
- New products of high value do not appear to cover the investment in technical irrigation
- Not to learn the techniques of technical irrigation to save the water use and to increase its productivity.

It is recommended to install a research center to innovate cultural technologies and use of technical irrigation. In addition it is recommended to establish an agricultural mechanism of credit to make possible the purchase of consumptions to increase the productivity.

1.11 Sustainability of the Program

The program of irrigation systems management has been developed at the design stage at the same way as it will be at the execution stage, that is, jointly between the State entities that regulate the administration of water resources and those in charge of the operation and self-management of irrigation systems (Irrigation committees, Commission and Board of Users).

The Formulation and Executing Unit of the Small and Medium Irrigation Program at the Peruvian Sierra is conformed by the Program of Rural Productive Development– AGRO RURAL.

The analysis takes into consideration the evaluation of indirect benefits (positive or negative) that could affect the individuals not necessarily comprehended among the beneficiary population, such as the participation of the population not defined as direct beneficiary of the Program in the irradiation of the economic effects of the interventions, in one sense; as the effects of water availability downstream, in the other sense. On the other hand, the analysis considers the identification and mitigation of threats and risks the Program will face during its execution, such as, difficulties for self-financing and organizational weakness of the Irrigation Committees, Commission or Board of Uses, among others..

The willingness to pay for the use of water by the direct beneficiaries remain clear from the results of the "Socioeconomic Survey to Benefited Farmers" of the subprojects, conducted at the Program intervention area; however, it is necessary to promote tasks of motivation and awareness to the level of users and the directive segment, to promote and/or strengthen said willingness to pay for irrigation water; the same that can be covered in part in the form of labor force contribution by the farmer community.

1.12 Environmental Impact

In this section of Environmental Impact, the Impact Analysis and an Environmental Management Plan are shown, based on the revision of the Legal and Institutional Framework of Peru, scope of the present program. The environmental legal framework is constituted by laws and norms issued by the MINAM and the MINAG that regulate the environmental management of the Program. The environmental impact was analyzed through the check list developed by JICA and a tentative classification of the required studies was made. The Study determines localized impacts that are of low intensity, of short term in the execution stage and positive during the formulation and operation and maintenance stages.

An Environmental Management Plan is suggested, where projects are classified and the results of the environmental studies will be supervised to be improved in the following stage. The environmental aspects to be later developed consist in completing the information of the projects to adjust them considering the possibility of the existence of intersection with Natural Protected Areas.

1.13 Selection of the Alternatives

Proposed Alternatives are as follows;

Alternative 1	This Alternative consists on the construction of irrigation works for the area of 38,732 ha (37,612 ha with gravity irrigation and 1,120 ha with technical irrigation), benefiting to 24,489 families, distributed in 50 micro watershed and in 56 districts in 9 departments, and the institutional building, specially for the organizations in the objectives micro watershed, regarding the efficient uses and the preservation of the water resource, so that they can plan and to manage the water resource at micro watershed level, conforming irrigation committees, and committees of Management of Micro watershed and technical irrigation. The Components of the Alternative are; a) Irrigation Infrastructure. b) Technical Irrigation c) Institutional Strengthening for the Water Resources Management at Micro Water shed d) Program Managements
Alternative 2	This Alternative consists on the construction of irrigation works for the area of 37,612 ha with gravity irrigation, benefiting to 24,489 families, distributed in 50 micro watershed and in 56 districts in 9 departments, and the institutional building, specially for the organizations in the objectives micro watershed, regarding the efficient uses and the preservation of the water resource, so that they can plan and to manage the water resource at micro watershed level, conforming irrigation committees, and committees of Management of Micro watershed and technical irrigation. The proposed components of this Alternative are; a) Irrigation Infrastructure. b) Institutional Strengthening for the Water Resources Management at Micro Water shed a) Program Managements

Main indicator for each alternatives are;

Indicator of the Alternatives

Item	Unit	Alternative 1	Alternative 2
Number of project		56	56
Number of Objective Department		9	9
Number of Objective District		56	56
Number of Project "Irrigation Infrastructure"		56	56
Number of Project "Technical Irrigation"		56	0
Number of Micro Watershed Strengthen	Micro watershed	50	50
Cost of Program	S/.x 10^3	243,108	225,407
Cost of component A (Irrigation Infrastructure)	S/.x 10^3	185,474	185,474
Improved and Constructed Area	Ha	37,612	38,732
Area of Technical Irrigation	Ha	1,120	0
Total Area of Beneficiaries	Ha	38,732	38,732
Number of Beneficiaries Families	Fam.	24,849	24,849
Cost of Program per ha	S/./ha	S/. 6,277 /ha	S/. 5,849 /ha
Harvest Area (Component A)	Ha	55,141 ha	55,141 ha
Yearly Increase of Gross Production values (Component A)	S/.x 10^3	143,789	143,789
Yearly Increase of Production Cost (Component A)	S/.x 10^3	78,247	78,247
Net Production Values (Component A)	S/.x 10^3	65,542	65,542
Harvest Area (Component B)	Ha	1,923	-
Yearly Increase of Gross Production values (Component B)	S/.x 10^3	11,337	-
Yearly Increase of Production Cost (Component B)	S/.x 10^3	6,308	-
Net Production Values (Component B)	S/.x 10^3	5,029	-
B/C at Market Price		1.76	1.75
IRR_{10} at Market Price		29.4	29.0%
NPV_{10} at Market Price	S/.x 10^3	169,414	155,574
B/C at Social Price		2.05	2.03
IRR_{10} at Social Price		36.6	36.1%
NPV_{10} at Social Price	S/.x 10^3	200,887	184,957

Fuente: Equipo del Estudio

Considering the difference between alternative 1 and 2, it will be recommended to select the Alternative 1. Justification of these judgments are as follows;

- The Alternative 1 present economic better indicators which determines a better profitability of the program.
- The Alternative 1 present a technical bigger viability for the increment of the agricultural production and an appropriate handling of the water resources

1.14 Implementation Plan, Organization and Management

The activities covered under the Program are:

Component	Activities
Component A: Irrigation Infrastructure	▪ Improving of the existing irrigation system and incorporation of irrigation upon rainfed land - Rehabilitation of canal (lining) - Construction of concrete canal - Construction of head work - Construction of dam ▪ Construction of lateral canal (by beneficiary) ▪ Training for the maintenance of canals and water conduction
Component B: Technical Irrigation	▪ Implementation of Technical Irrigation modules ▪ Bidding Fund ▪ Contestable Fund ▪ Training and technical assistance for the operation and maintenance of technical irrigation ▪ Formation of Irrigation Committee ▪ Preparation of Bidding Documents
Component C: Institutional Strengthening of Watersheds Management	▪ Elaboration of studies for the management of the intake area of the watershed. ▪ Organizational strengthening of the farmer community and committees of irrigation and management of the watershed.

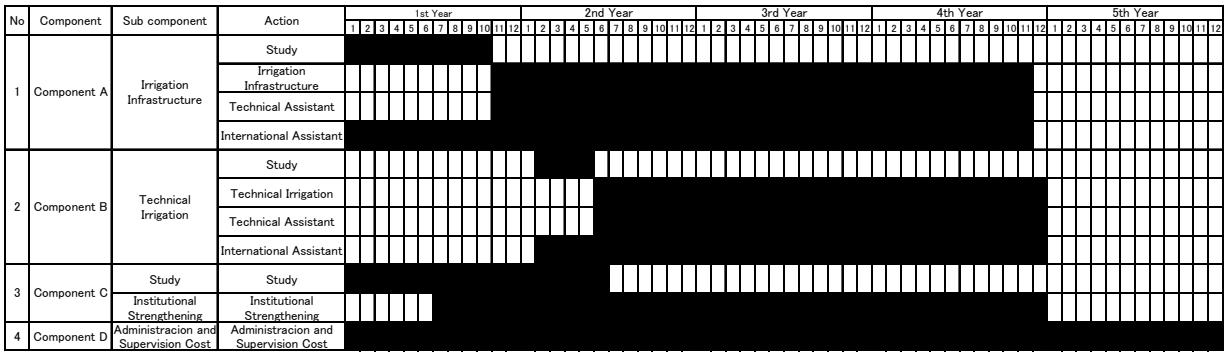
Source: Survey Team

(1) Implementation Schedule

The Implementation schedule is presented in two phase: the first shows the period for the Program investment development and the second shows the disbursement schedule, consistent with the Program execution process.

Concerning the physical development of the works, the sequence that should have between the Infrastructure of Irrigation construction (Component A) and the one corresponding to the Technical irrigation (Component B) should be considered. The first constitutes the critical route for the second, condition that should be considered in the process of works contracting. The schedule of the program is the following.

IMPLEMENTATION SCHEDULE OF THE PROGRAM
SMALL AND MEDIUM IRRIGATION INFRASTRUCTURE PROGRAM IN THE PERUVIAN SIERRA



Source: Study Team

2) Disbursement Schedule

The disbursement schedule is compatible with the Execution schedule, containing the plan of provision and allocation of the necessary financial resources for the suitable implementation of the Program; as shown below:

Disbursement Schedule(Unit: Thousand S./)

Components / Item			1 Year	2 Year	3 Year	4 Year	5 Year	Total
1	Component A	Irrigation Infrastructure	10,025	60,153	60,153	55,141		185,474
2	Component B	Technical Irrigation		3,471	6,941	6,941		17,353
3	Component C	Elaboration of Studies	5,875	6,144	4,274	4,274		20,567
4	Component D	Administrative Cost of National Supervision	4,171	3,388	3,276	3,163	948	14,946
		Contingency	953	953	953	953	955	4767
		Total	21,024	74,110	75,598	70,472	1,903	243,108

Source: Survey Team

(3) Form of Implementation of the Work

The Program will be implemented under the administration of AGRO RURAL central office, and the supervision of the Zonal Directions and Agencies, in coordination with Local and Regional Governments. The responsibilities of each part are the following:

Irrigation System Program Implementation

Works			AGRO RURAL		Government Regional/ Local	Consultant/ Management	Consultant /Local	Contractor	Beneficiary
Component		Detail	Central	Departmental					
Component A									
	Conglomerate Infrastructure of Irrigation	Pre-Qualification	●						
		Bidding		●		○		▲	
		Management	○	●		○			
		Study		○		▲	●		
		Supervision		○		▲	●		
		Works						●	
		Training		○	▲	▲		●	
	Works of Lateral Canals	Management		▲	○	●			
		Supervision		○	▲				
		Works			○	▲			●
Component B									
	Conglomerate Technical irrigation	Study		○		▲	●		
		Workshops		●		○			
		Bidding		●		○			
		Supervision		●	○				
		Training		●	○				
		Works		○	▲			●	▲
Component C									
	Study	Watershed Environment	○	○	▲	●			▲
		Inventory		○	▲	●			▲
		Action Plan		○	▲	●			▲
	Strengthening		○			●			
Others									
	Proposal of adequate products				○	●			▲
	Collaboration with entities of agriculture support				○	●			▲
Request for JICA disbursement			●	○		▲	▲	▲	

● : Entity in charge
○ : Supervising Entity/Supporting Entity
▲ : Related Entities

Source : Survey Team

1.15 Logical Frame

Logical Frame of the Program

Summary of the Project	Verifiable indicators objectively	Sources of verification	External conditions
Superior Objective Increase of the agricultural production of the families located in the territorial areas of smaller development in the Sierra.	Area of cultivation and volume of production in the irrigation area.	Registry of the cultivation area, statistical data	
Objective of the Program To improve the availability, conservation and supplying of the water resources to favor the increase of the agricultural production of the families located in the Sierra areas.	Area of Irrigation (24.800 farmer families, 38,700ha of land under irrigation) Water availability (38,700ha of land under irrigation) Activities of Conservation (50 micro-watersheds)	Report of Monitoring (Number of Executed Works, Areas of Conservation)	Availability of participation of the Community and Regional/Local Government Technical Assistance by the Local Government
Results · Increase of the Agricultural Production by increment of the irrigation area. · Incorporation of Technical Irrigation. · Sustainable development to assure self-sustaining natural resources by the farmers.	▪ 56 Sub-projects (Improvement of Irrigation Area 18,103ha and Incorporation of Irrigation Area of 20,629ha) · 56 modules of Technical Irrigation. · Studies and Promotion of the Management Committee of the Micro watershed of 50 Micro watersheds.	· Report of Monitoring · Number of Beneficiaries · Number of formed Committees · Implemented works · Number of formed Boards of Irrigation Users	Motivation of the Farmers Organizations and other agents Efficient maintenance Beginning of the activities of Conservation of the Watershed
Activities **Component A:** ▪ To improve Irrigation System ▪ Construction of Irrigation Infrastructures ▪ Training, Operation and maintenance of the Irrigation System.	▪ Improvement and construction of Channels for 56 sub-projects ▪ Improvement and construction of lateral channels for 38.700 ha. ▪ The budget of investment for component A is S/. 157 million ▪ Bidding and Contract ▪ Preparation of Bidding Documents (56 Subprojects) ▪ Environmental Study (56 Subprojects) ▪ Irrigation Committee Formalized	▪ Report of Monitoring ▪ Report of evaluation ▪ Acts of work reception and contract liquidation ▪ Cost by activity ▪ Report of Supervision ▪ Contract ▪ Report of Bidding Documents ▪ Environmental Study Reports	Opportune availability of financial resources. Good permanent administration of financial resources of the JUs. Good supervision. Predisposition of users to be formalized. Predisposition of regional, local and users to participate in seminaries, workshops, forums and public hearings.
Component B: ▪ Installation of Technical Irrigation Modules ▪ Training in Irrigation practices ▪ Training, Operation and Maintenance of Technical Irrigation..	▪ Number of Technical Irrigation Modules are of 56 sub-projects.. ▪ The budget of investment for the component B is S/. 14.6 million.. ▪ Irrigation Committee (S/. 6 millions)	▪ Reports of Supervision ▪ Registries of the Unit Executor, the JUs and the Agro Rural.	
Component C: **Activities:** - Elaboration of Studies for Management of the catchment's area of the Micro-Watershed.. - Organizational Strengthening of the Community Farmer and the Committees of Irrigation and Management of the Micro-Watershed.	Numbers of; ▪ Characterization Studies.. ▪ IPRH's, DES-P. ▪ Events of sensitization and motivation . Radial Spots, Notes of Press. Training and Technical Assistance.. ▪ Committees of Irrigation, Management of formed Micro-Watersheds..	· Ecological and economic zoning Study.. · Study of inventory and plan of action of water resources.. · Diagnosis and plan of action Study. · Final Memory Report, Report of Monitoring and Pursuit..	That financial availability for the execution of the studies exists.. Farmer Communities willing to accept sensitization and motivation. Predisposition of the organizations to fortify itself . Financial support of the Regional and Local Governments
Component D: To manage the implementation.	· Bidding and contracts. · Technical File (56 subprojects) · Study of Environment (56 sub-projects). · Management of the Component A, B and C. · Budgetary control	· Contracts · Reports of ET · Report of Environment · Monthly report of Management of the Program · Budgetary balance	

Source : Survey Team

1.16 Basic Guideline for Impact Assessment

Considering the objective of the Program "To structure the base of the irrigation infrastructure and to strengthen the institutional capacities for the management, handling and preservation of the water in the micro-watersheds and to contribute to increase the farming production of the families in situation of poverty and extreme poverty located at the Sierra", it settles down the basic guideline for impact evaluation;

Expected Results of the Program

Component	Area	Expected Qualitative Benefits
Program	Economic	• Improvement of the Incomes by the Sale of Production Surpluses. • Increase of labor opportunities by greater activity of the regional economy. • Increase of the Incomes per Agricultural Unit.
	Labor Force	• Reduction of emigration to work searching. • Increase of Opportunities to Work
	Human Capital	• Learning of new farming technologies. • Improvement of the Schooling.
	Access to Natural Resources	• Better use of the Natural Resources (Water and Soil). • Introduction of innovative agricultural practices and improvement of existing agricultural practices.
	Social Capital	• Leadership creation in the community by Program actions. • Existence of organizations in the community. • To strengthen the organization. • Possibility of creation of industries related to farming activity.
	Physical Capital	• Infrastructure availability. • Availability of services. • Access and distance to product Market and work. • Quality of the physical-biological environment in the community.
	Institutional Capital	• Access to credit system. • Access to technology transfer. • Access to legal support.
Component A		
Improvement of irrigation system	Agro economic	• Cost reductions through large scale repairs making instead of a number of small ones. • Increase of the reliability in the water supply.
Construction of New Irrigation System	Socio environmental	• Revitalization of the region and increase of the mutual cooperation by means of the creation of irrigation committees.
Increase of the agricultural production by means of the implementation of the irrigation system	Reduction of poverty Consideration to most underprivileged people	• Reduction of health expenses, by means of the stabilization of the food provision in the families. • Improvement of the health of the settler by the stabilization of the food provision. • Better education by means of the improvement of the familiar income • The water reserve for domestic daily use will reduce home work.
Component B		
Introduction of Top Technology	Agro economic	• Improvement of the familiar economy by the increase of production / Improvement in social level by the participation in the market. • Awareness of the farmer by means of qualification in introduction of top irrigation technology systems. • Increase of cultivation areas by the best use of the water.
	Socio environmental	• Reduction of the disputes by the water by means of the efficient use of the resource.
Component C		
Participation of the settlers in the Institutional Strengthening	Environment	• Awareness of the beneficiaries in the conservation of Water.
		• Recognition of the actions necessary to realize for the conservation of the Water.

Source : Survey Team

CHAPTER 2
GENERAL ASPECT

CHAPTER 2 GENERAL ASPECTS

2.1 Name of the Project

PROGRAM FOR THE SMALL AND MEDIUM IRRIGATION INFRASTRUCTURE IN THE PERUVIAN SIERRA

2.2 Formulating and Executing Agency

Formulating Unit

Name: AGRO RURAL

Person in Charge : Arch. Rodolfo Beltrán Bravo

Executing Unit

Name : AGRO RURAL

Person in charge : Arch. Rodolfo Beltrán Bravo

The Program Executing Institution is AGRO RURAL, through the zonal agencies, whose experience in the execution of irrigation facilities projects are sustained in projects already executed.

AGRO RURAL Regional Office, count on with a permanent presence in the area and are fully identified with the Communities' problems, being the main institution of the sector and the State that carry out activities of agricultural development in the sphere of provinces and districts of the 9 departments.

2.3 Participation of Concerned Agencies and Beneficiaries

The concerned entities are the following:

- Ministry of Economy and Finance (MEF)
- Ministry of Agriculture (MINAG)
- AGRO RURAL and its Zonal Agencies
- Committees, Commissions and Board of Users
- Farmer Communities
- Regional Governments
- Local Governments
- Japan International Cooperation Agency (JICA)

The participation of each one of the concerned entities in the execution of the program is the following:

- **Ministry of Economy and Finance (MEF)**

  Entity of the Central Government, approves funds of the public budget and JICA loans in the General Budget of the Republic, for the development of the program in accordance with the schedule and program of the same, previous approval of the both pre-investment and investment studies.

- **Ministry of Agriculture**

  Entity of the central government, direct agriculture and livestock activities who will revise and approve the contents of the study of the program at pre-investment and investment levels.

- **Japan International Cooperation Agency (JICA)**

  Institution of the Japanese Government, are financing the program in the preparation of the Pre-feasibility and Feasibility studies of the program, through the Consultant (Nippon Koei Co., Ltd.).

- **AGRO RURAL (EX PRONAMACHCS)**

  Institution of the Ministry of Agriculture in charge of the formulation of some of the Pre-investments studies at the different levels of perfil, Pre-feasibility and Feasibility and to review and include in the program, the perfiles submitted by local or provincial governments; also is the executor of the projects considered in each component of the Program. Likewise, it is coordinating with the Japanese consultant for the elaboration of the Pre-feasibility and Feasibility Studies of the Program.

- **Regional and Local Government**

  Both are important decentralized institutions of the State, that have been participating in the program by the submittal of their projects in the program, the participation of regional and local governments are fundamental for the program and projects sustainability because their contribution to finance the program are being considered.

- **Committees, Commission and Board of Users**

  Boards of Irrigation Users

  Each irrigation project have organizations such as the Irrigators Committees and Board of Users as organization of base, to be benefited with the program execution and they will be in charge of facilitating the accesses and physical spaces for the execution of infrastructure works and other actions of the different components of the program. In this manner the execution of actions prioritized in the program will be smoother. Also, once the works are concluded, they will execute the operation and maintenance of the irrigation infrastructures.

  Commissions and Committees of Irrigators

  They will have a major participation in the program activities, specially at the Pre-investment stage, execution of irrigation infrastructure works, technical irrigation and training for the reinforcement of their participation in the Micro watershed management. Also, they will be instructed to execute a proper operation and maintenance of the irrigation system and the conservation of water resources.

  For the following stage of the study, corresponding to the Program Feasibility, the participation of beneficiary organizations are considered through the signature of agreement statements to commit their participation specially in the operation and maintenance of the irrigation infrastructure to be constructed.

  In the investment stage, corresponding to the works execution and training activities, strengthening and administration of the program; they will be directly monitored and coordinate by AGRORURAL who is the entity to conduct said activities, closely coordinating with the board of users and irrigators committees and the ANA of MINAG through the Local Authorities of Water in each jurisdiction, being as leading actors the regional and local governments.

- **Farmers Communities**

Organizations in charge of facilitating the actions corresponding to the Watershed Management.

2.4 Framework of the Project

2.4.1 Summary of the Project Antecedents

The National Program for Watershed Management and Soil Conservation "PRONAMACHCS", now Program of Agriculture Productive Development AGRO RURAL, has been working for 27 years in the management of natural resources.

From 1997, PRONAMACHCS started the execution of projects oriented to the management of natural resources with a systemic approach of Watershed. In order to reduce the poverty in the rural area, the Peruvian Government arranged loan and credits from international financing institutions such as the World Bank, the Japan Bank for International Cooperation (JBIC) and others, being PRONAMACHCS of the Ministry of Agriculture, the entity in charge of said projects.

The Peruvian Government, taking into account the important role of agriculture in the national development strategy, has seen with much concern the water shortage problem in the sierra, caused by the seasonality of rainfall, that in most cases only allow an traditional agriculture practice with cultivation in rain fed area with one crop per year, for the majority of cultivated land cannot be worked by lack of water resources at the dry season (approximately 8 months per year).

The Program under Study has its origins in PRONAMACHCS, entity integrated by AGRO RURAL since March 2009, intervening in the whole country.

Following, the most important steps for its development from April 2006 are listed.

a) On April 28, 2006, PRONAMACHCS, by official letter Nª 464.2006-AG-PRONAMACHCS-GG/GPLAN sends to the General Office of Agriculture Planning of MINAG the project: "Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra"; pre-investment study at perfil level, requesting opinion and procedures,

b) On May 25, the General Office of Agriculture Planning (OGPA), by official letter Nª 2058-2006-AG-OGPA-OI- communicates to the General Manager of PRONAMACHCS that the perfil of the "Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra"; has been evaluated and approved by the OGPA, through technical report Nª 124-2006-AG-OGPA/OI recommending the elaboration of Pre-feasibility studies.

c) On June 5, 2006 the Ministry of Agriculture sends an official letter Nª 297-2006-AG-DM to the Ministry of Economy and Finance requesting the opinion of the National Direction of Multiyear Programming (DGPM) and the start of negotiations of the Loan Contract with the World Bank.

d) On August 1, 2006, the General Director of the Public Sector Multiyear Programming sends to the General Direction of Public Debts the report Nª 127-2006-EF/68.01 with its opinion on respect to the initiation of negotiations for the financing of the Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra.

e) In its report, the General Direction of Public Debts expresses that "it considers necessary more information to start financing negotiations, recommending to start the same once the pre-feasibility study is approved, or the observations described in the technical report Nª 127-2006-EF/68.01 are solved" attached to the memorandum.

f) By official letter Nª 336-2007-AG-DM of May 24, 2007, MINAG reiterated to the MEF its request to start negotiations of external indebtedness to finance the Program, in this opportunity, negotiations with JBIC, attaching an improved version of the Program study.

g) By Memorandum Nª 259-2007-EF/75.22, dated June 4, 2007, the General Direction of Public Debts once again requested the opinion of the National Direction of Multiyear Programming

h) The DGPM of MEF issued a technical report Nª 104-2007-EF/68.01 dated August 1, 2007 pointing out that "after review, analysis and evaluation of the "Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra"; it can be observed that the same has not attended all observations and recommendations expressed in the Technical Report Nª 127-2006-EF/68.01, reiterating thus, the opinion that before starting the financing negotiations the pre-feasibility study for the present program should be carried out.

i) The same technical report "recommends component 3 (training and technical assistance to irrigation users), to be submitted not as a separate component because its actions directly complement the actions of components 1 and 2 (irrigation infrastructure and technical irrigation, respectively). Integrating it to the said components, the adequate operation and maintenance of the infrastructure to be developed can be assured". From that point AGRORURAL and OPI-MINAG limited the program to only three components, having component 3 of the Institutional Strengthening for Watershed Basin Management.

j) On November 24, 2008, the Ministry of Agriculture of Peru, the General Manager of PRONAMACHCS and the Resident representative of JICA Peru, signed a Minute of Discussion about the implementation of the Preparatory Survey for the "Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra".

k) The Japan International Cooperation Agency, JICA, through a process of selection assigned the elaboration of the study to the Consulting company Nippon Koei (hereinafter the Consultant), awarded with the tender process.

l) The Consultant starts its works in Peru on March 2009, submitting the Inception Report that is soon discussed with the Peruvian Counterpart PRONAMACHCS (hereinafter AGRORURAL), adding a set of recommendations made by the counterpart institution. The said report contains the approach and methodology for the conduction of the study.

m) Actually, AGRO RURAL (EX-PRONAMACHCS) through the Executive Direction and the Planning Office have instructed the Zonal Directions to update the information about projects initially considered in the Program perfil, as also to prioritize with local authorities the projects to be incorporated, because some of them have been executed, being necessary to elaborate perfils and other have been submitted by local governments, and the sphere of action are at national level; also irrigation projects with systemic approach of the watershed are being formulated.

n) Considering the hilly topography of most of subprojects, the existence of proper land for agriculture and irrigation is limited to small extensions of land located in the inter-Andean valleys; this is one reason why it has been considered to execute only projects superior to 100 has. and consequently infrastructure works will be small and medium compared to the irrigation at the Peruvian Coast where there are canals that convey flow superior to 40,000 l/s.

2.4.2 Policy Guidelines Related to the Program

The National Law of Public Investment, Law Nº 27293 establishes among the objectives of the system: "Strengthen the Planning Capacity of the Public Sector" (art.5th); and accordingly in article 10.2, describe that: "Each sector and regional/local governmental office should be prepared Multiyear Programs of the Public Investment Projects in accordance with framework of the corresponding sector's Strategic Development Plans"

The same is reiterated by the General Direction of Public Investment System through the Direction Resolution "Nº 002-2009EF/68.01, article 12.2" that describe that pre-investment studies role "required to be compatible with the guidelines of sector policies and the corresponding institutional strategic plan".

(1) Multiyear Macroeconomic Framework 2010-2012

The Multiyear Macroeconomic Framework (MMM) enacted by the Ministry of Economy and Finance (MEF), is a political guideline that defines and clarifies the economic and social policies to be directed in the preparation of strategic plan for a period of three years.

According to the MMM: "To assure that the impact of the international situation is not greater to the local economy, as also to safeguard the gains in the reduction of poverty ratio that has fell down from 48,7% in 2005 to 36.2% in 2008, the economic authorities have adopted counter-cycle policies. The Ministry of Economy and Finance has launched a Plan of Economic Incentive (PEE) "Said program amounts to 3.2% of the GNP and is directed preferably to the sectors most affected by the crisis. Great part of the PEE "consists in a program to increase Public Investment and social expenses, leading in consequence to the reduction of the infrastructure gap with the effect of increasing productivity and promoting a long term growth."

The initiatives in the social field are directed to the infrastructure of education, health, agriculture and basic. The MMM has in its main aspect the achievement of social objectives, among them the most important is the goal to reduce poverty up to 30% in 2011.

Poverty ratio in year 2008 was situated in 36.2% (3.1 per cent less than 2007). Extreme poverty ratio in 2008 was 12.6% (1.2 per cent less than 2007). These figures indicate more rigidity in extreme poverty, in a scenario of continuous economic growth of the Peruvian economy during 92 months until the middle of February 2009.

(2) Agriculture Sector Multiyear Strategic Plan 2007-2011

The Strategic Plan of Agricultural sector defines three strategic objectives:

1. Increase Competitiveness of Agricultural Activity;
2. Achieve the sustainability of natural resources and biodiversity; and
3. Achieve the access to basic and productive services for the small agricultural producer.

For these strategic objectives, there are six corresponding strategic themes: Water management, access to market, agrarian information, capitalization and security, agriculture technological innovation and rural development.

The specific objective of the "Water Management" strategic theme is to upgrade the efficiency in water management and to attain the sustainable use of water resources having as guideline, "Promote the modernization of agriculture through the introduction of technical irrigation systems", guideline where the "Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra" fits in.

The strategic theme of rural development has as objective,

- Focus the intervention of the public sector's effort in agriculture, specially at poverty zones, mainly in the Sierra and Selva trough a territorial and multi-sector

approach"

This objective has a guideline: Focus the agriculture public sector intervention in rural poverty areas and to promote the sustainable management of natural resources.

The same Plan sets forth as strategy for the development of both guidelines:

- Re-organized MINAG's projects for rural development, increasing public investment in agriculture in zones of poverty and extreme poverty"; and also points out, "development of tools and projects for the good use of natural resources with economic purposes in zones of rural poverty".

(3) Water Resources Law Nª 29338 (31/03/09)

The Law of Water Resources regulates the use and management of water resources, as a National asset, of public use and in harmony with the common good, environment protection and interest of the Nation. It also establishes that "There is no private property over water" (Title I. Art. 2).

Concerning the Rights of Farmers and Native Communities (Art. 64) establishes the following:

- The State acknowledges and respects the right of farmers and native communities in the use of the existing waters that runoff through their land, as well as the springs, for the purpose of economic, transportation, survival and cultural activities, in the framework of the Peruvian Political Constitution.

- This right has no prescription, is prevalent and in accordance to the ancestral uses and habit of each community.

There are a significant number of farmers' communities that are social and economic agents in the sphere of the "Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra.

(4) Organic law for the sustainable use of natural resources. Law Nª 26821 (06/10/97).

The objectives of the law for the sustainable use of natural resources are as follows: "promote and regulate the sustainable use of the natural resources" Natural resources are "all components of nature, susceptible to be used by the human being for the satisfaction of the necessities and with potential market valu" The first of the components named by the law are superficial and underground water.

The law for the sustainable use of natural resources also establishes in its Art. 18 that: "The farmers and native communities have preference in the sustainable use of natural resources of their land, duly registered, unless express reserve of State or exclusive rights or excluding of third parties."

On the other hand, it describe in Art. 20 that: "All use of natural resources by part of private persons give place to a economic retribution that is determined by economic, social and environmental criteria.".

(5) National Strategy of Rural Development. Supreme Decree Nª 065-2004-PCM 5/09/04

The objectives of the National Strategy of Rural Development are as follows: "promote human development in the rural area with criteria of economic, social and environmental sustainability and equity and democracy in local decisions."

The Strategy contains a diagnosis of the Peruvian rural sector, being the main issues:

- Low profitability of agricultural activities "mainly expressed in the low income of rural families, low labor productivity, improper economy of scale of several productive processes, lack of market coordination, high financial costs, volatility of intern market prices among others"

- Restrictions to the access to Productive Assets.

Expressed "in a high informality in land possession and an ambiguity in rights of property approximately, the 80% of the total extension of rural land is not legalized. The 42% of the private land has no land title; and the 53% of the claimed communal property declares they are registered.

The fragmentation of farmer's land is also a restriction to the access to productive assets; "Small units participate with the 92% of the total of agricultural productive units (84% with less than 10 hectares, 70% with less than 5 hectares), and represent 15.55 hectares of land for agriculture use and 66% of the agriculture area and involves approximately a million and half households (33% of the total) a situation of fragmentation that is more intensive at the Southern center Sierra area that presents units with sizes under the national average of 3.28 hectares and 3.3 lots per property. It is estimated that 24% of the total of agriculture units in the country corresponds to very small property, less than one hectare, and are mainly concentrated in the Sierra."

- Low Rural Economic Infrastructure

The diagnosis points out a poor irrigation infrastructure, vulnerability of the same in case of earthquake, intense rain and landslide. Also points out an inadequate road and communications infrastructure. Among other structural aspects, the Strategy points out the poor development in human capital, high level of social and cultural discrimination and vulnerability of the rural population in relation to extreme natural phenomena.

- Poor Agriculture Financing

The Rural Development Strategy also mentions: "Decentralized investment decisions and oriented towards the marginal sectors and extensive application of the National System of Public Investment and its adaptation to the rural area". Also it mention "Construction of roads and vicinal roads in zones of market potential for the agriculture production, in charge of local governments and the selling of environmental services. Development and extension of the small and medium irrigation infrastructure, with a proper administration and maintenance with the participation of the users."

(6) National Policy and Strategy of Irrigation in Peru. RM 0498-2003-AG

The Ministry Resolution establishes the National Strategy of Irrigation in Peru, determining the orientation and priority of investments, clarifying the organization and technical-administrative procedures. Such should be implemented in the national, regional and local sphere with the participation of users and in accordance with the existing social and economic conditions. This policy should contribute to the welfare and development of the rural population.

The national policy and strategy of irrigation states that: "The main objective of the agriculture policy is to increase profitability and competitiveness in agriculture". The first agriculture policy related with the irrigation sub sector, concerns the Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra, stated as the "development of platforms of agriculture services, improving water management through the promotion of investment in modern irrigation technologies and the proper operation and maintenance of the existing irrigation infrastructure."

In the principles of the strategy, it is stated that:

- "The State acknowledges and assures the traditional rights over natural resources, keeping their quality and proper use".

Another guideline is, "Promote the dissemination of sustainable technological changes to increase the efficiency in the use of irrigation water and soils".

(7) AGRO RURAL Policy

AGRO RURAL is, through the Supreme Decree 014-2008, the entity responsible for the promotion and participation in financing projects of agriculture productive investment in rural zones and to promote and provide technical support to initiatives of productive projects of agriculture in rural zones.

AGRORURAL is a new entity of the agriculture sector under the Ministry of Agriculture, created by Legislative Decree Nª 997 of June 20, 2008, entity that absorbs the following entities:

a) Coordination Unit of the of Natural Resources Management in the South Sierra– MARENASS

b) Special Project for the Promotion of Utilization of Fertilizers Produced from Sea Birds– PROABONOS

c) Program of Support Services to Accede to Rural Markets – PROSAAMER

d) National Program of Watershed Basin and Soil Conservation Management – PRONAMACHCS

PRONAMACHCS is one of the most important institutions for the policies of the State in agriculture issues, particularly for the rural Andean poorest economies of the country.

2.4.3 Guidelines of Policy and Strategy of the Agriculture Sector Multiyear Plan 2007-2011 (RM Nª 0821-2008-AG) and its correspondence with the Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra

The following table shows a summary of the articulation of the Program with the Guidelines and Strategies of the Agriculture Plan, a tool of the MINAG policy, showing the fundamental directions of actions in the agriculture sector.

Guidelines and strategies of the Agriculture Plan and its relation with the Program Components

Policy guidelines RM Nº 0821-2008-AG(Textual)	Strategies (Textual)	Relation with the Program Components
Promote the construction and rehabilitation of irrigation infrastructure, assuring the availability and optimum use of water sources.	Approve and implement mechanisms to co-finance projects of irrigation infrastructure rehabilitation in costa and sierra with the participation of Local and Regional government and the private sector.	Component 1 of the Program: "Improvement and construction of irrigation infrastructure", directed to the rehabilitation, improvement and construction of irrigation facilities to improve the efficient use of water in the Sierra. Implemented with the participation of users, local and regional government.
Promote the modernization of agriculture through the installation of technical irrigation system	Implement mechanisms to co-finance projects of technical irrigation with the participation of Local and Regional government and the private sector.	Component 2 of the Program "Technical irrigation" proposes to incorporate users and Local and Regional government, using adequate technology. The program area is in the poorest zones of the rural area in the center and northern sierra.
Strengthen the conservation and sustainable use of water resources, soil and forest in the watersheds.	Develop reforestation projects in watersheds promoting private investment	Component 3 of the Program "Strengthening Institutions for Watershed management", considers the coordination between irrigation users, Local and Regional government and other entities to improve watershed management.
Grant legality for the access to water	Legalize the conditions of the irrigation users	The Law of Water Resources Nª 29338 establishes that "There is no private property in case of water" and creates the National System of Water Resources Management. Also defines the role of Local and Regional Gov government and the committees, commissions and boards of irrigation users. The legal condition of the users is the starting point for the component 1 of the Program.
Promote the proper use of water in the watersheds maintaining the balance between the water supply and demand, within the concept of water security, foreseen the occurrence of crisis and conflicts due to this resource.	"Create the authority of watersheds and develop watershed management plans in the national territory under the conduction of the watershed authorities"	Component 3 of the Program proposes a plan to reinforce and organize, depending on the case, the institutionalism of the watershed management.
Strategic Theme Rural Development		
Focus the intervention of the agriculture public sector in zones of rural poverty	Reordering the development projects of MINAG and increasing public investment in agriculture at poverty and extreme poverty zones	"Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra", is intentionally located in poverty and extreme poverty zones at the Sierra
Contribute to the improvement of management capacity in issues of rural development in regional and local governments	Develop agreements, projects and programs for the capacity building of territorial management of rural development within the local and regional governments	The three components of the Program necessarily imply to work with both levels of regional and local. The transference and strengthening of capacities is the result of joint work.

2.5 Diagnosis of Actual Situation

2.5.1 Program Ambit

(1) Departments, Provinces and Districts at the Program Area

The Subprojects ambits are located in 9 departments of Peru: Amazonas, Cajamarca, Piura, La Libertad, Ancash, Huánuco, Junín, Huancavelica and Ayacucho. The Districts and Provinces in the Program area are the following:

Table 2.5-1 Departments, Provinces and Districts at the Program Area

DEPARTMENT	PROVINCE	N°	DISTRCIT
1. Amazonas	1. Bagua	1	La Peca
	2. Chachapoyas	1	Balsas
	3. Utcubamba	1	Bagua Grande
		1	Cajaruro
		1	El Milagro
2. Ancash	4. Aija	1	Aija
	5. Bolognesi	1	Aquio
		1	Huasta
		1	Pacllòn
	6. Carhuaz	1	Acopampa
	7. Carlos Fermin Fitzcarrald	1	San Luis
	8. Huaráz	1	Olleros
		1	Recuay
		1	Ticapampa
		1	Catac
	9. Huaylas	1	Caraz
	10. Mariscal Luzuriaga	1	Llumpa
	11. Pomabamba	1	Pomabamba
	12. Sihuas	1	Chingalpo
		1	Quiches
		1	San Juan
	13. Yungay	1	Ranrahirca
3. Ayacucho	14. Cangallo	3	Maria Parado de Bellido, Los Morochucos, Cangallo
	15. Fajardo	2	Huancapi-Huancaraylla
	16. Huamanga	3	Acocro, Chiara, Vinchos
	17. Lucanas	1	Puquio
	18. Vilcashuaman	1	Concepción
4. Cajamarca	19. Cajabamba	1	Condebamba
	20. San Miguel	1	San Silvestre
	21. San Pablo	3	Tumbaden, San Pablo, San Luís
	22. Santa Cruz	1	Yauyucán
	23. Huaytará	1	San Antonio de Cusicancha
6. Huánuco	24. Huánuco	1	Quisqui
	25. Yarowilca	1	Aparico Pomares
7. Junín	26. Concepcion	1	Sta Rosa de Ocopa
		1	S.J. Quero
	27. Huancayo	1	Chicche
	28. Jauja	1	Yauli
	29. Junin	1	Junin
	30. Tarma	3	Acobamba, Tapo, Tarma
8. La Libertad	31. Bolivar	1	Ucuncha
	32. Gran Chimú	1	Lucma
	33. Sanchez Carrión	1	Chugay
9. Piura	34. Ayabaca	2	Ayabaca, Montero
	35. Huancabamba	1	Sondor
9 Departamentos	35 Provincias	56 Districts	

(2) Space Area, Population and Beneficiaries

In terms of population and area, the subject districts of the Program area occupy 6.7 % of the surface area and the residing population is 7.1 % of the total population in the 9 departments respectively. In the following table the relative and absolute area and population in the Program area are shown.

Table 2.5-2 Area and Population in the Program Area (2007)

Department	Area (km2)			Population		
	Department	Districts of the Program	% Population at the Program's Districts	Department	Districts of the Program	% Population at the Program's Districts
AMAZONAS	39,659	3,416	8.6%	371,870	111,337	29.9%
ANCASH	35,955	3,362	9.4%	1,047,985	137,537	13.1%
AYACUCHO	43,462	4,523	10.4%	603,686	70,882	11.7%
CAJAMARCA	32,986	2,001	6.1%	1,372,142	81,816	6.0%
HUANCAVELICA	21,871	603	2.8%	448,396	6,560	1.5%
HUANUCO	36,990	346	0.9%	753,668	12,863	1.7%
JUNIN	44,051	2,501	5.7%	1,186,593	88,531	7.5%
LA LIBERTAD	25,334	1,314	5.2%	1,598,814	45,999	2.9%
PIURA	36,088	3,127	8.7%	1,665,101	86,064	5.2%
Total	**316,396**	**21,192**	**6.7%**	**9,048,255**	**641,589**	**7.1%**

Source; INEI, CUANTO

According to INEI data (Institute CUANTO) in 2007, the 43 % of the population of 9 departments lived in the rural area. In departments like Huancavelica (73%), Cajamarca (72%), Amazonas (63%) and Huánuco (57%), more than half of the population live in the rural area, showing a high ratio compared with the national mean ratio(27.1%).

Table 2.5-3 Population at the program area 2007 (thousand of inhabitants)

Department	Population	Urban	Rural
AMAZONAS	371,870	37.3%	62.7%
ANCASH	1,047,985	60.6%	39.4%
AYACUCHO	603,686	61.7%	38.3%
CAJAMARCA	1,372,142	27.7%	72.3%
HUANCAVELICA	448,396	26.9%	72.9%
HUANUCO	753,668	42.8%	57.2%
JUNIN	1,186,593	69.5%	30.5%
LA LIBERTAD	1,598,814	70.4%	29.6%
PIURA	1,665,101	76.5%	23.5%
Total	9,048,255	**56.8%**	**43.2%**
National	**28,750,770**	**72.9%**	**27.1%**

Source: INEI, CUANTO

In terms of beneficiaries, the Program would be benefiting 23.1 % of the households within the Program's target Districts. The percentage of beneficiaries in each Department are shown in the following table,.

Table 2.5-4 Beneficiary population and households in the Program area (2007)

Department	Household		
	Districts	Number of Beneficiaries	% Beneficiaries
AMAZONAS	27,561	4,379	15.9%
ANCASH	34,606	8,949	25.9%
AYACUCHO	19,649	6,544	33.3%
CAJAMARCA	19,951	6,778	34.0%
HUANCAVELICA	1,923	1,579	82.1%
HUANUCO	3,076	277	9.0%
JUNIN	22,865	2,840	12.4%
LA LIBERTAD	11,194	2,361	21.1%
PIURA	19,438	3,261	16.8%
Total	**160,263**	**36,968**	**23.1%**

Source; Estimated by the Study Team

It is estimated that the majority of beneficiaries are in situation of poverty or extreme poverty. As shown in Table 2.5-9, corresponding to the Average Expense and IDH at the Program Area Districts.

2.5.2 Socioeconomic Aspects

(1) Role of the agriculture sector in the economy of the Department

The agriculture in the 9 Departments has an important role, both in the Gross Net Product(GNP) and in the population dedicated to it. The figures of the 9 departments are shown in the following table:

Table 2.5-5 Contribution of the Agriculture Sector to the Department GNP (2006)

Department	GNP (2006)	Agriculture in GNP		Rural Population
	In million of Soles	In million of Soles	% of contribution to the GNP	
AMAZONAS	2,402	760	31.6%	62.70%
ANCASH	13,439	1,393	10.4%	39.40%
AYACUCHO	2,443	445	18.2%	38.30%
CAJAMARCA	10,258	1,081	10.5%	72.30%
HUANCAVELICA	1,739	206	11.8%	72.90%
HUANUCO	4,158	498	12.0%	57.20%
JUNIN	10,648	914	8.6%	30.50%
LA LIBERTAD	17,956	2,046	11.4%	29.60%
PIURA	9,942	1,241	12.5%	23.50%
Total 9 Departments	**72,985**	**8,584**	**11.76%**	**43.20%**
Total National	**302,551**	**16,596**	**5.5%**	**27.10%**

Source; Statistics Yearbook , Peru in Numbers Cuanto 2007, 18.19

In average, 43.3% of the population lives in rural areas, in consequence the role of agriculture is very important. It should be stressed that in the Departments of Cajamarca and Huancavelica, the contribution of the agriculture sector to the Department GNP is between 10 to 11 %, however the rural population in said departments is higher than 70%.

(2) Existing Infrastructure Conditions in the Departments

1) Road Network in the Provinces of the Program

The present condition of the road network in the provinces of the program are summarized as follows:

Table 2.5-6 Road Network in the Program Area

Type of road	Length (km)	%	Length by type of paving (km)			
			Paved	Compacted	Unpaved	Trail
NATIONAL	8,942.08	18.08	3,822.75	3,711.58	1,204.27	203.48
DEPARTMENT	7,406.49	14.98	377.49	3,629.18	2,527.02	872.80
LOCAL	33,102.34	66.94	342.16	5,853.74	7,661.96	19,244.48
Total	49,450.91	100.00	4,542.40	13,194.50	11,393.25	20,320.76
(%)	100.0%		9.2%	26.7%	23.0%	41.1%

On the other hand, the total length of local, provincial and national roads and the occupation density indicators in the Sierra, classified by Departments are shown in the following Table:

Table 2.5-7 Length and Road Density by Department

Department	Area (km2)	All Types		National and Departmental		% of Sierra to the Total	
		Total Length (km)	Density (m/km2)	Total Length(km)	Density (m/km2)	Sierra Area (km2)	% to all
AMAZONAS	39,249.1	2,311.44	58.89	1,131.03	28.82	4,722.5	12.0%
ANCASH	35,914.8	4,937.43	137.48	2,460.00	68.50	25,828.2	71.9%
AYACUCHO	43,814.8	8,895.94	203.04	2,522.00	57.56	41,739.7	95.3%
CAJAMARCA	33,317.5	6,296.15	188.97	1,895.97	56.91	19,091.1	57.3%
HUANCAVELICA	22,131.5	6,360.75	287.41	1,411.93	63.80	22,131.5	100.0%
HUANUCO	36,848.9	2,975.77	80.76	1,131.67	30.71	20,295.2	55.1%
JUNIN	44,197.2	6,440.49	145.72	1,464.19	33.13	20,254.4	45.8%
LA LIBERTAD	25,499.9	4,410.61	172.97	1,882.65	73.83	13,426.6	52.7%

PIURA	35,892.5	4,398.00	122.53	1,435.20	39.99	6,329.5	17.6%
Total	**316,866.2**	**47,026.58**	**148.41**	**15,334.64**	**48.39**	**173,818.70**	**54.9%**

Source; Technical Team 2005, Regional Direction of Transports and Communication, prepared: ETP of PVDP of Regional Government of Amazonas - 2005
DRTC-Ancash/ Direction of –Roads –2005, Direction of –Roads Technical Team -2005 – Regional Government of Ancash, DRTC – Ayacucho 2005
DRTC – Cajamarca 2005, Technical Team 2005, DRTC-LL / Road Inventory. Year 2003., Elaboration: Technical Team– Regional Government of La Libertad., Elaboration Technical Team Piura – 2005, Ministry of Transports, Communication, Housing and Construction 2003

2) Road Network

Road network in Peru has more than 70,000 km. of roads, organized in three major groups: national roads, department roads and local roads, said routes are under the charge of PROVIAS, decentralized entity of the Ministry of Transports and Communications that is responsible for the maintenance and extension of said roads, by the quality and type of vehicles that use each, they can be classified in three categories: highways, paved roads and gravel roads.

Highways have two main lanes and one safety lane at each direction, separated by a shoulder and have good signaling, in Peru, there are about 300 km. of highways corresponding to sections of the north and south access to Lima through the Pan-American Highway. Paved roads have only one main lane and one safety lane at each direction, separated by horizontal paving marks in the middle, the type of signals and basic services depend on the relation of proximity to the main cities.

Most part of Peruvian roads are gravel roads constructed with earth and gravel. There are three types of gravel roads in Peru: those belonging to the national network, secondary and local roads and the trails. The type of roads by departments at the Program area is shown:

AMAZONAS

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	736.79	31.88	175.34	518.12	31.35	11.98
DEPARTMENTAL	394.24	17.06	2.95	264.16	122.13	5.00
LOCAL	1,180.41	51.07	0.00	395.01	137.42	647.98
Total	2,311.44	100.00	178.29	1,177.29	290.90	664.96
(%)	100.00		0.08	0.51	0.13	0.29

Source: Regional Direction of Transports and Communications, prepared : ETP of PVDP Regional Government of Amazonas - 2005

ANCASH

Type of roads	Length (km)	%	Extension by type of pavement (km)			
			Paved	Compacted	Unpaved	Trail
NATIONAL	1,433.21	29.03	707.09	726.12	0.00	0.00
DEPARTMENTAL	1,026.79	20.80	139.34	416.52	310.83	160.10
LOCAL	2,477.43	50.18	23.60	360.51	853.26	1,240.06
Total	4,937.43	100.00	870.03	1,503.15	1,164.09	1,400.16
(%)	100.00		0.18	0.30	0.24	0.28

Source: DRTC-Ancash/ Road Direction -2005
Technical Team Road Direction -2005 – Regional Government Ancash

AYACUCHO

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	1,472.55	16.55	425.43	321.00	726.12	0.00
DEPARTMENTAL	1,049.45	11.80	0.00	523.75	525.70	0.00
LOCAL	6,373.94	71.65	8.50	1,092.91	2,888.08	2,384.45
Total	8,895.94	100.00	433.93	1,937.66	4,139.90	2,384.45
(%)	100.00		0.05	0.22	0.47	0.27

Source: DRTC – Ayacucho 2005

CAJAMARCA

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	1,229.97	19.54	403.41	637.06	85.00	104.50
DEPARTMENTAL	666.00	10.58	0.00	594.05	48.10	23.85
LOCAL	4,400.18	69.89	4.00	608.43	455.39	3,332.36
Total	6,296.15	100.00	407.41	1,839.54	588.49	3,460.71
(%)	100.00		0.06	0.29	0.09	0.55

Source: DRTC – Ayacucho 2005

HUANCAVELICA

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	580.20	9.12	189.80	390.40	0.00	0.00
DEPARTMENTAL	831.73	13.08	0.00	511.57	320.16	0.00
LOCAL	4,948.82	77.80	0.00	1,279.78	1,100.71	2,568.33
Total	6,360.75	100.00	189.80	2,181.75	1,420.87	2,568.33
(%)	100.00		0.03	0.34	0.22	0.40

Source: Technical Team 2005

HUANUCO

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	667.83	22.44	282.93	130.90	204.00	50.00
DEPARTMENTAL	463.84	15.59	6.00	203.00	122.24	132.60
LOCAL	1,844.10	61.97	0.00	185.60	90.40	1,568.10
Total	2,975.77	100.00	288.93	519.50	416.64	1,750.70
(%)	100.00		0.10	0.17	0.14	0.59

Source: Technical Team 2005

JUNIN

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	874.39	13.58	505.50	368.89	0.00	0.00
DEPARTMENTAL	589.80	9.16	34.20	482.00	66.60	7.00
LOCAL	4,976.30	77.27	36.40	1,636.50	1,353.85	1,949.55
Total	6,440.49	100.00	576.10	2,487.39	1,420.45	1,956.55
(%)	100.00		0.09	0.39	0.22	0.30

Source: Technical Team 2005

LA LIBERTAD

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	697.34	15.81	378.30	241.94	77.10	0.00
DEPARTMENTAL	1,185.31	26.87	50.20	244.30	613.86	276.95
LOCAL	2,527.96	57.32	124.16	72.10	272.85	2,058.85
Total	4,410.61	100.00	552.66	558.34	963.81	2,335.80
(%)	100.00		0.13	0.13	0.22	0.53

Source: DRTC-LL / Road Inventory Year 2003.
Elaboration: Planning Technical Team– Regional Government of La Libertad.

PIURA

Type of roads	Length (km)	%	Length by type of pavement (km)			
			Paved	Gravel	Unpaved	Trail
NATIONAL	857.00	19.49	664.50	126.50	29.00	37.00
DEPARTMENTAL	578.20	13.15	144.80	159.00	68.10	206.30
LOCAL	2,962.80	67.37	134.30	51.70	313.60	2,463.20
Total	4,398.00	100.00	943.60	337.20	410.70	2,706.50
(%)	100.00		0.21	0.08	0.09	0.62

Source: Technical Team Piura - 2005

3) Social Infrastructure in the Provinces of the Program

The existing conditions of social infrastructure, such as water and sewerage services and electric power for each department of the Program are shown in the following table.

Table 2.5-8 Social Infrastructure

Departments	Rate of Installation (%)		
	Sewerage	Water	Electric Power
AMAZONAS	83.3%	42.7%	49.0%
ANCASH	74.4%	72.5%	74.1%
AYACUCHO	69.2%	56.4%	52.3%
CAJAMARCA	80.8%	58.6%	41.4%
HUANCAVELICA	42.4%	34.3%	56.3%
HUANUCO	78.6%	62.6%	74.5%
JUNIN	78.6%	62.6%	74.5%
LA LIBERTAD	82.4%	65.7%	73.1%
PIURA	68.9%	64.1%	67.4%
AVERAGE 9 Dpts.	**73.2%**	**57.7%**	**62.5%**
NATIONAL AVERAGE	**82.8%**	**68.6%**	**75.2%**

4) Poverty Conditions Districts in the Program Area

The Districts of the Program area show very high poverty indicators, being the average per capita expenses S/. 268, with a Human Development Indicator (HDI) of 0.529. The average indicators of the Program area Districts are shown in the following table.

Table 2.5-9 Average expenses and HDI in the Program area Districts

Department	Expenses per Capita (S/./month)			HDI		
	(A) Department	(B) Subproject Districts	(B)/(A)	(A) Department	(B) Subproject Districts	(B)/(A)
Amazonas	328.4	368.5	112.2%	0.547	0.557	101.8%
Ancash	315.1	299.5	95.0%	0.548	0.540	98.6%
Ayacucho	241.3	219.7	91.1%	0.513	0.502	97.9%
Cajamarca	271.9	263.4	96.9%	0.535	0.534	99.7%
Huancavelica	187.4	225.9	120.5%	0.498	0.510	102.3%
Huanuco	256.1	206.6	80.7%	0.516	0.498	96.6%
Junin	330.1	319.7	96.8%	0.579	0.572	98.7%
La Libertad	334.6	233.6	69.8%	0.567	0.530	93.6%
Piura	347.8	282.1	81.1%	0.554	0.520	93.8%
Average	290.3	268.8	92.6%	0.540	0.529	98.1%
National Average					**0.559**	
Lima/San Isidro		**954.8**			**0.809**	

Source; Poverty Map at Provinces and Districts 2007

On the other hand, of the 1832 districts in Peru, among 10% of the poorest district, 8 districts are located in Huancavelica, Ayacucho, Ancash and La Libertad, showing that even in those departments that seems to have a proper level of development within the Program areas, they really have huge inequities in the rural Andean zone. The range of HDI of the Districts within the Program area are as follows;

HDI range	Nr. Of Districts	District Name
0.475<	5	CONGALLA, MARIA PARADO DE BELLIDO HUANCARAYLLA, CHUGAY LLUMPA
0.475 – 0.50	10	
0.50 – 0.55	29	
0.50 – 0.60	20	
0.60 – 0.65	3	

Source; Poverty Map by Province and Districts , 2007

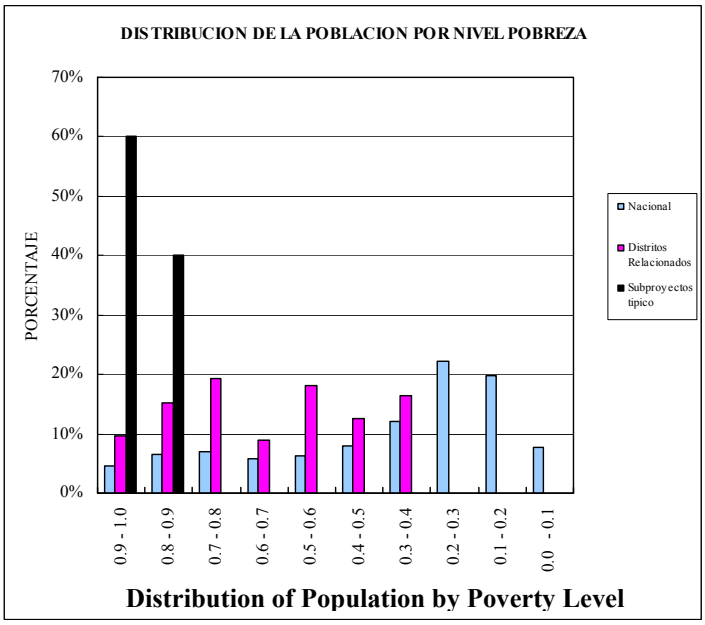
In the Program area the malnutrition, infant mortality, illiteracy, and life expectancy indicators reach critical levels. Children under 5 years of age receive only one third of the caloric and protein level necessary for a regular level of development. It should be pointed out that approximately 85% of the poor immigrants in the urban area come from the Sierra. The following table shows the social indicators of the Program area districts:

Table 2.5-10 Social Indicators of the Program area districts

Department	Poverty Ratio		Poverty Indicator		
	Poverty level	Extreme poverty level	HDI	Life expectancy	Literacy
Amazonas	48.10%	13.10%	0.557	69.68	87.22
Ancash	51.35%	22.08%	0.540	67.26	77.80
Ayacucho	82.20%	48.00%	0.502	64.97	72.31
Cajamarca	77.40%	39.66%	0.534	69.81	79.03
Huancavelica	85.24%	39.66%	0.510	63.10	80.40
Huanuco	90.81%	55.05%	0.498	64.85	76.85
Junín	44.49%	14.34%	0.572	68.84	87.23
La Libertad	89.78%	52.61%	0.530	67.51	79.21
Piura	12.14%	6.20%	0.520	67.28	77.08
Average 75 Districts	**63.34%**	**29.95%**	**0.533**	**67.39**	**79.01**
Lima	**18.0%**	**0.9%**	**0.707**	**76.00**	**97.80**

Source; INEI. Poverty Map by Province and Districts , 2007

The table below shows the significant difference of the existing poverty between the national level, in comparison with that in the districts of the Program and that in the area belonging to the typical subprojects involved. Poverty in the scope of the typical projects is widely larger, at relative terms, than those existing at the other aforementioned areas. This fact strengths the objective location of the Program being focused upon the rural Sierra areas where poverty is relatively larger, and –as it has previously seen- less flexible to reduce by the means of assistance programs or global economic growth.



Distribution of Population by Poverty Level

Source : INEI. Mapa de Pobreza Provincial y Distrital 2007

2.5.3 Characteristics of Agriculture in the Program Area

(1) General Aspects

In the sierra, the diversity of habitats are common, generated by the distinct Andes topography, besides the variable exposition to the sun at the slopes area, the protection against the wind and the presence of rocky or stony areas. In the Sierra, farming on the slopes area or in the narrow inter-Andean valleys are predominant.

Most of the Andean agriculture depend on the rain, with certain frequency in the periods from October/November to March/April. Rainfall condition in the Sierra are irregular, both in volume also period, causing one of the main problems of this region for the agricultural practice.

The Sierra also cultivate variety of crops according to the elevation of farm lands. Up to 2,500 meters, the sugar cane, up to 3.000 meters maize and bean, highland, up to 3,800 meters, barley and wheat and highest, a little more than 4,000 meters, the potato and an important variety of root crops and Andean crops are cultivated.

The factors to explain the low productivity in the agriculture at the sierra, related to rural poverty are the limited land, applied traditional agricultural practice and water shortage for irrigation to allow the upgrading of the yields.

For the Water resources development project, in some case requiring the construction of dam, distanced conveyance canal, the project cost, in many cases, are over the maximum limits of investments fixed by the MEF, resulting the project implementation impossible. A poor infrastructure of roads, high vulnerability of the production (pests, frosts, droughts, etc.) and the asymmetrical relation of commercialization are evident, because the farmers sell their crops in low price to the intermediary agent who supplies to distributor at high prices.

The small production represents approximately 92.11% of the total number of producers in the country that contributes spatial and regionally to the following proportion: 15.1% in the costa, 14.3 % in the selva and 70.6% in the sierra.

(2) Land Property

1) Land Property by Department

Agriculture occupies a central place in the Peruvian Sierra economy and society where the small traditional rain fed agriculture with low yields is predominant, refluxing the complexity of the Andean element (specially for the type of soil and climate) and the high population concentration. According to the Agrarian Census III (1994), 22.7% of the agriculture farm units are under 1.0 ha, and 84.6% are less than 10.0 ha. The distribution of agriculture farm units in the 9 Departments is shown in the following table.

Table 2.5-11 Distribution of land property by Department

Department	Total of agriculture units	LESS THA 1.0 Ha	FROM 1.0 TO 3.0 Ha	FROM 3. 0 TO 10.0 Ha	FROM 10.0 TO 50.0 Ha	From 50.0 TO 500.0 Ha	FROM 500.0 TO 3.000.0 Ha	3000.0 Ha. AND MORE
Amazonas	48,002	6.7%	24.1%	38.1%	26.7%	4.2%	0.2%	0.1%
Ancash	113,805	29.0%	37.5%	26.8%	5.6%	0.9%	0.2%	0.1%
Ayacucho	87,263	28.8%	37.0%	25.8%	6.8%	1.2%	0.3%	0.1%
Cajamarca	199,183	17.4%	32.7%	33.9%	14.7%	1.3%	0.1%	0.0%
Huancavelica	85,337	29.5%	35.4%	26.9%	6.7%	1.1%	0.3%	0.1%
Huánuco	93,156	17.5%	33.5%	31.5%	14.3%	3.0%	0.2%	0.1%
Junín	118,360	37.2%	25.7%	20.2%	14.3%	2.3%	0.2%	0.1%
La Libertad	95,616	13.2%	31.3%	41.7%	12.6%	1.0%	0.1%	0.1%
Piura	113,037	20.0%	20.0%	34.9%	6.7%	0.4%	0.1%	0.1%
Total (9 Departments)	953,759	22.7%	31.0%	30.9%	11.5%	1.5%	0.2%	0.1%

Source; III NATIONAL AGRICULTURAL CENSUS, PERU (1994)

Concerning land distribution in the departments of the Program, the structure is as follows:

Table 2.5-12 Land property distribution by Department (Sierra)

Department	Total of agriculture units	LESS THA 1.0 Ha	FROM 1.0 TO 3.0 Ha	FROM 3. 0 TO 10.0 Ha	FROM 10.0 TO 50.0 Ha	From 50.0 TO 500.0 Ha	FROM 500.0 TO 3.000.0 Ha	3000.0 Ha. AND MORE
Amazonas	16,656	2.2%	16.3%	26.4%	48.1%	6.2%	0.8%	0.0%
Ancash	103,028	15.8%	38.5%	28.8%	15.6%	1.0%	0.4%	0.0%
Ayacucho	81,258	13.1%	41.1%	27.5%	16.4%	1.2%	0.6%	0.0%
Cajamarca	161,150	8.8%	31.1%	30.6%	27.8%	1.6%	0.2%	0.0%
Huancavelica	85,266	13.6%	37.8%	28.5%	18.5%	1.1%	0.6%	0.0%
Huánuco	79,514	7.3%	35.4%	31.7%	23.6%	1.4%	0.6%	0.0%
Junín	89,785	30.2%	38.0%	18.2%	11.1%	1.8%	0.6%	0.0%
La Libertad	72,942	4.8%	25.2%	34.8%	33.5%	1.4%	0.3%	0.0%
Piura	22,645	3.4%	3.4%	54.9%	37.5%	0.6%	0.1%	0.0%
Total 9 Departments	712,244	12.7%	33.6%	29.4%	22.4%	1.5%	0.4%	0.0%

Source; III NATIONAL AGRICULTURAL CENSUS, PERU

(3) Structure of Land Use

The following table shows the agriculture land distribution. Most of land use are for livestock use. The percentage used for transitory crops is approximately 8.5%.

Table 2.5-13 Land Use in the 9 Departments of the Program Area

Department	Agriculture area (ha)	Transitory crops (ha)		Permanent crops (ha)	Cultivated pasture (ha)	Livestock use (ha)	Others (ha)
Amazonas	975,034	69,794	7.2%	29,865	38,840	815,100	21,435
Ancash	1,326,342	121,621	9.2%	4,752	11,901	1,022,014	166,054
Ayacucho	1,715,208	70,773	4.1%	20,321	11,534	1,506,872	105,708
Cajamarca	1,703,921	197,206	11.6%	53,507	55,519	1,085,711	311,978
Huancavelica	1,305,491	112,825	8.6%	839	11,705	1,085,696	94,426
Huánuco	1,343,788	111,116	8.3%	20,534	20,797	953,328	238,013
Junín	2,264,730	128,057	5.7%	88,020	9,190	1,908,476	130,988
La Libertad	1,009,058	181,848	18.0%	9,703	5,770	601,269	210,468
Piura	1,117,079	94,600	8.5%	31,586	10,487	872,718	107,687
Total	12,760,651	1,087,841	8.5%	259,126	175,743	9,851,184	1,386,757

Source; III NATIONAL AGRICULTURAL CENSUS, PERU

In the 9 Departments of the Program area, there are 9,317,053 ha of farming land, only 7.8 % used for transitory crops. The following table shows the distribution of area by region.

Table 2.5-14 Use of soil in the Sierra region at the 9 Departments of the Program

Department	Agriculture area (ha)	Transitory crops (ha)		Permanent crops (ha)	Cultivated pasture (ha)	Livestock use (ha)	Others (ha)
Amazonas	396,622	17,832	4.5%	6,831	7,132	355,975	8,852
Ancash	1,248,790	94,671	7.6%	3,001	10,923	991,136	149,058
Ayacucho	1,680,069	68,341	4.1%	7,786	11,510	1,496,932	95,500
Cajamarca	1,222,123	140,675	11.5%	13,672	22,924	800,963	243,889
Huancavelica	1,305,491	112,825	8.6%	839	11,705	1,085,696	94,426
Huánuco	902,473	80,083	8.9%	7,437	1,699	665,485	147,768
Junín	1,419,293	93,425	6.6%	3,328	3,332	1,257,737	61,471
La Libertad	778,315	94,019	12.1%	7,464	2,357	513,847	160,628
Piura	363,877	24,885	6.8%	3,252	2,601	280,814	52,325
Total	9,317,053	726,756	7.8%	53,610	74,185	7,448,586	1,013,916

Source; III NATIONAL AGRICULTURAL CENSUS, PERU (1994)

The 68.5% of the agriculture land is rain fed area, cultivating one crops a year. Only 31.5% has irrigation system, but with serious problems in the structures of conduction and significant water loss due to poor operation and maintenance system of the facilities and an improper water management system.

In the non-cultivated land, the large extension of land use for natural pasture (51.5%). However, this huge potential is practically abandoned and in constant degradation by the informal shepherding. In this activity, farmers are not attention about pasture cultivation or regeneration. There is a smaller area dedicated to cultivated pasture (18.2%). Also with degradation and desertification due to the intense deforestation for fuel provision (firewood) by the farmers, are predominant. The other lands covers an area equivalent to 10.6%.

(4) Irrigation and Rain fed Areas

According to the III National Agricultural Census, Peru, the cultivation land is distributed as follows;

Table 2.5-15 Cultivation land surface (1994)

Department	Department (ha)			Sierra Zone (ha)		
	Total	Irrigated	Rain-fed land	Total	Irrigated	Rain-fed land
Amazonas	71,595	16,413	55,182	18,559	1,093	17,465
Ancash	279,365	130,810	148,554	236,009	87,803	148,206
Ayacucho	168,141	68,087	100,054	156,293	68,085	88,209
Cajamarca	447,087	92,725	354,362	339,522	68,314	271,208
Huancavelica	197,839	47,512	150,327	197,839	47,512	150,327
Huanuco	331,047	50,671	280,376	217,992	50,552	167,440
Junin	237,016	35,272	201,744	146,858	34,930	111,928
La Libertad	381,447	190,623	190,824	246,316	55,809	190,506
Piura	181,900	120,257	61,643	70,153	30,504	39,649
TOTAL	2,295,437	752,371	1,543,066	1,629,541	444,604	1,184,938
%	100.0%	32.8%	67.2%	100.0%	27.3%	72.7%

Source; III NATIONAL AGRICULTURAL CENSUS, PERU (1994)

The following table shows the percentage of irrigated and rain fed area for each department.

Table 2.5-16 Distribution of irrigated and non-irrigated area in cultivated land

Department	Department		Sierra Zone	
	Irrigation	Rain-fed Land	Irrigation	Rain-fed Land
Amazonas	22.9%	77.1%	5.9%	94.1%
Ancash	46.8%	53.2%	37.2%	62.8%
Ayacucho	40.5%	59.5%	43.6%	56.4%
Cajamarca	20.7%	79.3%	20.1%	79.9%
Huancavelica	24.0%	76.0%	24.0%	76.0%
Huanuco	15.3%	84.7%	23.2%	76.8%
Junin	14.9%	85.1%	23.8%	76.2%
La Libertad	50.0%	50.0%	22.7%	77.3%
Piura	66.1%	33.9%	43.5%	56.5%
Average	32.8%	67.2%	27.3%	72.7%

Source; III NATIONAL AGRICULTURAL CENSUS, PERU (1994)

(5) Aspects of Agricultural Production

1) Agricultural Production

Agriculture is the main activity of the identified regions and in average 45 kinds of products are produced at region, some of them oriented towards exports or markets with higher purchase capacity in Lima. The main crops at the 9 Department are the following:

Table 2.5-17 Harvested Areas in the 9 Departments – 2007 (ha)

Product	AMAZONAS	ANCASH	AYACUCHO	CAJAMARCA	HUANCAVELICA	HUANUCO	JUNIN	LA LIBERTAD	PIURA	Total 9 Departments	TOTAL NACIONAL
COFFEE	44,230	--	6,497	61,109	20	4,029	84,948	360	6,871	208,064	324,062
RICE	37,469	3,067	465	29,070	--	7,182	1,736	29,934	43,369	152,292	337,639
POTATO	5,062	10,548	12,739	26,978	8,163	33,128	20,739	23,510	1,310	142,177	268,160
AMILLACEOUS MAIZE	6,432	10,384	15,249	40,916	9,933	14,211	7,766	14,099	17,569	136,559	199,545
WHEAT	850	18,768	8,959	33,746	4,626	9,214	5,484	28,422	9,902	119,971	144,524
YELLOW MAIZE	10,793	16,218	1,063	22,586	207	9,341	3,474	29,146	17,303	110,131	282,766
BARLEY IN GRAINS	345	11,799	11,821	14,102	11,443	7,139	10,945	25,536	513	93,643	143,062
BANANA	11,343	146	608	5,388	103	8,415	17,471	575	11,237	55,286	147,817
DRY BEAN IN GRAIN	7,552	2,413	1,344	17,720	2,719	5,466	3,483	3,425	3,133	47,255	75,242
MANIOC	12,312	473	933	9,793	--	3,959	4,892	2,397	905	35,664	103,537
ARVERJA GRANO SECO	462	1,718	3,271	15,611	2,384	1,111	1,604	7,493	4,295	37,949	44,375
SUGAR CANE	--	5,588	--	--	--	--	--	29,135	--	34,723	67,952
ALFALFA	32	6,509	7,635	2,710	10,046	211	1,984	4,503	328	33,958	127,854
CACAO	6,191	--	8,849	1,205	--	3,705	7,079	47	398	27,474	59,835
CHOCLO MAIZE	1,077	4,938	1,145	8,946	396	1,038	6,710	996	369	25,615	41,321
BROAD BEAN DRY GRAIN	177	1,989	4,614	2,699	2,923	3,447	2,586	4,632	429	23,496	49,336
COTTON	--	5,543	2	44	--	1,253	--	879	16,271	23,992	89,428
GREEN PEA GRAIN	973	608	1,107	10,989	2,864	1,534	4,178	689	--	22,942	28,730
MANGO	85	500	39	1,149	20	70	183	410	15,594	18,050	22,936
OLLUCO	542	1,508	1,794	3,523	913	1,827	2,622	2,136	416	15,281	26,946
ORANGE	453	374	542	1,015	55	881	10,967	474	681	15,442	25,971
LEMON	589	53	105	109	37	127	242	193	11,778	13,233	19,051
AS´PARAGUS	--	1,500	--	--	--	--	--	10,980	--	12,480	23,547
PINEAPPLE	879	--	237	276	--	293	6,462	1,109	45	9,301	14,289
OCA	47	911	1,029	2,146	213	646	1,154	1,602	348	8,096	16,577
BROAD BEAN FRESH	297	138	988	813	1,271	425	2,904	90	--	6,926	12,486
AVOCADO	119	305	269	444	56	198	3,354	1,844	229	6,818	13,603
Others	1,271	3,495	4,017	6,675	895	2,427	9,572	11,975	6,536	46,863	206,591
Total	149,582	109,493	95,321	319,762	59,287	121,277	222,539	236,591	169,829	1,483,681	2,917,182

Source; http://sisca.minag.gob.pe/sisca

Sugar cane had the greatest production in 2007, at La Libertad department, followed by potato in Huánuco, rice in Piura, alfalfa and yellow maize in Lambayeque.

Among these crops with higher commercial dynamics outside the limits of the region are the following: Mango, coffee, avocado, beans and sugar cane.

Of these 9 Departments, maize, rice, coffee, potato, barley, peas, etc. correspond to almost 50% of the national production.

2) Livestock Production

Main products in the Departments of the Program are meat, fiber, wool, milk and eggs.

Concerning animal farming, due to the characteristics of each of the regions two types can be defined: (i) extensive (traditional breeding without technology) and (ii) intensive, defined by the administration of breeding and the quality of food, among other factors.

Table 2.5-18 Livestock production by Departments 2006 –TM

Departments/ Products	Amazonas	Ancash	Ayacucho	Cajamarca	Huancavelica	Huánuco	Junín	La Libertad	Piura
Meat									
Poultry	928	18,356	510	2,088	406	614	828	131,753	14,314
Cattle	6,728	6,835	8,786	23,799	4,360	4,032	3,846	5,492	10,778
Sheep	68	986	1,936	1,586	1,329	232	2,544	1,846	650
Alpaca	--	11	429	--	654	--	77	6	--
Llama	--	--	377	--	370	--	98	--	--
Pig	1,085	1,048	22,632	3,856	1571	6,375	191	8,378	7,231
Goat	27	207	506	358	399	209	2,017	516	2,250
Sub product									
Eggs		2,370	389	901	743	312	133		
Milk	1,734	17.603	20,268	239,505	19,999	10,006	18,657	42,457	3,961
Wool	59,002	57	380	330	563	66	971	90,775	35,016
Alpaca Fiber	23	7	91	1	167	2	44	686	--
Llama Fiber	--	--	2,064	--	13	--	33	13	--

Source: MINAG and DRA

In 2008 the Departments with higher commercial dynamics that have exported non-traditional products (agriculture and agro-business) have been: La Libertad, Piura, Ayacucho and Ancash. The following table shows the exports by region of origin.

Table 2.5-19 Exporting Regions 2008

Region	Million US$	Percentage (%)
Total non- traditional	1,912	100.00
Amazonas	0.2	0.01
Ancash	13.9	0.73
Ayacucho	16.2	0.85
Cajamarca	5.8	0.30
Huancavelica	0.2	0.01
Huanuco	9.5	0.50
Junín	7.8	0.41
La Libertad	396.1	20.72
Piura	158.2	8.27
Total	607.9	31.79

Source: ADEX

(6) Producers Associations

There is an extended net of agricultural producers associations at national level, there is no statistics by region, making it difficult the identification; thus information provided by INEI (legal condition of producers) and the National Association of Ecological Producers of Peru that has offices at regional level will be taken into account.

1) National Association of Ecological Producers of Peru ANPE-PERU:

It is an initiative of a set of organizations and organized ecological producers within regional scope, that decided to integrate themselves in a national association in order to unite initiatives and efforts around a proposal of nation agro-ecology. There are 15,000 farmers affiliated.

Table 2.5-20 Regional offices of ANPE

Region	Organization
Amazonas	ASCOPAE- Asociación Comunal de Productores Agro ecológicos (Communal Association of Agro-ecologic Producers)
Ancash	ARPE ANCASH- Asociación Regional de Productores Ecológicos de Ancash (Regional association of ecological producers in Ancash)
Ayacucho	ARPOA - Asociación Regional de Productores Orgánicos de Ayacucho- Huamanga (Regional Association of Organic Producers in Ayacucho – Huamanga)
Cajamarca	APER-C Asociación Regional de Productores Ecológicos de Cajamarca (Regional association of ecological producers in Cajamarca).
Huancavelica	ARPE-H – Asociación Regional de Productores Ecológicos de Huancavelica (Regional association of ecological producers in Huancavelica
Huanuco	ADPE- Asociación Departamental de Productores Ecológicos - Huanuco(DEpartmental association of ecological producers – Huanuco)
Junín	APEREC – Asociación de Productores Ecológicos de la Región Centro (Association of ecological producers of Central Region)
La Libertad	ARPELL - Asociación Regional de Productores Ecológicos de La Libertad. (Regional association of ecological producers in La Libertad)
Piura	No representation

Source: ANPE

2) Farmers and agricultural organizations according to National Institute of Statistics and Information INEI:

Farmers and agricultural organizations define the social and commercial relations in and out the production frame, and assure the relation of the associates or the production line with the State. This social base is very heterogeneous, even within the committees of specialized producers, and the organizations are very diversified. The relative importance and land distribution of producers who belong to an organization clearly shows three organizational levels:

1. Costa counts on with the participation of organizations with a very corporative nature, predominantly the Board of Users and the Producers Committee.
2. Sierra has less participation of producers in one organization, privileging the defensive and communal activity.
3. Selva and Ceja de Selva have a very diversified participation, oriented towards Producers Committees and in defense associations, according to the region and the size of the agricultural unit.

Table 2.5-21 Legal status of producers by region

Regions/ Organization	Amazonas	Ancash	Ayacucho	Cajamarca	Huancavelica	Huánuco	Junín	La Libertad	Piura
Natural person	47,147	108,984	86.918	192,136	84,371	91,378	116,005	89,329	112,429
Society by fact	683	4,777	944	8,047	1,632	1,805	3,199	6,845	1,315
S.R.Ltd	6	14	5	14	2	7	22	127	28
Stock companies	2	18	1	11	2	1	11	58	48
Farmers Group	2	28	17	19	21	7	31	9	18
Group of landless farmers	2	5	--	2	--	--	8	--	2
Farmers community	50	350	454	110	500	241	414	125	154
Native community	193	--	--	4	--	11	203	--	--
Agriculture cooperative	--	--	--	4	--	--	6	--	2
Sugar cane production cooperative	--	--	--	--	--	1	--	10	--
Coffee production cooperatives	--	--	--	2	--	--	--	--	1
Users' agriculture cooperative	--	5	--	2	--	--	--	2	1
Communal Cooperative	--	--	--	--	--	--	2	--	1
Workers' agriculture cooperative	1	--	--	4	--	--	1	7	1
Agricultural Society of Social Interest	--	1	--	2	--	--	2	1	--
Others	87	272	307	423	249	175	408	146	126
Total	**48,173**	**114,454**	**1,815**	**200,780**	**86,777**	**93,626**	**120,312**	**96,659**	**114,126**

Source: CENAGRO 94

(7) Water Users Organizations (WUO)

Law Nr 17752, General Law of Waters, originated the organization of agricultural water users that became the genuinely representative institutions of farmers along the years, with capacity to share with entities of the State the administration of water and promote agricultural rural development as a whole. Presently said law has been replaced by Law Nª 29338 Law of Water Resources, consolidating the participation of users' organizations in water resources management.

With the purpose of integrating and having a first level national representation, the organizations of agricultural water users, decided to create the NATIONAL BOARD OF IRRIGATION DISTRICTS USERS OF PERU (JNUDRP) a national entity to institutionally represent and support them, officially acknowledged by the Ministry of Agriculture in October 1987.

The JNUDRP has 112 associated, strategically distributed in the entire Peru; in the valley of the costa there are 66 boards, in the inter-Andean valleys there are 35 and 11 in the selva.

All of them controls a total of 1,452,000 ha. of irrigated farmland, corresponding 66% to the costa, 24% to the sierra and 9% to the selva. The number of Irrigation Users' Committees is 1,538 with 11,550 leaders.

General objectives of JNUDRP

1. Institutionally place the JNUDRP in the national and international sphere.
2. Contribute to the decentralized rural development in the framework of the integrated watershed management.
3. Strengthen the board of users in the management of water resources.
4. Promote the competitive entrepreneurial development.
5. Promote the inclusion of agriculture producers.
6. Promote the equity of gender in the participation of the board of users.

The following table shows the board of users at the Program area.

Table 2.5-22 Boards at region level

Regions	Nº of boards	Zones
Amazonas	2	Bagua, Uctubamba
Ancash	6	Callejón de Huaylas, Casma, Huarmey y culebras, Irchim, Nepeña, Santa.
Ayacucho	2	Cora Cora, Ayacucho.
Cajamarca	6	Llaucana, Cajabamba, Jaen, Mashcom, Rio Chonta, Rio Tingo.
Huancavelica	0	
Huánuco	3	Huallaga, Marañón, Tingo Maria.
Junín	3	Mantaro, Perene, Tarma.
La Libertad	10	Alto Chicama, Alto Jequetepeque, Chao, Chavimochic, Chicama, Guadalupito, Jequetepeque, Moche, Santiago de Chuço, Viru.
Piura	6	Huancabamba, Alto Piura, Chira, Medio y bajo Piura, San Lorenzo, Sechura.
Total	**38**	

Source: JNURDP

2.5.4 Characteristics of the Natural Condition

Concerning natural environment characteristics, Peruvian Sierra is located at the Andes mountain range. From south to north, it presents a variety of climate, from the mild warm to glacial temperature, concerning hydrology, in the sierra there are more than 12,000 lakes and ponds over 3,000 m above sea level and the snow above 5,200 m above sea level. represents natural water reservoirs that feed the river watersheds. The topography is conformed by a set of elevations that run aligned to parallel chains. There located the inter-Andean valleys with the old population centers of Ayacucho, Cuzco, Cajamarca, among others.

(1) Climate

The study area is located in the Peruvian Sierra, with altitudes higher than 1000 m, distribution of rain and temperature are characteristics parameters that define the climate in each sub-region is directly influenced by the orography.

Also the mountain range is distributed as follows: Pacific mountainside, Atlantic mountainside, Titicaca mountainside, with elevations from sea level up to little more than 6000 m.

Sierra has a broad climate typology, with climate from warm valleys to highlands and Andean peaks with a very cold and humid climate, going through distinct warm climate, Andean regions considers the "cordillera" (mountain range) zone that due to its orography, determine the existence of many altitude levels (a descent of approximately 5 ºC to 6 ºC by ascending kilometer).

During the winter, the sierra is dry so humidity is not generated. Sun ray passes freely and heat the land area during the day but in the nights, the soil liberates the received heat so fast as it heated during the day, so the temperature drops to very low levels.

In the sierra the wind comes from the west and in less measure from the north, northeast and northwest; the direction predominantly west and north are due to the general aerial circulation due to the predominance of the high subtropical pressures, but very influenced by the orography of the valleys that condition the air circulation.

Pacific mountainside

The average annual temperature is 10.9ºC, temperature variation is stable during the whole year, with a medium direction of Northeast wind.

Atlantic mountainside

The average annual temperature is 14.2ºC, with the same characteristics of the previous mountainside.

Climate Characteristics

In Peru the following climate types are relevant:

- Very Dry Semi-Warm Climate (Sub Tropical Desert-Arid)
  This type of climate is one of the most remarkable climatic events in Peru, comprising almost the entire costa region, from Piura to Tacna and from the Pacific seaside up to a approximate level of 2,000 m above sea level, representing 14% of the total country area. It has an annual average rainfall of 150 mm. and average temperature of 18° to 19°C, decreasing at higher levels of altitude.
- Very Dry Warm Climate (Desert or Tropical Arid)
  Comprises the northern sector of costa region, including a great part of Tumbes and Piura departments, between the seaside and the coast up to 1,000 m above sea level. It represents less than 3,0% (35 thousand km2) of the country surface area. It is characterized by being very dry, annual average rainfall of around 200 mm. and average temperature of 24°C, without a defined thermal change in winter.
- Sub-Humid Warm Climate (Steppe and Low Inter-Andean Valleys)
  Climate characteristic of the sierra region, corresponding to the low and medium inter-Andean valleys, located between 1,000 to 3,000 m above sea level. Temperature higher than 20°C. and annual rainfall are below 500 mm. although at higher parts, humid and oriental, can be higher than 1200mm.
- Cold or Boreal Climate (Mid-Andean Valleys)
  This type of climate at the sierra region extends from 3,000 to 4,000 tm above sea level. It is characterized by annual average rainfall of 700 mm. and average temperature is 12°C. It has rainy summers and dry winters with harsh frost.
- Frigid Climate (Tundra)
  This type of climate, know as Puna climate, corresponds to altitudinal heights of the Andean region between 4,000 and 5,000 m above sea level. It covers around 13,0% of the national territory (170 million km2). It is characterized by presenting annual average rainfall of 700 mm. and average temperature of 6°C. Comprises the Andean hills, plateaus and peaks. Summer is always rainy and cloudy and winter (June-August) are harsh and dry.
- Snowy Climate (Icy)
  This climate corresponds to the very high mountains perpetual snow, average temperature during the whole year under the frosting point (0°C). It is distributed at the altitude sectors over 5,000 m above sea level and are mainly represented by the huge masses of snow and ice of the Peruvian Andes high peaks.
- Very Humid Semi-Warm Climate (Very Humid Sub-Tropical)
  This type of climate is predominant in the high selva or oriental woody Andean slopes and rainfall above 2,000 mm/annual. with some zones with more than 5,000 mm as in the Six Thousand zone. Temperature is mostly below 22°C. Higher temperatures are registered at the bottom of valleys and the transition to the Amazon plains.
- Humid Warm Climate (Humid Tropical)
  This climate corresponds to the Peruvian Amazon plains and is characterized by annual average rainfall of 2,000 mm. and temperatures of 25°C or higher, without a defined thermal change in winter. The area under this type of climate corresponds to around 43,0% of the territorial area of the country.

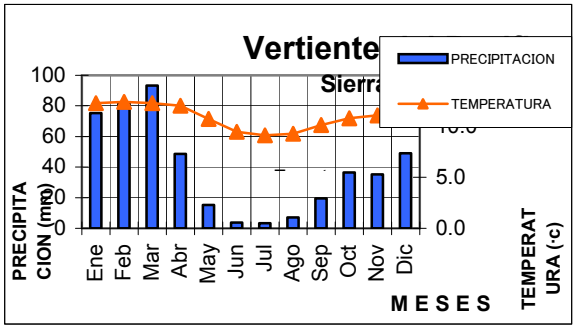
Subprojects of the program are located at the area with the climates described in a), b), c), d) and e)

1) Rainfall

Relief represents an important factor in rainfall distribution, for it acts as part of a barrier or modifier of the wind direction, usually this distribution of rainfall is very irregular between the two

mountainsides of the same mountain range, mostly when the axis is more or less perpendicular to the dominant humid wind direction. Peru is influenced by the low equatorial pressure during summer and the high subtropical during winter, giving origin to rainy summer months and dry winter months.

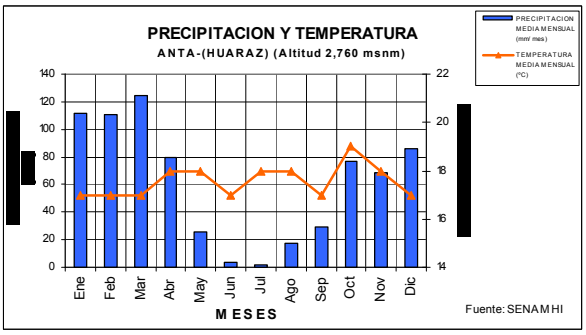
Peruvian sierra has a clearly seasonal rainfall regime, it shows patterns of variability very accentuated in the sierra, mainly due to the orography and the altitude. That is why in the whole sierra region, rainfall clearly increases according to the altitude; also the difference among the valleys, canyons and highlands can be perceived.

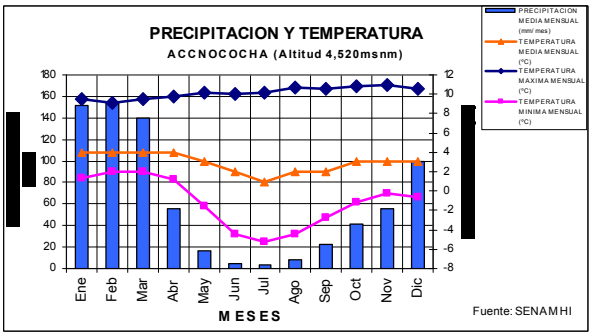


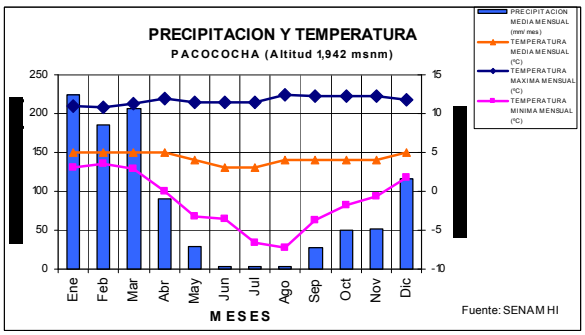
(a) Rainfall at the Pacific Mountainside

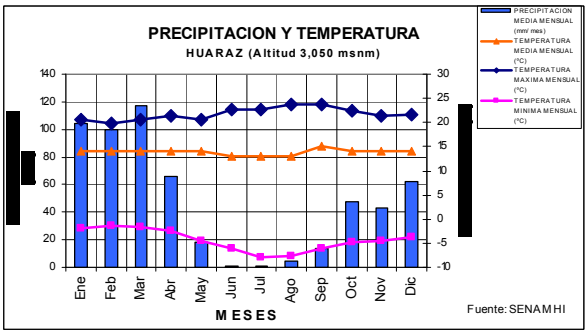
Rainfall pattern in the region is Orography type, influenced by the drafts of two warm fronts from the Pacific, during the year, rainfall have two very defined periods, the average monthly rainfall corresponds to the period between December and April and the lowest between June and July; moreover, between January and March rain is more intense.

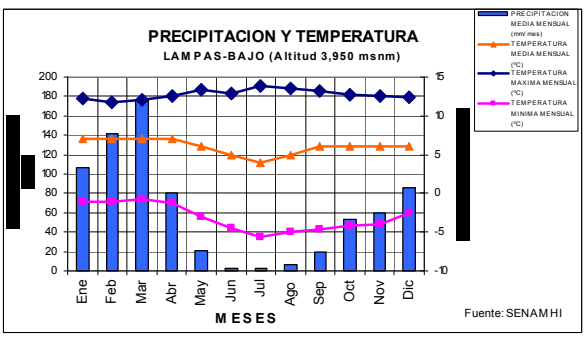
Orographic rain is originated by humid drafts that clash with the mountain barrier, ascending and consequent cooling, causing condensation, and as a result, the occurrence of rainfall at the side the wind blows (windward) towards the mountains. The following figures and tables summarize the main climatic parameters of the Pacific mountainside:





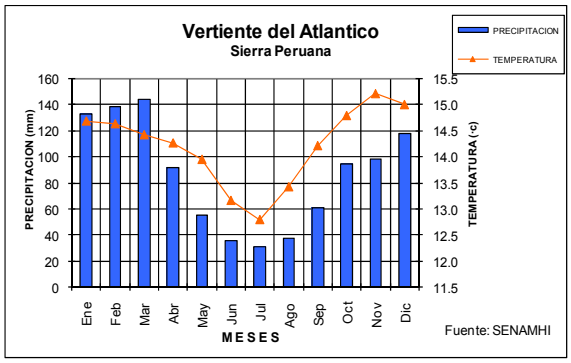






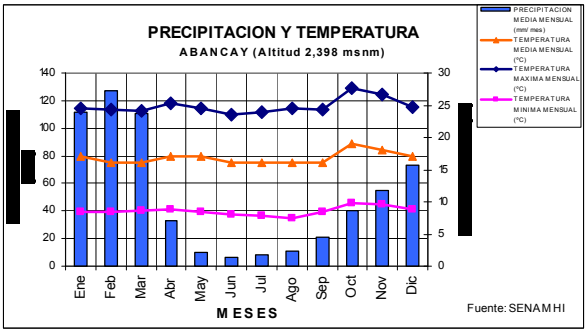
(b) Rainfall at the Atlantic Mountainside

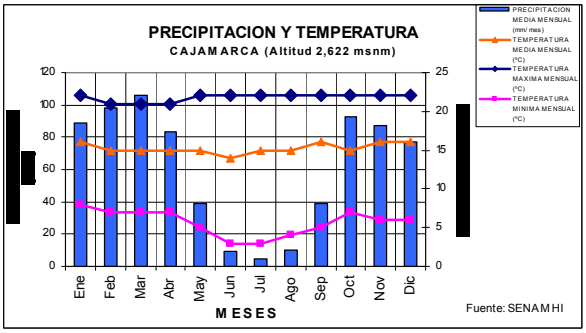
The region is characterized by high rainfall in the mountain area that descents through runoffs.

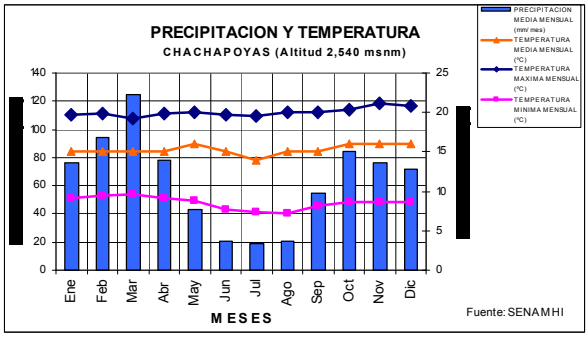


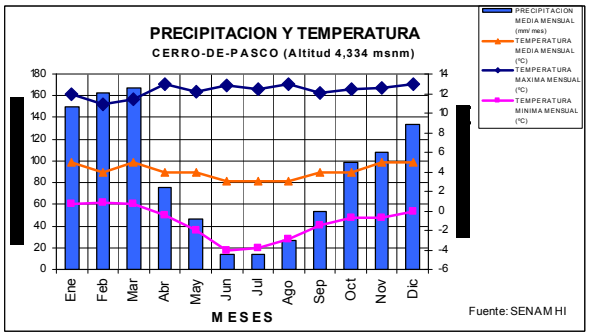
Water resources of the region are closely related to the rainfall distribution behavior. An analysis of the main seasons shows two periods: the first rainy period between October-April, reaches the maximum values in February and March; the second from May to September, shows the lowest rainfall values in June and July. Climate characteristics show a marked difference in the whole area, rainfall increases in the northern part, and the total annual rainfall is in average 1038.96 mm at the sierra, being higher towards the foothills of the Andean mountains.

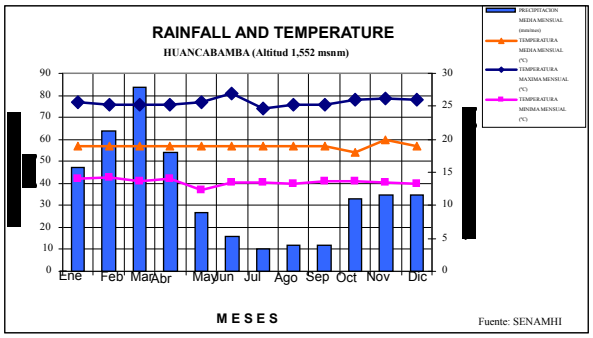
The following figures and tables show monthly average rainfall and temperature at the Sierra region in the Atlantic mountainside.

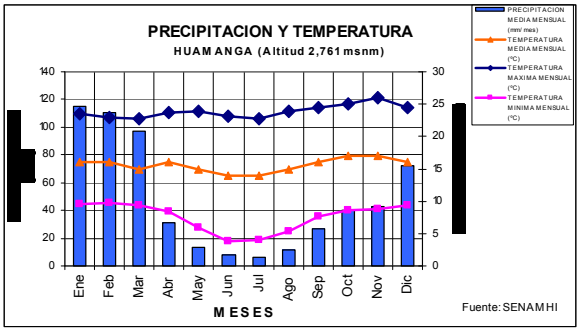






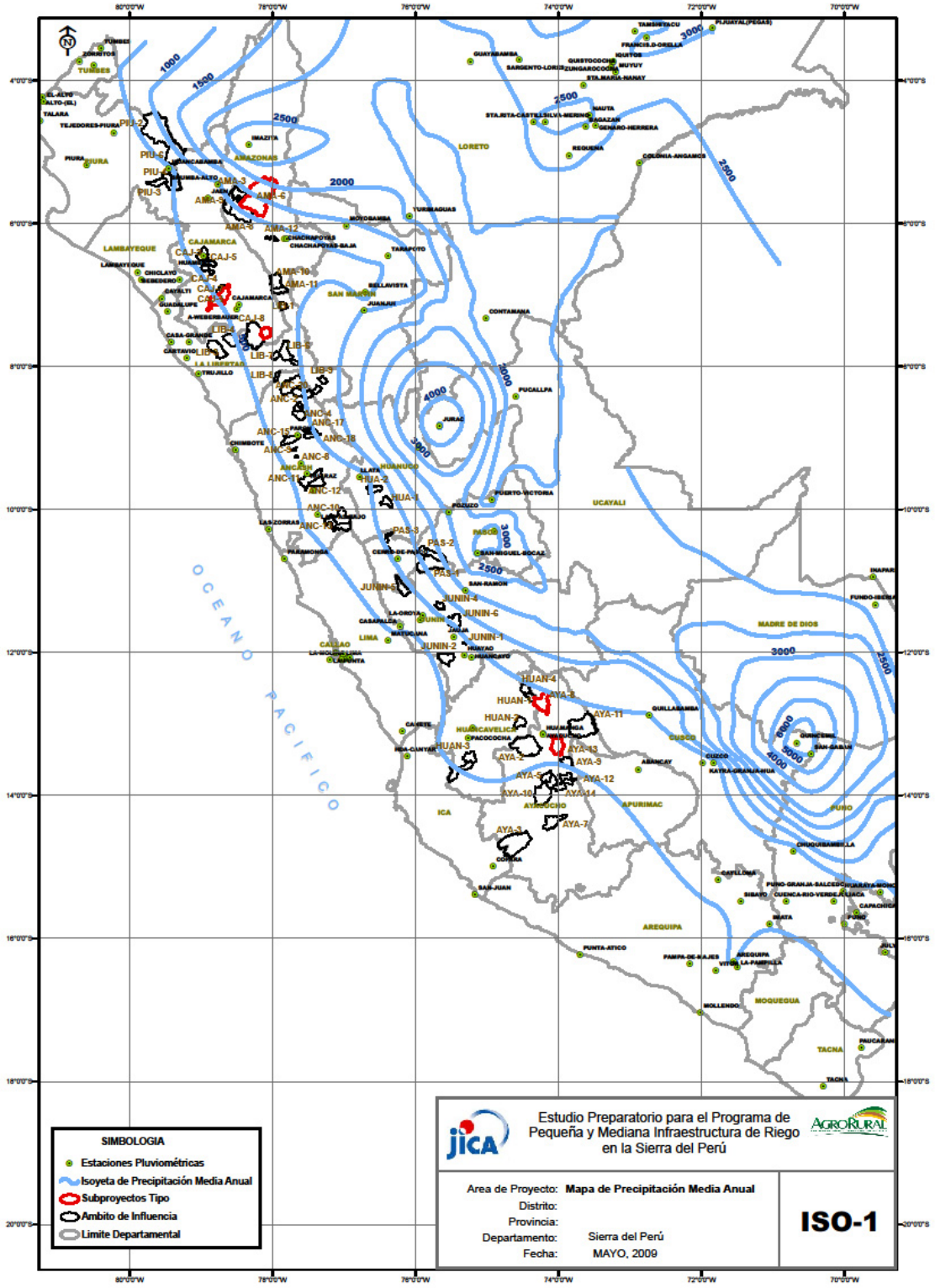






The rough Peruvian relief and its orientation respect to the atmospheric circulation is other relevant factor in rainfall distribution, also there are winter rain, consistent in the movement of cold air fronts from the Poles.

The following figure shows the annual average rainfall.



2) Life Zone

Due to the wide climatic variety, at the study area that comprehends the departments of Ancash, Amazonas, Ayacucho, Cajamarca, Huancavelica, Huánuco, Junín, La Libertad and Piura, and where

the Preparatory Survey for the Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra, there are many zones of natural life recorded, according to the classification system developed by Leslie R. Holdridge and that is used in the country since 1970s. According to this system, the vegetal and ecological formations that can be present in a zone from the bio-temperature and average annual rainfall can be predicted according to the altitude and latitudinal zones. The referred zones are presented in the life zone map in this chapter.

- Costa region presents climatic homogeneity, with very low values of rainfall and high relative humidity
- Selva region does not present great climate heterogeneity, and in its huge extension, 31 zones of natural life have been recorded according to the classification system developed by Leslie R. Holdridge.
- Sierra region, due to the wide climate variety, has several zones of natural life according to the same system of classification. According to it, vegetal and ecologic formation can be present in one zone from the bio-temperature and yearly rainfall average, according to the latitude and height zones.

(2) Hydrology

1) Pacific Mountainside

The drainage from the source in the central mountains, toward the Pacific mountain side, characterizes to have short extension (100 to 150 km), during which rivers increase their flow through several minor tributaries, watersheds are characterized by being narrow and elongated shape, excepting Santa river basin in Huaraz.

In general, runoffs present the direction east-west, towards the Pacific Ocean, developments, like the watersheds are short, excepting Santa river, where great part of the way from the source is from south to north till joining Tablachaca river to go toward east west direction, and finally end in the Ocean, running almost 270 km.

2) Atlantic Mountainside

In the Peruvian territory, drainage from the source in the Andean Sierra towards the Atlantic mountain side is characterized by large extensions in relation to the Pacific mountain side, rivers increase their flow through innumerable minor tributaries.

In general the regional orientation goes in the way rivers receive important contribution from other seasonal creaks that in the rainy season carry distinct flows. Toward North and Northeast there is great

density of drainage, mainly in parts where hills are predominant, while in the low parts circulation is slower due to the change of slope in the soils.

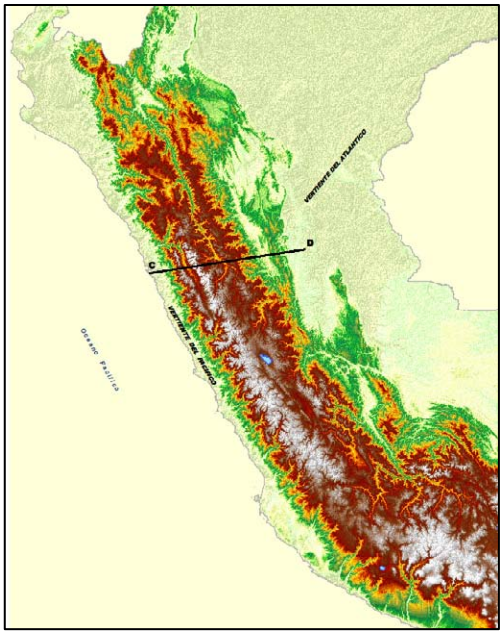
(3) Relief

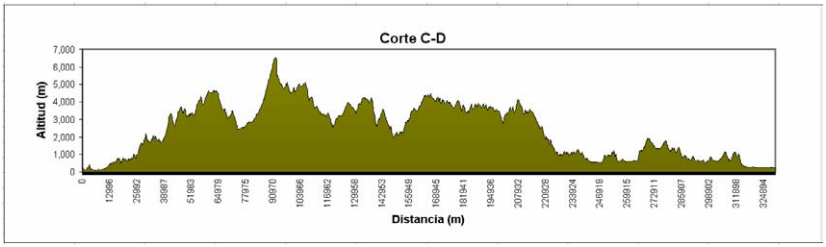
Peruvian relief is characterized by the diversified orography with elevations from sea level up to 6200 m, origin of a huge biodiversity.

Table 2.5-23 Altitudes

DEPARTMENTS	0 - 1000 m	1000 to 2000 m	2000 to 3000 m	3000 to 4000 m	> 4000 m
AMAZONAS	47.96%	27.25%	18.87%	5.88%	0.04%
ANCASH	20.46%	10.38%	13.46%	23.45%	32.25%
AYACUCHO	1.78%	7.60%	15.38%	37.68%	37.57%
CAJAMARCA	11.80%	31.64%	33.54%	22.35%	0.67%
HUANCAVELICA	0.08%	2.81%	12.51%	31.23%	53.38%
HUANUCO	31.07%	17.02%	15.12%	23.57%	13.21%
JUNIN	20.01%	21.66%	11.57%	17.82%	28.93%
LA LIBERTAD	33.45%	13.01%	17.74%	30.16%	5.63%
PIURA	77.72%	10.29%	9.04%	2.95%	0.00%

The Study area relief goes from sea level up to the peak of the water break, in the runoffs that originate the varied hydrography of the place, reaching altitudes higher than 6,000 m above sea level in the high watershed of the "Cordillera Blanca" mountain range in Ancash, as can be seen in the following figures;





The analysis of elevation distribution in the Study area shows that Piura and Amazonas have most of their area <1000 m, Cajamarca between 1000 and 3000 m, in Huancavelica and Ayacucho elevation is concentrated in >2000 m, Ancash, La Libertad, Junín and Huánuco have gradual altitude.

(4) Geology

The Andean cycle starts at the beginning of the Mesozoic up to the Quaternary; in this cycle the main characteristics of the Andean mountain range were given.

The Nevadiana tectonic phase started at the end of the medium Jurasic, producing the emersion of the Peruvian territory, giving place to the continental deposits of the Sarayaquillo formation, this phase also affected the Pucará Group.

Peruvian phase caused the rock bending of Mesozoic, in this phase a notable change occurred in the sedimentation type of a carbonated and siliciclastic (Orient Group Chonta, Vivian formations) to a continental molasic sequence of Huayabamba group.

The Inca phase, nothing more than the compressive nature, gave place to wide and smooth bending, and longitudinal failures. It is considered the phase with the great deformation, originating a broadness in the sialic cortex of the Oriental Range.

During the Quechua Phase, the compressive stress were predominant bending the sediments of the Chambira del Mioceno formation, that can be seen at the Pozuzo sector.

The last tectonic phase is named Plio – Quaternary, that is nothing less than compression, associated to the arising of the Oriental Range.

The characteristics of the geological units based in the lithostratigraphy will allow to conduct quantitative, analysis, orientation, interpretation and use of the same that will serve as base for the analysis and model of the geographic space.

Following there is a description of each geologic unit of the departments of Ancash, Amazonas, Ayacucho, Cajamarca, Huancavelica, Huánuco, Junín, La Libertad, Pasco and Piura, according to its distribution, the lithostratigraphy units, conducting the analysis supported by studies carried out by the Geological and Mining-Metallurgic Institute– INGEMMET.

The lithologic complexity allows different geological behavior, like the distinct types of parental material that originate distinct types of soil. The geological structure of the selected departments are the result of distinct processes of sedimentation and tectonics; that have been molding the relief since the Precambrian till today.

The geological units have been classified according to the lithostratigraphic characteristics, based on it more than 100 units have been classified, including igneous intrusions, that give place to upwelling of igneous bodies from the Paleozoic, Mesozoic and Cenozoic.

The lithostratigraphy units are distributed since the Precambrian represented by the Marañón complex, considered as a metamorphic complex. In the Paleozoic a varied sedimentation follows where the formation of distinct groups can be seen. During the Mesozoic the tectonic activity is manifested originating changes that give place to marine, continental, marine continental sequences and the transitional sequence.

In the Cenozoic an accelerate denudative stage, the tectonic activity decreases, originating the sedimentation of continental red layers. In the quaternary the bio-climatic changes are accentuated and the geodynamic processes increase originating the alluvial sedimentation and from quaternary, Pleistocene and Holocene.

(5) Physiography

The physiographic description of the Study area affects the external aspects (slope, magnitude or relief, dissection, rugosity, etc.), as also internal aspects that are important for the particularities of the project, like the lithology that concerns the characteristics of the materials that superficially conform the relief. The Physiography is the base of the geo-morphological characterization and so the shape of the land are grouped in very general simple morphological sets, like plains, hills, mountains, etc.

1) Physiography of the Costa

a) Plains

This topography groups the plains relief with slopes from 0 to 15%, originated mainly by the

accumulative action of external erosive agents. In the coast plains it can be distinguished due to the action of the sea, alluvial and wind power accumulation, however, marine shapes are not seen at the Study area.

b) Platform and hills

Topographic elevations generally corresponding to upwelling of the pre-quaternary rocky sub-base. With some exception, slopes are superior to 10% and frequently superior to 50%. These shapes can be grouped in two categories:

Platform

Reliefs with smooth and wavy topography with elevation not higher than 20 meters and slopes between 10 and 50%. Origin of denudation type, results from the pronounced wear out of pre-existing reliefs, conformed by pre-quaternary intrusive or Pleistocene sedimentary rocks.The present action of morpho-dynamic processes is little appreciable due to the scarce slope of the gradient. The lithology varies according to the zone it developed;

Hills

Roughed reliefs with accentuates slope and little altitude. Slopes are mainly between 15 and 50% and by definition, the height of the topographic elevations is not more than 300 above the level of the plains around. The hills of the area correspond mainly to granitic plutonic rocks and dioritic of coastal batholiths, stationed during the cretaceous. Usually the hills have cover of sand brought by the wind and coat of weathering of several decimeters to meters of thickness, with tendency to reduce the slope of hills and hiding rocky accidents.

2) Sierra Physiography

The sierra shapes the most defined Andean landscape. Great mountain sides semi-humid or steppe, crowned by highlands and massifs, sometimes glaciers, with snowy peaks that show in the indirect area of influence. The basic characteristic of the Sierra is the presence of great altitude unevenness in short distances, precisely due to the existence of great mountain sides that create said unevenness. As consequence, the variety of landscape in the sierra is broad.

a) Plains and Hills at the Sierra

Lower elevation reliefs with less gradient.

Generally they are stable or slightly unstable surfaces, with little significance or located erosive actions. Mostly they correspond to the highlands and less to the bottom of valleys.

These reliefs present less geodynamic risks, on the contrary, they are means where generally the land has a greater economic and social value, specially the lowlands, with less than 3,800 m above sea level of altitude, where it is possible to cultivate in relatively productive conditions; the same happens at slightly steep mountainsides and in less measure in the moderately steep mountain sides.

3) Selva Alta (High selva) Physiography

a) Mountain sides

Like in the Sierra, mountainsides are the predominant physiographic set dominating the high selva, that comprehends moderately steep slopes to very steep, from 15 to more than 70%, the magnitude of the reliefs corresponds to the height of the mountain slopes, established between 300 to more than 1,000 m measured between the peak and the base of the slope, the reliefs that are bigger and sloped are

generally less productive because soils are more superficial or inexistent and increase the intensity of erosive actions, although the dense vegetation that covers the slopes in high and middle height of selva.

The eventual or sporadical mass movements that occur in the region can be aggravated or provoked if the slopes are improperly cut.

Mountains at the high selva are complex zones that include a high potential of erosion in case of deforestation, low productive capacity, several ravines with considerable flow during the rainy season, presence of small springs and sporadic cultivated land. Due to the heterogeneous tropical wood, the high selva mountains include important habitats of several species of wild flora and fauna.

In the limits of the Pacific and Atlantic water division the Sierra mid-Andes, low Andes and High Andes are predominant.

The departments of Amazonas, Huánuco, Pasco, Junín and Ayacucho and these two last regions also include Ceja de Selva and Selva Baja.

The main characteristics of the great regions are described in the following table:

Table 2.5-24 Physiographic Units (km2)

Department	Estuary	Plain	Wavy to Plain	Rises and Hills	Hills and mountain	Mountain	Others
AMAZONAS		4.16%	0.06%	9.89%		85.25%	0.63%
ANCASH		2.73%	5.07%		49.10%	40.04%	3.06%
AYACUCHO		0.58%	11.49%		41.33%	46.41%	0.19%
CAJAMARCA		1.26%	3.98%		13.29%	81.40%	0.07%
HUANCAVELICA		0.27%	4.96%		49.25%	44.97%	0.55%
HUANUCO		5.89%	0.71%	16.53%	19.43%	56.69%	0.76%
JUNIN		3.06%	3.33%	2.95%	29.48%	60.10%	1.08%
LA LIBERTAD		14.96%	5.64%		30.19%	48.98%	0.24%
PIURA	0.04%	34.81%	18.00%		26.34%	20.61%	0.19%

Table 2.5-25 Physiographic Units

REGION	ZONE	SHAPE
COSTA	Costa	Plain
		Wavy to plain
		Hill and Mountain
SIERRA	Andean High	Plain, , Wavy to plain, Hill and Mountain
	Mid Andean	Plain, Wavy to plain, Mountain
	Andean Low	Plain, Mountain
SELVA	Ceja de Selva	Mountain
	High Selva	Mountain
	Low Selva	Plain, rises and hills

The analysis of slope distribution at the Study area shows that great part of the area have slope >10 %, excepting the department of Piura where 44% of its territory presents slope under 3 %, and about 38% of the same with slope >10 %.

Table 2.5-26 Slope distribution

DEPARTMENTS	< 3%	3 to 5%	5 to 10%	**>10 %**
AMAZONAS	6.84%	4.59%	8.34%	80.23%
ANCASH	3.14%	2.52%	5.69%	88.64%
AYACUCHO	3.50%	4.03%	11.35%	81.13%
CAJAMARCA	1.45%	1.36%	4.74%	92.45%
HUANCAVELICA	1.29%	1.74%	6.93%	90.04%
HUANUCO	8.99%	5.59%	9.06%	76.36%
JUNIN	4.53%	3.13%	8.24%	84.09%
LA LIBERTAD	13.56%	3.87%	5.88%	76.69%
PIURA	43.49%	9.79%	8.68%	38.03%

(6) Soils

The project area corresponds to distinct zones: platform, hills, foothills of the occidental Andean mountain side, alluvial terraces, low alluvial terraces usually flood zones.

The Study area in general is located in rises and hills, followed by the Andean occidental mountain range.

1) Edaphologic description of soils

In the Project area 7 great units of soil have been identified and characterized according to the United Nations Food and Agriculture Organization (FAO) soil classification.

Soils are of residual, alluvial and colluvio-alluvial, come from the lithology of volcanic agglomerates, lava spillage, sandstone and conglomerates of distinct granulometry with some intercalations of shale. Color of soils varies from reddish brown to pale green, superficially associated with rocky upwelling, relief is disected with slopes superior to 8 - 25%, the capacity of use is for crops, pasture, forestry and for protection in bigger slopes

At the study area in the 9 departments topography is very irregular, stony and rocky soil are predominant (lithosol) and in the low parts they are sandy (regosols), in turn there are fluvial deposits of gravel lime to stony lime located in the riverbeds, in the low parts of slopes, this soil has not a define horizon because it is conformed by recent deposits (recent Quaternary), and the vegetation has not produced sufficient organic matter to conform organic horizons. Its depth ranges between 50 to 150 cm, percentage of gravel and stone are in general higher than sand, lime and clay (60 to 70%), in most cases, these soils are covered by a coat of sand deposited by the wind, with up to 3 distinct strata, in some places it is covered by fine material of volcanic origin; other type of soils found at the study area is characterized for having much lithic material accompanied mainly by sand of wind power origin, deposited over the mother rock; superficial soils of denuded rock exposition, formed over parental material of varied lithology and in predominantly steep topographic positions. The rocky nature and abrupt topography determine the so called “lithic formations”, also there are soils formed by great sand deposits and in some cases almost completely cover some slopes, these soils show several profiles of material deposition, gray to whitish in color and of distinct thickness, they have coarse texture to sandy, little developed and with insertion of rock fragments in the superficial horizons. Lastly, the other type of soil that completes the edaphic scenario are the superficial soils (leptosols) with strong slope (> 50 %) and of thin area.

2.5.5 Flora and Fauna

(1) Wild Flora

Peru has three natural regions: costa, sierra and selva. Sierra region is situated from 1,000 m above sea level to more than 6,000 m (According to MINAG classification) and this range is sub-classified in 5 sub regions 1)YUNGA , 2)QUECHUA, 3)SUNI ,4)PUNA , 5) JANCA or CORDILLERA according to the altitudes, as shown in the following table. In Sierra region there are humid woods, dry woods, moors and highlands. The flora present in the sierra according to the regions are as follows:

Region in Sierra	Approx. Height.	Description
YUNGA	500 – 2,500 m	In the slopes of Andean mountainside there are cactus, the “achupallas” *(Pitcairnia sp).*, “mito” (*Aegithalus caudatus*). In the narrow valleys grow the willow (*Salix alba*), pepper tree (*Schinus poligamun*), reed (*Cortaderia*), “pájaro bobo” (*Tessaria absimthioides*), “tara” (*Colocasia esculenta*), etc.

QUECHUA	2,300 – 3,500 m	The characteristic tree is the alder (*Alnus acuminata*), used in carpentry. Other specie are "gongapa", "arracacha", "yacón", "ñuña", "pashullo, maize (more than hundred varieties), squash, "granadilla", tomato, papaya and "caigua".
SUNI	3,500 – 4,000 m.	"Sauco" (*Sambucus nigra*), cantua (*Cantua buxifolia*), "cola de zorro", "wiñay-wayna" (quechua, "everlasting youth ", a variety of orchidy), "quinua" *(Chenopodium quinoa***)**, "cañihua", "tarhui" (a variety of lupine), "oca" and "olluco".
PUNA (4,000 – 4,800 m.)	4,000 – 4,800 m	Typical flora of this region is constituted by grassland (grass densely covers the highland), represented by the "ichu" (*Stipa ichu*), "pumacho" and "chillhuar". Special importance has the Puya Raimondi (*Puya Raymondi sp*), also known as "cara", "titánica" or "santón". Is a species that can live between 40 and 100 years, during the bloom, it is covered with more than 10.000 flowers. It can be 12 meters high. It is an endangered species due to indiscriminate cut down. Ichu, has multiple uses, as the main forage for the cattle, auquenids and sheep breeding that is the most important activity of the population in this area
JANCA or CORDILLERA	4,800 – 6,768 m	Due to the harsh and wild condition the presence of animals and vegetation is very scarce. Typical flora is the "yareta", "yaretilla", "festuca", moss and ,lichen

Note: Classification Dr. Javier Pulgar Vidal.

Puya Raymondi.
The biggest Bromeliaceae.
Grows over 3,800 AMSL.
(Photo:. PROMPERU homepage)

Tropical Andes occupies the medium continental sector that goes from Venezuela to Northern Chile, determining one of 34 hot spots of world biodiversity defined by classification according to activities of International Conservation (International NGO), it has at least 1,500 specie of vascular plants (> 0.5 per cent of the world total) as endemism and at least 70 per cent of the original inhabitants were lost.

The existing situation presented by International Conservation is the following:

Table 2.5-27 Situation of biodiversity in Tropical Andes

Hotspot –Original Area (km2)	1,542,644
Hotspot – Remaining vegetation (km2)	385,661
Endemic specie of plants	15,000
Endangered endemic birds	110
Endangered endemic mammals	14
Endangered endemic amphibian	363
Extinguished specie +	2
Human population density (persons/km ^{2})	37
Protected Areas (km ^{2})	246,871
Protected Areas (km ^{2}) in Categories I-IV*	121,650

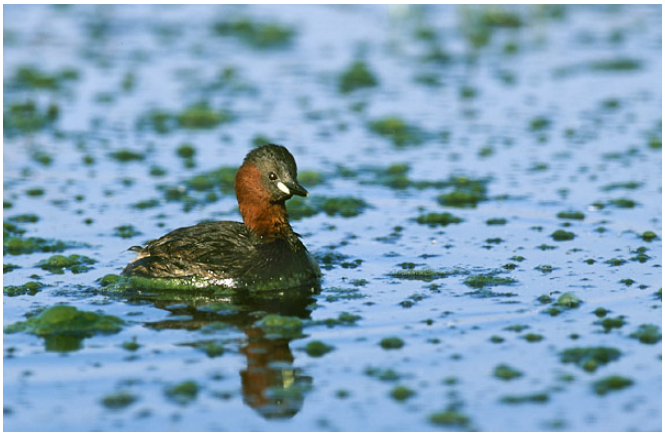
+ Extinctions registered since 1500. *Categories I-IV require higher levels of protection.

(2) Wild Fauna

In the Sierra, auquenids or South American camelids such as alpaca, guanaco, llama and vicuna, from the family of mammals that live in Southern Andes highlands can be found. Lakes and rivers of the zone have theirs own fauna that is diversified. It has birds such as the gulls (*Larus belcheri*), Andean flamenco (*Phoenicopterus chilensis*), ducks (*Anas discors*) and diving ducks (*Podiceps majur*) and a great variety of autochthonous fish.

The description of fauna in each region of Peruvian Sierra is as follows:

Region in Sierra	Approx. height	Description
YUNGA	500 – 25,00 m	Typical fauna: "chaucato or chisco", "soña", "chauco", "josesito", "taurigaray", etc
QUECHUA	2,300 - 3500 m	The characteristic birds are the gray thrush and the "huipcho". Also there are pigeons, goldfinch, sparrows, sparrow hawk and partridges. Among the mammals there are deer, puma, fox and wild rabbit. Among the domestic mammals there are the cow, donkey and horse.
SUNI	3,500 – 4,000 m	Suni region also has a diversity of fauna; fox, "wild rabbit", skunk, deer, bear, black thrush or "yana yuquish", forgs, dominic or arge, sparrow hawk, condor, puma, "cocha yuyo". In lakes and rivers, trout that is abundant in the entire region, can be found.
PUNA (4,000 – 4,800 m)	4,000 – 4,800 m	Typical fauna of the region are the auquenids like the llama. alpaca, guanaco and vicuña Mammals like skumk, Andean fox, wild cuy, puma, "taruka" or hind, grey deer, among others; birds like the partridge, "pamperos", American sparrows, condor, flamenco, rhea of height; and reptiles such as lizards and snakes. In lakes and rivers there are insects, frogs and toads
JANCA o CORDILLERA	4,800 – 6,768 m	Fauna is conformed by condor, wild rabbit and male vicuña.



Zambullidor de Junín. Endangered species, unique in Peru natural of lake Lago Chinchaycocha in Junin department (Municipality of Junin)

(3) Natural Protected Areas

The legal base for the Natural Protected Areas is the National System of State Protected Natural Areas (SINANPE) under the Ministry of Environment (MINAM). SINANPE areas are regulated by four legal tools: The Political Constitution, the Law of Natural Protected Areas (Law No. 26834), Supreme Decree of the Master Plan and the legal framework of SINANPE with the Regulation of the Law of Natural Protected Areas of which description is shown in Chapter 3.10.

Categories of Natural Areas:

1. National Parks
2. National Sanctuaries
3. Historic Sanctuaries
4. Landscape Reserves
5. Wildlife Shelters
6. National Reserves
7. Communal Reserves
8. Protected Woodland and
9. Hunting preserve.

The Areas are determined according to the level of political administration such as a) Areas of national administration, b) Areas of Regional Administration and c) Areas of Private Conservation (Chapter V, Regulation of Law of Natural Protected Areas).

In 2008, there were sixty three (63) Natural Protected Areas (Table). Among these 63 Natural Protected Areas, 32 are located in the 10 departments that integrate the Program under Study.

The present Study will identify the location of these Natural Areas, particularly if they cross or are adjacent to the subprojects areas that integrate the Program.

Table 2.5-28 Natural Protected Areas

Category	Number of Areas	Approx. Area (ha)	Number of areas in the 9 departments of the project.
NATIONAL PARK	12	7,967,119	7
NATIONAL SANCTUARY	7	263,982	2
HISTORIC SANCTUARY	4	41,279	2
NATIONAL RESERVE	11	3,298,712	3
WILDLIFE SHELTER	2	8,592	0
LANDSCAPE RESERVE	2	651,818	1
COMMUNAL RESERVE	7	1,753,869	2
PROTECTED WOODLAND	6	389,987	3
HUNTING PRESERVE	2	124,735	2
RESERVED ZONES	10	3,543,286	5
TOTAL	63	18,043,379	27

Source: INRENA (January, 2008)

2.6 Definition of the Problem

2.6.1 Diagnosis of the Existing Situation of Agricultural Sector in the Sierra

(1) Conditions of Producers in the Sierra

The program area is very heterogeneous, with a variety of ecologic zones, micro-climates and physical geographical conditions that change in a very short distance and that would limit intensive production but can help to obtain a variety of products. Additionally, cultural and social factors require particular analysis depending on each area or zone. Also, the different levels of economic activity and articulation with the markets have to be taken into account. Farmers mostly occupy marginal land or with accentuated slope, especially small land holders. According to Statistics of Agrarian Census III,

smallholders (less than 1 ha) of the Sierra possess an average of 0.43 ha of land, and the cultivated area ranges from 0.1 to 0.3 has. Tand use situation is indicated in the following table:.

Table 2.6-1 Land Use Estimation for Smallholding farmers (ha)

Department	Unit of Producers (less than 1 ha); Units.	Areas (has)						
		Area of Agriculture unit	Cultivated area	Cultivated area	Fallow land	Livestock	Others	Non Agrarian
Amazonas	373	0.46	0.35	0.16	0.04	0.01	0.13	0.12
Ancash	16,299	0.44	0.41	0.22	0.11	0.01	0.06	0.04
Ayacucho	10,671	0.49	0.42	0.24	0.08	0.02	0.08	0.07
Cajamarca	14,210	0.43	0.33	0.17	0.08	0.01	0.07	0.10
La Libertad	11,594	0.46	0.39	0.18	0.10	0.00	0.10	0.07
Huancavelica	5,781	0.49	0.41	0.29	0.04	0.01	0.08	0.07
Huanuco	27,109	0.53	0.46	0.25	0.09	0.00	0.12	0.06
Junin	3,492	0.42	0.39	0.29	0.03	0.01	0.05	0.03
Piura	774	0.39	0.35	0.09	0.17	0.01	0.09	0.03
Promedio	94,590	0.43	0.33	0.17	0.08	0.01	0.07	0.10

Source; STATISTICS OF AGRARIAN CENSUS III, PERÚ (1994)

Producers survive with small cultivated areas of approximately 0.17 ha. Besides, most of smallholder land is located in accentuated slopes. Land located in uniform areas less sloped are few. Cultivated products and productivity vary, depending on the altitude. According to the Study "Ecodevelopment in High Andes, 1996, Mario Tapia", the average production of main crops is the following;

Table 2.6-2 Productivity of Crops according to the Agro-ecological Zone, Chimis, Cajamarca

Product	Productivity (t/ha)			
	Quechua Semi-humid	Low Hillside	High Hillside	Jalca (Best place)
Ryegrass +clover	2.0 – 2.5			
Maize	0.8 – 1.6	0.3 – 0.5		
Wheat	0.9 – 2.5		0.3 – 0.6	0.3 – 0.6
Barley		0.3 – 0.5	0.4 – 0.6	0.4 – 0.8
Potato		2.6 – 4.6	2.5 – 4.5	5.5 – 7.5
Pea		0.4 – 0.6		
Quinua		0.3 – 0.6		
Oca			2.0 – 6.0	4.0 – 6.0
Oluco			2.0 – 5.0	3.0 – 5.0
Rye			0.2 – 0.4	
Mashwa			5.0 – 8.0	2.0 – 4.0

Source; Ecodevelopment in High Andes, Mario Tapia, Table 28

The potential of farmers to produce food can be the following:

Table 2.6-3 Estimation of Food Production by a Small Landholder

Product	Land distribution	Productivity (t/ha)	Cultivated Area (ha)	Maximum Production (kg)	Minimum Production (kg)
Barley	33%	0.4 – 0,8	0.0561	45	22
Potato	35%	5.5 – 7,5	0.0595	446	327
Wheat	12%	0.3 – 0,6	0.0204	12	6
Oca	11%	4.0 – 6.0	0.0187	112	75
Olluco	6%	3.0 – 5.0	0.0102	51	31
Rye	2%	0.2 – 0.4	0.0034	1	1
Mashwa	1%	2.0 – 4.0	0.0017	7	3
	100%			675	465
				1.84 kg/day	1.27 kg/day

This production is in a range of 1.27 kg/day to 1.84 kg/day. It is estimated that this quantity does not cover the minimum necessities of a farm household. It should be noted that the average number of the

population per agriculture unit is 2.57 persons. In consequence, it is necessary to increase this production and assure the food of farmer households.

(2) Condition of land, Structure of possession and production

1) Population and Land Possession

Land conditions were analyzed based on data of San Pablo district, San Pablo Province, Department of Cajamarca, as an example. The population of San Pablo District is 13,845 (1993), being 20.7% urban and 79.3% rural.

Table2.6-4 Population of San Pablo District (1993)

	Population Total	Urban	Rural
DISTRITO SAN PABLO	13845	2871 20.7%	10974 79.3%

Source; STATISTICS OF AGRARIAN CENSUS III, PERÚ (1994)

According to Statistics, the province of San Pablo has 4,770 producers, 78,3% showing insufficient agricultural activity to attend family economy or household expenses.

Table2.6-5 Area of agriculture activity to attend household expenses

	PRODUCERS (household)		AREA (ha)	
SAN PABLO (Province)	4,770	100.0	38,313.73	100,0
SUFFICIENT	996	20.9	8,693.13	22.7
INSUFFICIENT	3,734	78.3	28,718.12	75.0
NON SPECIFIED	40	0.8	902.48	2.3

Source; TABLE No 1.21

It should be noticed that San Pablo District has a high percentage of irrigation area, approximately 63% (454 ha of irrigation area /721 ha of transitory crops area), showing insufficient production for self-consumption. Land use structure in San Pablo District is the following;

Table 2. 6-6 Land Use In San Pablo District (1994)

Category	Agriculture Unit	Agriculture unit area	Transitory crop	Fallow land	Rest land	Permanent Crop	Farmed pasture	Non agricultural
		(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)
Less than 1.0 Ha	516	227	30	116	4	5	12	61
From 1.0 - 3.0 ha	1,067	1,720	166	795	56	10	109	585
From 3.0 - 10.0 ha	889	4,247	322	1,674	231	19	241	1,760
From 10.0 – 50.0 ha	225	3,785	170	1,052	315	12	49	2,187
From 50.0 – 500.0 ha	33	3,659	34	377	133	0	40	3,075
From 500.0 - 3000 ha	1	600	-	-	-	-	-	600
More than 3000 ha	0	0	0	0	0	0	0	0
Total	**2,731**	**14,238**	**721**	**4,015**	**739**	**45**	**451**	**8,268**
Average per unit		**5.21**	**0.26**	**1.47**	**0.27**	**0.02**	**0.16**	**3.03**

Source; III CENSO NACIONAL AGROPECUARIO, PERÚ (1994)

Considering that almost 80 % of producers deal with lack of food, it is estimated that producers with less than 3.0 ha of land are not producing enough food for self consumption. It should be stressed that the average area of transitory crop harvested is 0.12 ha (186 ha/ 1,583 units).

2) Physiography of the Land

Land distribution according to land gradient in the District of San Pablo is the following;

Table2.6-7 Distribution of gradient in the Distrito de San Pablo

Slope (%)	Area (ha)	Percentage	Accumulated Area (ha)
< 1	53	0.3%	53
> 1 to < 2	13	0.1%	67
> 2 to < 3	15	0.1%	81
> 3 to < 5	52	0.3%	133
> 5 to < 10	1,023	5.1%	1,156
> 10 to < 20	6,713	33.2%	7,869
> 20	12,331	61.0%	20,200
Total	20,200	100.0%	

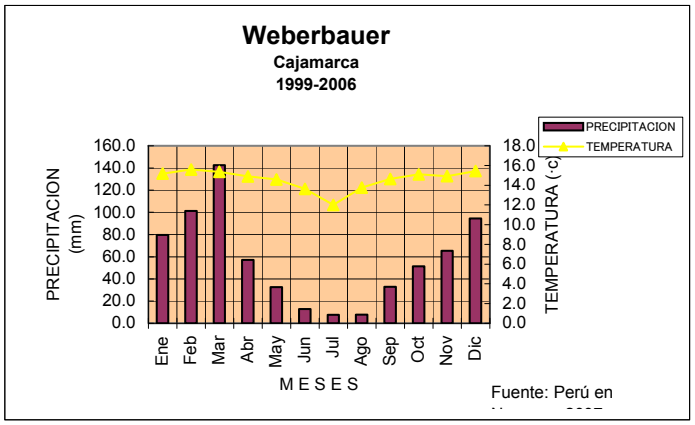
Source; GIS estimation based on topographic map scale 1/25.000

Most part of the land (94.2%) has steep slopes (more than 10%). Considering that cultivated area in the District of San Pablo is more than 700 ha, it can be figured that agriculture land is located in areas of steep slopes. In the case of small producers who generally have agricultural land in marginal areas, it is estimated that their land would be located in areas of steep slopes, without irrigation system.

3) Conditions of rain

The data at Cajamarca station are shown in the following table. Annual average rainfall at Cajamarca is 685.8 mm/year, having dry season from June to August.

MONTH	RAINFALL (mm)	TEMPERATURE
Jan	79.6	15.2
Feb	101.3	15.6
Mar	142.6	15.4
Apr	57.2	14.9
May	32.5	14.6
Jun	12.8	13.6
Jul	7.5	12.0
Ago	7.9	13.8
Sep	32.9	14.6
Oct	51.4	15.1
Nov	65.4	14.9
Dec	94.7	15.5
	685.8	



It is estimated that at least 40% of agriculture land in the Costa are affected by processes of desertification and bad drainage. Moreover, the annual flood of rivers in summer and when the El Niño occurs, and due to lack of riverside defenses, important surface of scarce agriculture land is lost.

In the Sierra at least 60% of agriculture soil is affected by processes of erosion of medium to extreme gravity by lack of handling techniques and the destruction of vegetation in hillsides.

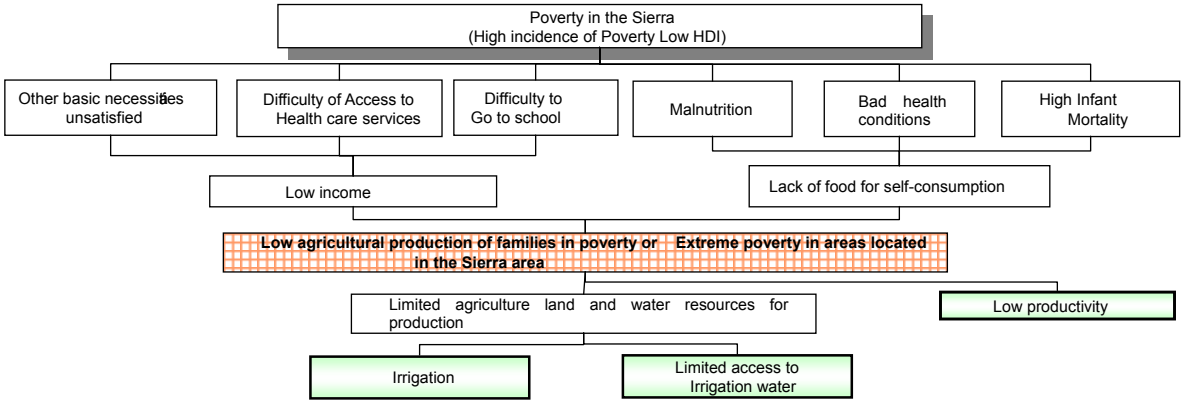
Factors explaining poverty in the rural area at the sierra are related to the limited available land, soil quality and limited water sources. Also it is evident the existence of an improper infrastructure of roads, high risk of production (plagues, frost, draught, etc.) and problems of commercialization because farmers sell their products at low price to the first link of the chain and purchase their production supplies at high prices to the last link of the chain. The access to a good education is also an important deficiency.

(3) Summary of poverty conditions in the Sierra

It can be considered that in the Sierra; there is a high incidence of poverty, extreme poverty. Low HDI

is consequence of the limited areas of agricultural land located in zones with steep slopes less proper to agriculture practices. In consequence, there is a strong restriction to expand the agricultural area, and the best options would be to maximize the physical cultivated area up to the limit, with much difficulty and high cost. So, since the lack of food is an evident consequence, productivity has to be increased in the area where farmers can cultivate. In areas with irrigation systems, the situation of food production is moderate, compared to production areas with no irrigation. In these areas, the estimation of average food production by agriculture unit is between 1.27 kg/day to 1.87 kg/ha, that is insufficient to cover the basic food necessities of the households.

The said estimations, besides the official numbers, show the seriousness of poverty in the Sierra and the analysis of causality is indicated in the following table:



From the causal graphic about the existing situation in the Peruvian Sierra, the following problems to urgently be dealt with are identified

1. Mitigate the lack of water for irrigation
2. Increase the reach of irrigation water to cover the largest area possible
3. Increase agricultural productivity

Low profitability of agricultural products is a significant consequence of lack of irrigation water and improper agricultural practices with a improper management of soil fertilization, besides the incipient producers' organizations, which is worsened by the meager support from the state and other organizations.

The said conditions determine low productivity that does not allow the commercialization of products, causing the low income of the producers.

(4) Water Resources Conditions

1) Management of Irrigation Systems

The problems of irrigation systems management in the 9 departments of the Program area are related with the natural environment, productive systems and the organization of beneficiaries and the existing irrigation infrastructure.

i) Natural Environment

Problems are presented by the meteorological events and actions of man (anthropic).

- Irregular water availability, poor during dry season.

- Agricultural areas susceptible to frosts.
- Deforestation in the ravine springs.
- Irrigation at the slope direction washes the soils, reducing fertility and originating low productivity.

ii) Productive systems
- Inefficient irrigation methods with considerable loss of water that deteriorate soils
- Users do not know about irrigation techniques
- Users without technical assistance

iii) Organization of beneficiaries
- Weak and/or inexistent organization for the irrigation system management
- Rules of water distribution are unequal concerning users and irrigation areas.
- Lack of coordination between organizations and users that capture water from the same river.
- Absence of the authorization system of water right

iv) Irrigation Infrastructure
- Operation of inlet, conveyance and distribution structures is inefficient, considering the demand of water at the cultivated areas.
- Infrastructure deteriorated by the effect of river and ravine flood and/or landslides.
- Defective and/or inexistent maintenance of the existing irrigation infrastructure.

Among the objective of the Technical Irrigation Component, the support of public and private institutions towards farmers and their organizations is necessary so they can apply properly the installations and technical proposals for the irrigation system administration.

2) Conflicts with Water Management

Water management conflicts at watersheds occur due to situations related to the quantity, quality and opportunity of use of water resources, and the risk of conflicts is greater by the diversity of uses by the users who compete over the same poor resource.

In watersheds of Peru, there are open and closed confrontations and potential or latent conflicts that in any moment can become violent, especially in periods of draught and also by other conflicts like mining pollution, for instance.

Relevant conflicts of water management identified at the watersheds are the following:

- Conflicts by watershed border and their integral management
- Conflicts of authority and responsibility in the multi-sector management
- Legal, administrative and institutional conflicts
- Socio cultural conflicts
- Conflicts of water right
- Conflicts in the priority of public resources assignment
- Conflicts by water pollution

There are many causes that can originate conflicts in water management and slowness and improvisation for solutions are counterproductive and in many cases worsen the issue becoming a problem that some times reach the highest levels of the State decisions, due to a lack of a system that integrates the National Water Authority with regional authorities and committees, commissions and

board of users to conduct water management at their scope of action with a multi-sector and integrated nature, with an autonomy backed up by law.

2.6.2 Definition of the Problem and its Causes

(1) Definition of the main problem

Most of beneficiaries that are in situation of poverty or extreme poverty many case cannot produce enough food for self consumption, because of limited water resources and irrigation areas and low yields. The malnutrition levels are critical, as shown in the statistics. Actually, agricultural land in the Sierra is limited, especially those corresponding to rural marginal farmers. The possibilities to increase cultivation areas are very limited and almost always, inexistent. The extension of cultivated area will only be possible for those marginal lands of strong gradient and less quality of soil. In these places, however, where mechanization is impossible, agriculture tasks will be much more complicated.

The only way to increase food production is two or three harvests in the same land with the introduction of irrigation. However, climate conditions do not allow two or three harvests, due to the seasonal rain pattern; dry season usually starts in April till September making cultivation impossible. Most of farmers produce in rain-fed land. According to statistics, areas with and without irrigation are at the 9 departments of the Program area are as follows;

Table 2.6-8 Area of Transitory Cultivation and Area With and Without Irrigation (ha)

Department	Area of Transitory Cultivation (ha)	Area With Irrigation		Area Without Irrigation	
		Area (ha)	(%)	Area (ha)	(%)
Amazonas	69,794	16,021	23.0%	53,774	77.0%
Ancash	121,621	69,181	56.9%	52,440	43.1%
Ayacucho	168,141	68,087	40.5%	100,054	59.5%
Cajamarca	197,206	52,823	26.8%	144,384	73.2%
La Libertad	181,848	114,007	62.7%	67,841	37.3%
Huancavelica	112,825	26,716	23.7%	86,109	76.3%
Huanuco	111,116	23,266	20.9%	87,850	79.1%
Junín	128,057	28,195	22.0%	99,863	78.0%
Piura	94,600	83,093	87.8%	11,507	12.2%
Total	**1,185,208**	**481,388**	**40.6%**	**703,820**	**59.4%**

Source; STATISTICS OF AGRARIAN CENSUS III, PERÚ (1994)

The Table shows that almost 40% of land used as transitory cultivated area has irrigation system. Considering that the harvested area in the 9 Departments is 1.5 million of ha, it is estimated that there are two harvests per year at irrigated areas. However, under these conditions, agriculture activity is not sufficient to produce and attend family consumption. To overcome the said condition, irrigation area has to be increased. In the long term, it will be necessary to increase productivity to increase food production as well.

The main problem of the rural sector can be summarized in the following idea:

Low agricultural production of families in situation of poverty and extreme poverty located in the areas of the Sierra

(2) Identification of causes

Agricultural low production and productivity of farm households in poverty or extreme poverty at the Sierra zone is consequence of the limited agricultural area and limited water resources for production.

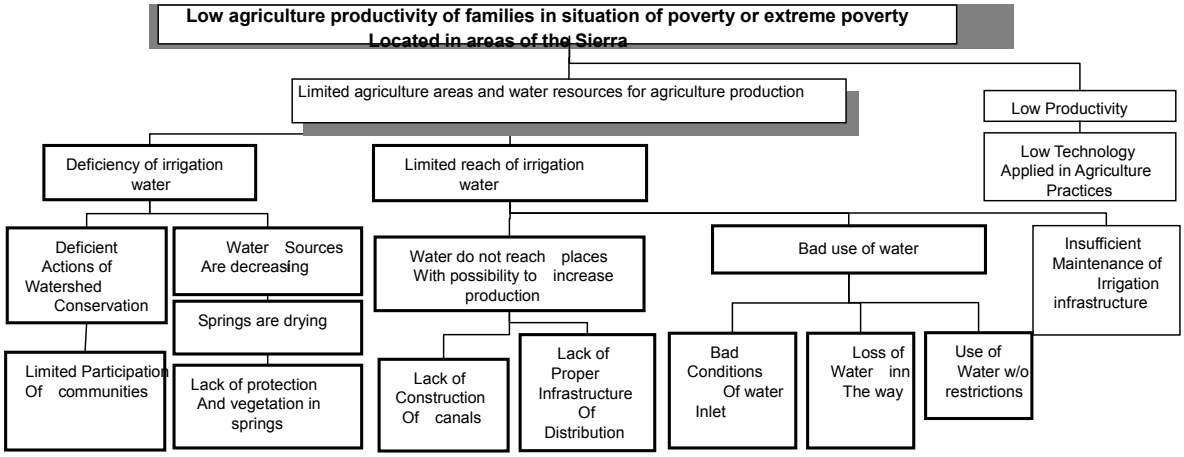
Due to the need to count on with irrigation water for agriculture, in general users constructed an improvised, improper inlet and conveyance infrastructure, that usually have artisanal or rustic intakes at ravines and rivers, ditches or canals with stone or earth slopes, with canal bottom in earth or over

loose stone and in other cases with concrete canals without guidance, some sections have excessive slope. Usually, these are the causes for the rapid erosion and deterioration of minor irrigation infrastructure, that cause loss by filtration in the way, originating in its turn one of the main causes for the small quantity of irrigation water available.

One of the main causes for low production and productivity in agriculture is the shortage of irrigation water, but at the 66 project areas, this situation is complicated even more due to the low technological level, deficiency in water management, lack of organization and poor operation and maintenance of irrigation structures. Finally, low income does not generate resources to improve the deteriorated irrigation infrastructure.

The execution of this Program will avoid farmers to go on watering as they do now, seasonally during the period of rain and part of it using the same earth canal or ditches in the dry season, with permanent loss of irrigation water.

The relation of causes and effects of the indicated problems are shown in the following figure.



Problems can be summarized in the following points:

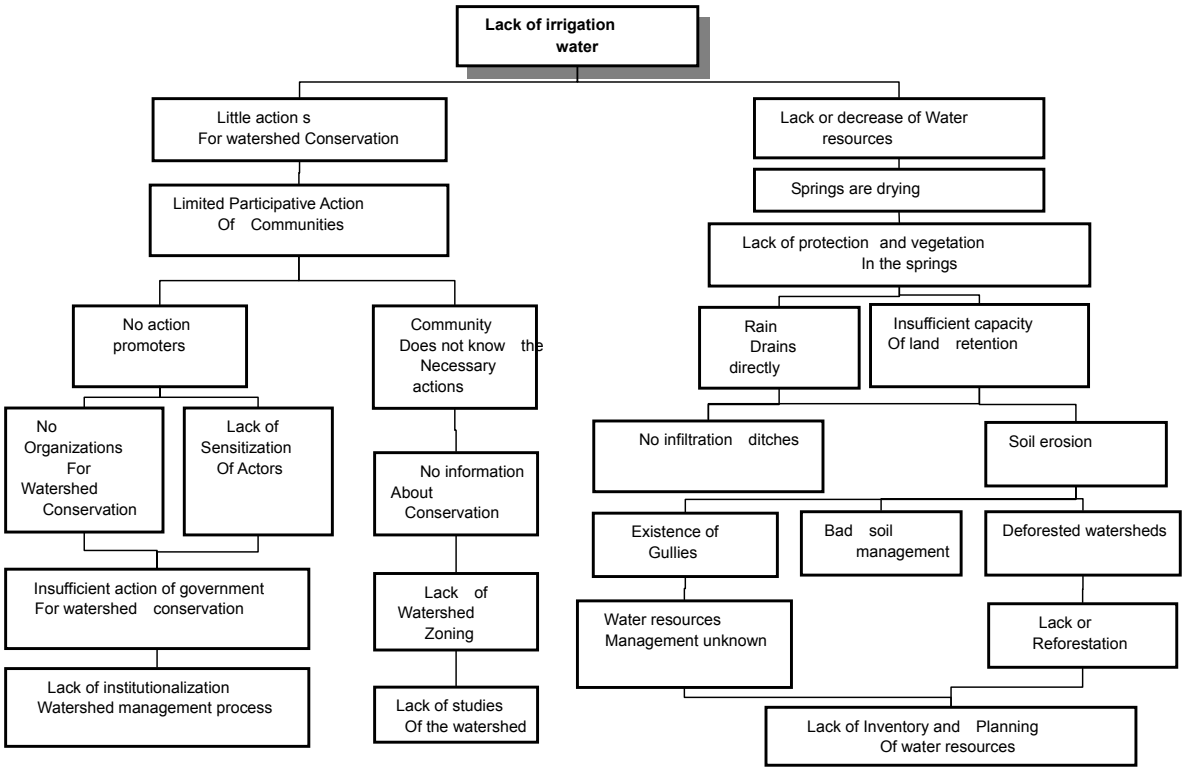
1 Lack of water for irrigation requiring water resources sustainability in Upper zone of Watersheds

2 Limited irrigation reach: producers need to have access to irrigation to increase harvests. Deficiency is also generated by bad water distribution, requiring a sensible and economic use by producers and also the construction of a proper irrigation infrastructure the cultivated areas in soils with good quality will increase.

3 Practices applied by farmers in the Sierra are traditional, without use of agricultural supplies and highly dependent on the natural conditions, giving place to agriculture vulnerable to nature.

(1) Irrigation water shortage for agricultural production:

Water source is more and more rare in the Sierra due to soil degradation and erosion consequence of deforestation. In the Peruvian sierra, rainfall is concentrated on the months from November to April; watershed degradation directly affects the water source that finally is the source of income for farmers. In the next diagram, the causal relations that originate the lack of irrigation water are indicated:



There are two main reasons that can be typified as causes for irrigation water shortage and can be summarized as follows:

1 The source of water resources at upper watershed are not retaining pluvial waters in a adequate form, due to the scarcely vegetation covering originated by the deforestation and degradation of the lands.

2 Activities of watershed conservation is rare due to the limited participation of the community in a upper and middle micro watershed. There are not conservation programs and activities and communities are unaware of the necessary measures to be taken to protect springs that are the source of irrigation water.

By effect of soils degradation, rain water runs directly to the low parts of the watershed by lack of contention in the high and medium watershed.

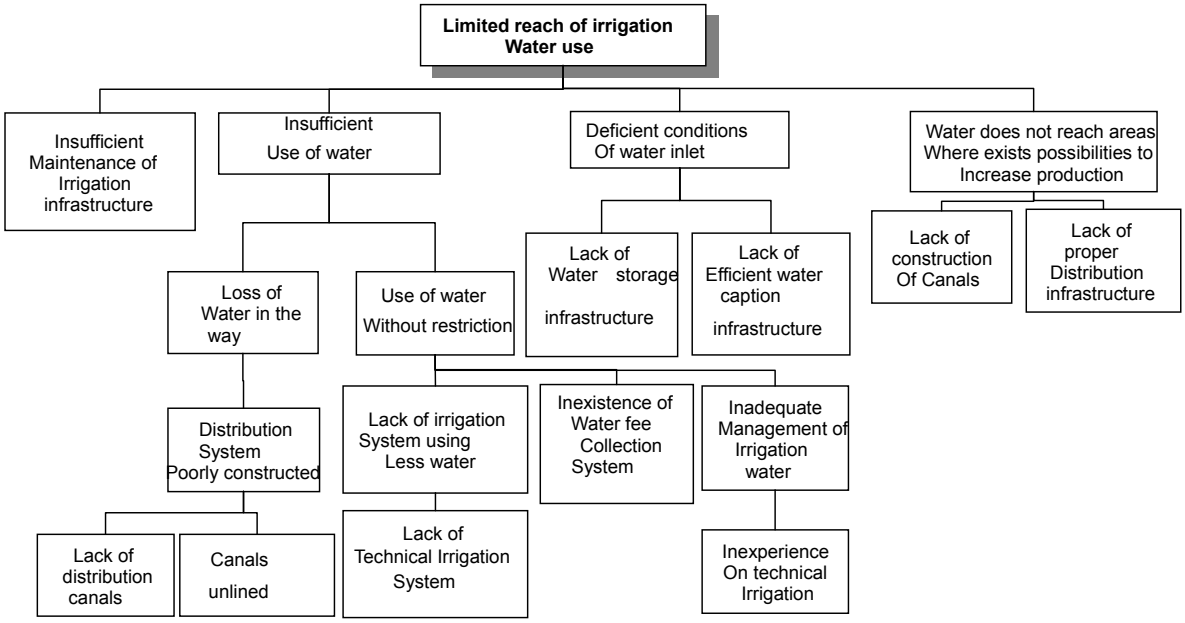
Lack of knowledge about watersheds does not allow them to take the necessary measures. Information is precarious and insufficient to execute proper measures of conservation, mainly in areas where farmers depend on water sources for production.

Micro watershed requires measures to alleviate the erosion that is to say lost of soil, it was achieved it to mitigate developing actions to conserve the water and the floor, through the execution of retention structures, grasses and forestation in the middle and high parts of the micro watershed.

Taking into account the activities of conservation at the high parts of the watershed where water resources for farmers are produced, institutions and community, who are responsible for this issue, have an important role but are incapable of managing said measures. It is necessary to promote actions in the community, together with the institutional reinforcement to confront this problem with efficiency.

2) Limited reach of irrigation

For many farmers, access to irrigation is the dream of generations that would allow them to produce twice or three times in their lands. In the Sierra, approximately 25% of the cultivated land has irrigation system and 75% do not count on with irrigation. However, as water sources are exhausting, it is necessary to maximize the use of existing water. The following diagram shows the tree of the problem.



The main causes of agriculture low production and productivity is due to the irrigation water deficit at the influence area; this situation is complicated even more by the lack of irrigation infrastructure, low technological level, deficiency in water management, lack of organization, as well as insufficient investments by State and private entities.

Presently, in the majority of cases there is a precarious, rustic and almost artisan-like irrigation infrastructure that is not enough to assure irrigation of land proper for agriculture. It is necessary to indicate that water availability is not critical from November to March, (rainy season), that generally occurs in the whole Peruvian sierra and the inter-Andean valleys.

The problem also is originated by the lack of maintenance and improper use of water with the existing irrigation infrastructure. As consequence, the water does not reach new areas where there are possibilities to increase production. To increase new areas it is necessary to save water consumption at the conveyance and use sections, besides non used resources have to be exploited. The improper use of water is a critical factor that comes from the bad conditions of water inlet, loss of water in the way and use of water without restrictions. The problem may be summarized as follows:

1 Rainfall is concentrated in the months from November to April. Part of said resource can be stored to be used during the dry season, improving water inlet infrastructure, irrigation areas would increase.

2 Usually, conveyance canals are earth made with high loss. Part of the captured water in the source is lost in the way to the canal. Loss of water occurs in the conveyance canals, distribution canals and in the lot.

3 Irrigation practice in the sierra is surface irrigation using ditches with low efficiency.

4 There is the bad habit of using excessive water, affecting the need of the resource in the surrounding lots. Many times, pasture is watered by pounding irrigation, without considering water requirements, condition that affects the problem for the efficient

use of irrigation water.

5 If said economies are introduced, new areas of irrigation with two or three harvests per year could be created.

6 To extend the reach of irrigation (new areas), it is necessary to construct new irrigation systems.

7 It is necessary to increase efficiency of the existing irrigation systems.

A deficient irrigation water management is aggravated by the improper management and distribution that does not allow an optimum use of cultivation land, this fact is one of the factors for agriculture low production and productivity.

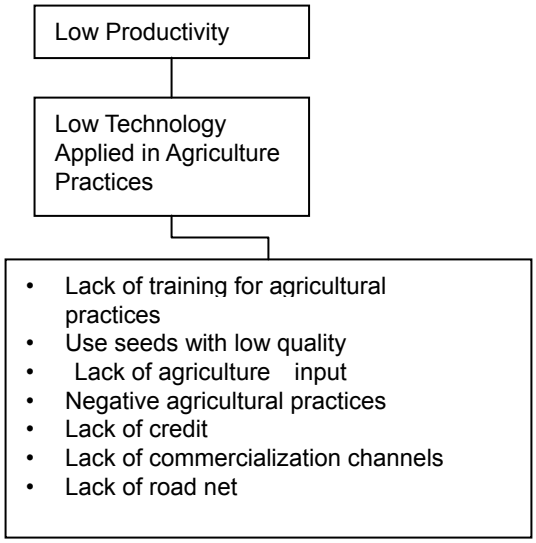
To this factor it should be added the situation of farmers who do not have access to the use of improved irrigation techniques with a better level of water management, so water reaches the lots timely in enough quantity so that the resource can be rightly administrated..

3) Low Productivity

At the identified regions there is land proper for farming and most of it is used for farming. They have low natural fertility or cultivable depth is too superficial with strong slopes, that when associated to the lack of rain during April to October, makes this resource neither intensively nor properly used.

During the dry season, most of the agricultural land at the 9 Departments are not cultivated, due to the lack of rain and irrigation infrastructure to conduct the water resource and to make possible a more production in a second crop.

The improper agriculture practices cause loss of nutrients of the soil by superficial water dragging due to the slope and decrease of vegetation protection caused by bad agriculture practices like burning pasture and mono-cultivation, among others. The indirect causes of the limited use of agriculture surface are the following:



(3) Effects of the problem

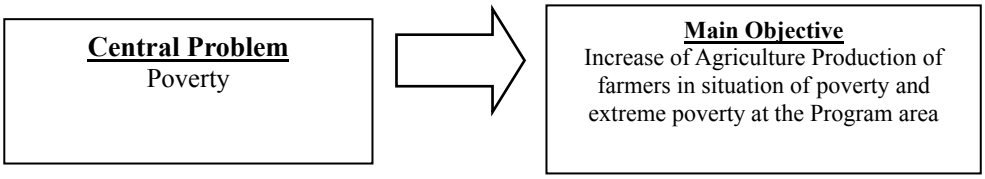
The effects can be summarized as follows

High incidence of poverty	▪ As there is no access to irrigation, income is low and there is not enough food for self-consumption. As consequence, the districts of the Program area show very high poverty figures, being in average 67.3% of poverty incidence and 34.6% of extreme poverty
Low income	▪ The average per capita expenses (2007) was S/.257.9. (Lima/San Isidro: S/.954.8)
Lack of food	▪ With difficulty of production for lack of water, it is estimated that farmers without irrigation produce only between 1.27 Kg/day to 1.84 kg/day by agriculture unit (for 2.57 persons).
Low productivity	▪ Productivity is low, especially producers without access to irrigation systems
Lack of water resources	▪ Only 25% of producers have access to irrigation system. As the average area is 0.17 ha, the importance of water for agriculture is vital.
Heavy labor and watershed erosion	▪ As the lot is insufficient to produce food, farmers are occupying marginal land with strong slopes. As consequence, labor is harder. Besides, pressure for more land determines deforestation of the medium and high part of the watershed, increasingly being used for animal breeding.

2.7 Objective of the Program

Based on the cause and effect tree, a tree of means and ends was constructed to show the positive situation that would be produced when the causes that motivate the main problem are solved.

Central objective

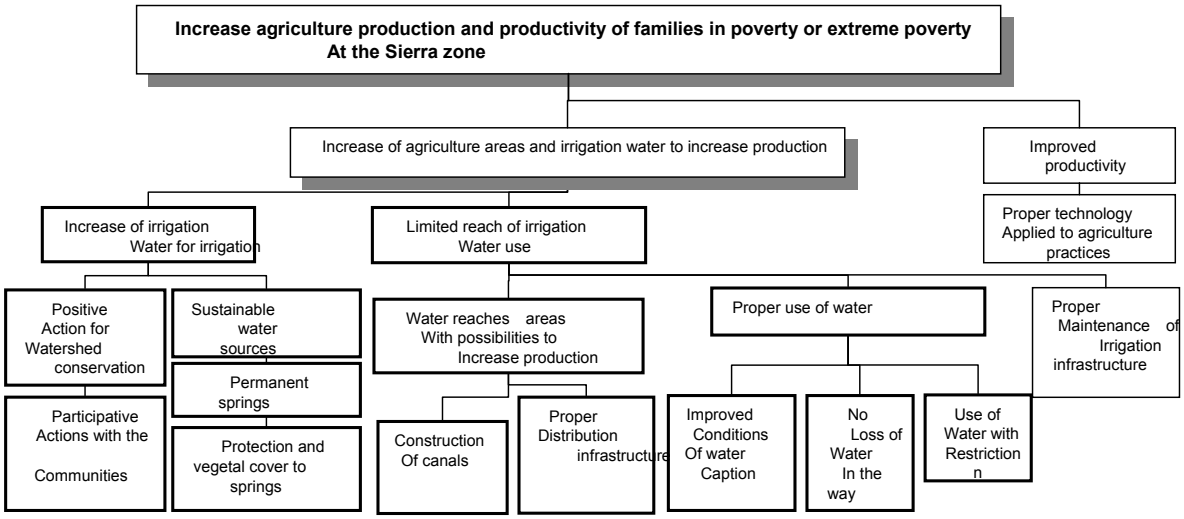


The objective of the Program is to "Increase the Agricultural Production of the rural families in areas of poverty"

This Objectives will be achieved through the availability, conservation and appropriate use of the water resources to maintain and to increase of the agricultural production of 38,732 ha, benefiting to 24,849 families located in the les development area, implementing irrigation infrastructure, technical irrigation and the managements of the water resources in the micro watershed.

2.7.1 Means to attain the Central Objectives:

order to obtain the solution, the causes that originated it have been replaced by an opposite fact that contributes to solve them, taking into consideration the ones of great importance to be considered and to solve the problem. The fundamental and first level means are shown as follows:



Since the land for agriculture use are limited, especially for farmers at the Program area, the only alternative to increase production would be to increase productivity. It can be achieved through the increase in the number of harvests. The measures for that will be:

1 Overcome the situation of deficient irrigation water increasing new areas and maintain agriculture sustainability. It could be achieved through actions of watershed conservation.

2 Increase the reach of irrigation area to increase harvest production. Since water resources are limited, it is necessary to save water resources that are being wasted.

3 Improve land productivity

1) Improve the situation of water shortage

The solution for the problem of lack of water is a long awaited farmers' wish. According to the Cajamarca Regional Government SIG data, agriculture cultivation area is 592,797 ha, being 197,206 ha used for transitory crops. In the case of the Department of Cajamarca, there are 16.7ha of land for each (1) hectare of cultivation. Also, annual average rainfall is 600 mm/year. It is estimated that water resources are sufficient. In the following table, the land use in the Department of Cajamarca is shown.

Table 2.7-1 Land Use in the Department of Cajamarca

Description	Area_(ha)	Percentage
Water bodies	1,804	0.05%
Permanent crops and bush vegetation	92,645	2.81%
Mixture of crops, pasture and bush vegetation	320,015	9.72%
Agriculture crops	592,797	18.00%
Pasture	560,791	17.03%
Forrest Plantation	17,945	0.54%
Woods	938,186	28.49%
Rocky upwelling	697,130	21.17%
Degraded land, poor vegetation and rocky upwelling	71,367	2.17%
	3,292,679	100.00%
Note; Areas of transitory crop (INEI data)	197,206	
Harvest Area (MINAG data)	319,762	

Source; Surface data calculated by Cajamarca government SIG

Since rainfall is concentrated during the months of November to April, storage of water resources in the high parts of the watershed would be a solution. However, to achieve this, problems indicated in the previous section would have to be solved. The problem, in this case, is the inexistence of enough information to define the proper actions.

2) Increase the reach of irrigation area

There are two ways to increase the irrigation area: a) Saving the use of water since most of the existing irrigation systems are conventional and improper, originating significant loss of water, b) Introduction of appropriate retaining and water conservation practice in the high/medium parts of the micro watershed.

(a) Through Water saving

The efficiency in water conveyance can increase by the main canal lining, in an average of 85% an in small canals up to 95% can be achieved. In canals without lining efficiencies are low to very low from 20 to 70% depending on the type of soil that is linked to filtration and evaporation process, canal length, vegetation, leaks, conducted flow, slope, etc. In evaluations made at ChancayValley in Huaral by the Project for Evaluation of Water Sources, the following efficiencies were found:

Description	Uncoated	Coated
Range	20 a 70%	85 a 95%
Average	45%	90%

Under irrigation by gravity or surface, the efficiency of application varies, depending on the zone; for the Irrigation Users Board of Jesús del Valle the evaluations made showed values among 30 and 45% , while efficiencies in irrigation by sprinklers in the Irrigation Users Board La Esperanza have records that vary between 72 and 75%. (Source: Project Evaluation of Water Resources Chancay Huaral, GP)

It is estimated that with the structural change, water resources could be saved, making it possible to increase the irrigation area.

Description	Expansion
Change to lined canal structure	1.1 times
Introduction of Technical Irrigation	1.6 times

(b) Exploitation of new water resources

It is considered that the easiest water resources to attain are in the existing irrigation systems. However, there is also space to explore new water resources during the rainy period. Such could be:

a) Storage at the high part of the watersheds

b) Construction of intakes with availability of water resources

3) Increase productivity

In the following table the average productivity of the main products at the 10 are indicated.

Table 2.7-2 Average Productivity of Main Products (2007) kg/ha

PRODUCT	AMAZONAS	ANCASH	AYACUCHO	CAJAMARCA	HUANCAVELICA	HUANUCO	JUNIN	LA LIBERTAD	PIURA	Promedio
BARLEY –GRAIN	1,087	1,033	897	881	1,222	1,310	1,411	1,528	815	1,172
YELLOW MAIZE	2,040	5,069	1,754	3,302	1,275	2,722	2,534	7,980	3,686	3,160
POTATO	14,705	10,453	13,304	10,869	9,340	13,507	14,153	14,341	11,546	12,239
WHEAT	1,030	1,032	1,048	944	1,185	1,192	1,439	1,599	818	1,166

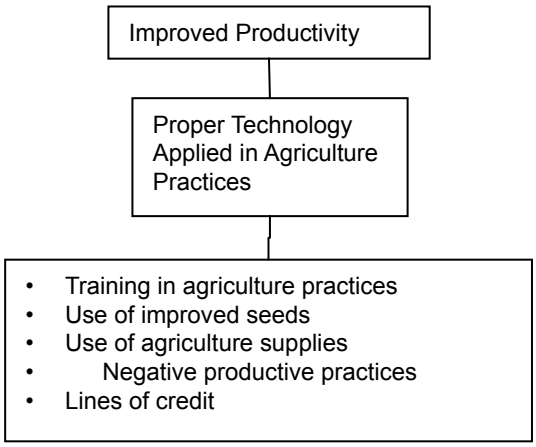
The figures in the previous table show a low productivity. In the following table, the productivity in others countries is shown (France and United States), indicating the average of the Program's nine departments production by farmers at the Program area.

Table2.7-3 Comparison of Productivity for the Main Products (2007) Kg/ha

Product	USA	France	Peru	Average Program's Departments	Comparison France/10 Departments	Farmers
Potato	38,714	43,248	12,574	12,239	28.3%	5,500 – 7,500
Wheat	2,597	6,250	1,255	1,166	18.7%	300 – 600
Maize	9,482	8,850	2,830	3,160	35.7%	300 – 1,800

http://faostat.fao.org/site/567/default.aspx#ancor

In order to increase productivity besides the good management of water resources, the following actions are required:



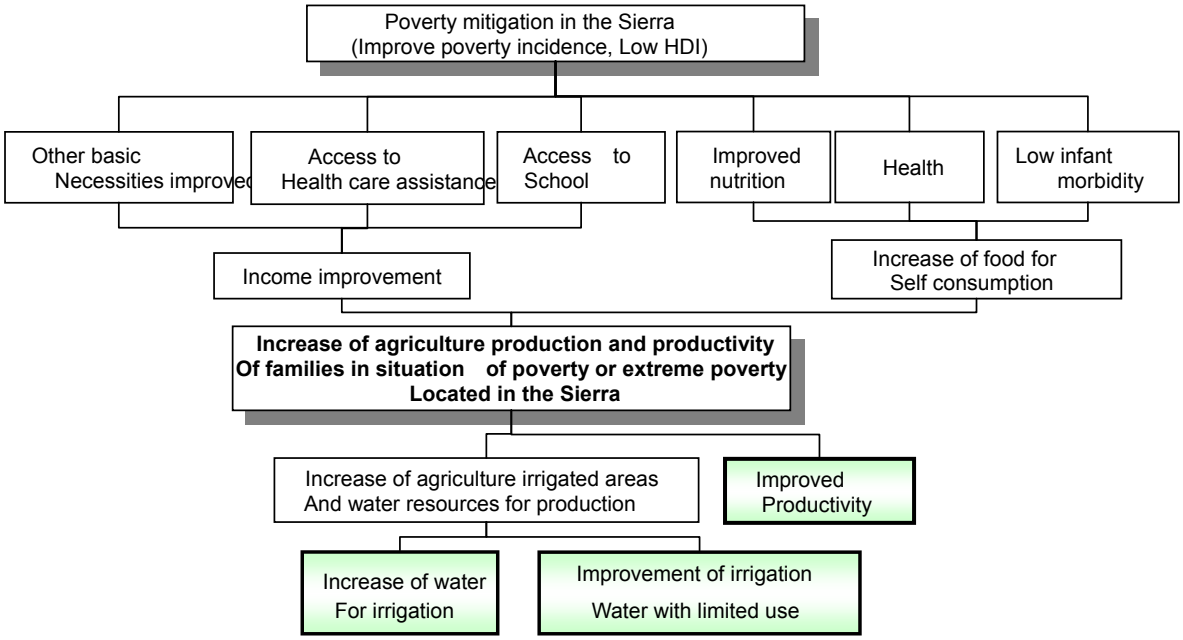
2.7.2 Analysis of Fundamental Means

(1) Analysis of first and medium level means

The fundamental means constitute a set of concrete actions oriented to deal with the causes of the problem and its definition comes from the systematic replacement of causes by activities that allow the solutions.

Like the procedures of analysis of causes, the first level direct effects are identified, as well as the final effects that are detailed as follows:

Low agriculture production and productivity is consequence of lack of water, that in turn influence the existence of agriculture land not exploited that contributes to the socio economic delay of farmers at the zones concerned in the Program. The idea is to generate as final effect the “Poverty Mitigation in the Sierra”, resulting from an increase of agriculture production of families in poverty and extreme poverty at the Program area through the incorporation of actions to increase water for irrigation, improvement of the reach of irrigation water use to increase productivity.- The following diagram shows the flow.



As first level means to increase agriculture production there are five (5) alternatives as indicated in the following diagram:

a) For watershed conservation

b) For incorporation of irrigation at unirrigated areas

c) For the improvement of existing irrigation systems

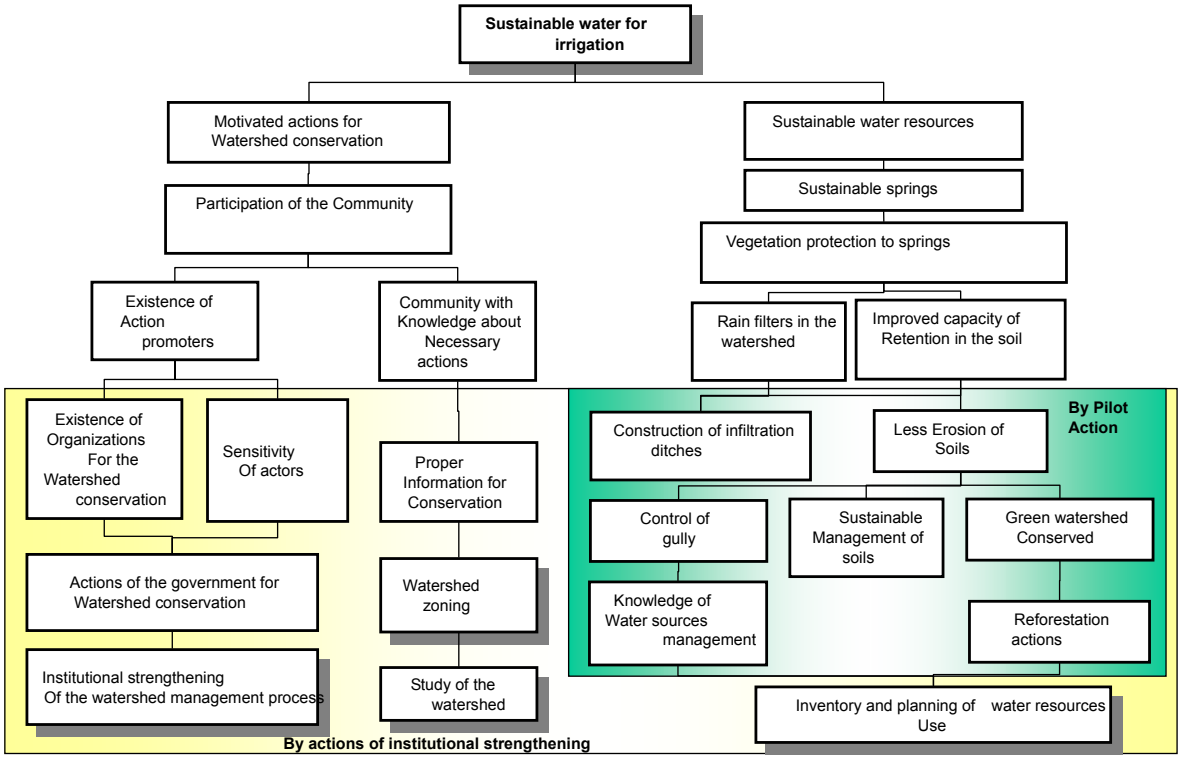
d) For the introduction of technical irrigation

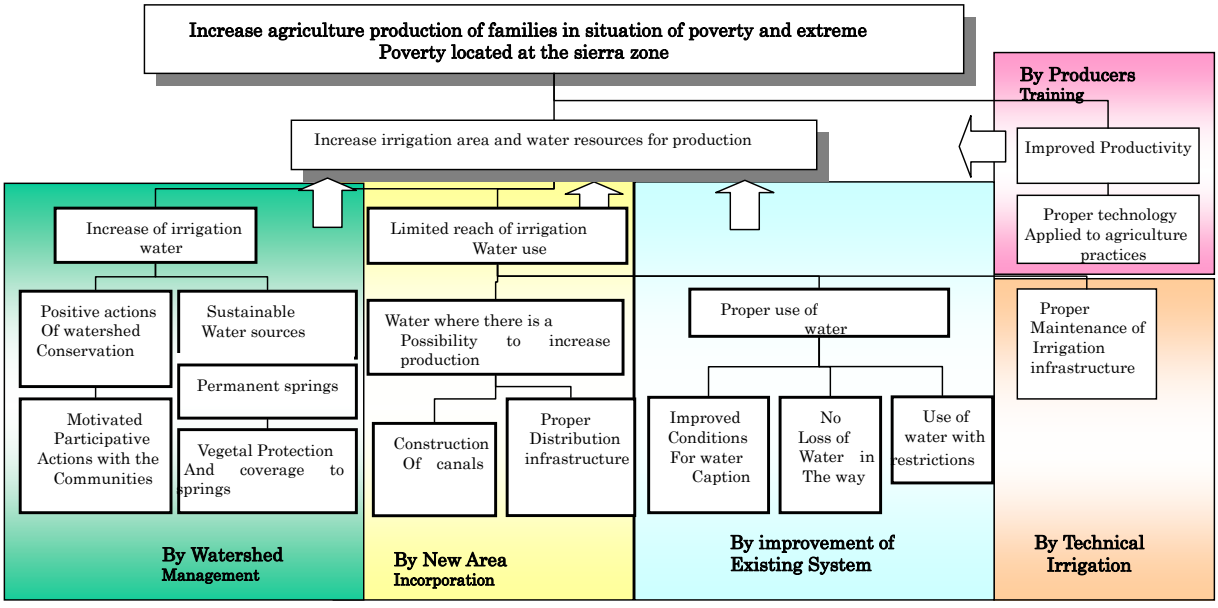
e) For training of producers in cultivation technology

(2) Fundamental means and actions

1) For the water resources conservation at micro watershed

For farmers, water resources conservation at high/middle micro watershed where the water fountain is born for irrigation is more and more important for the production of its foods. Conservation activities however, are not usual for many reasons. The reason for this situation could be the lack of budget and programs and actions necessary for watershed conservation. Many institutions, including regional governments are conducting agro-economic zoning at department level. However, it is not possible to motivate or trigger actions from the communities by lack of detailed information and detailed plans and programs. The following diagram shows the summary of the means and actions tree.





Conservation action is a long term process that sensitizes and motivate communities to participate in the watershed conservation activities: reforestation, agriculture management, actions against erosion, etc. Institutional/Organizational strengthening indicating the necessary actions for watershed conservation has a fundamental role. This fundamental activity would be the preparation of conservation plans and actions consented in the integral form by the management comitte of the micro

watershed.

When plans are consented with initiatives of the local communities, actions have continuity or sustainability. In order to structure a consented plan with the community, a pilot project has in important role because it incorporates control actions of erosion, reforestation, spring protection, etc... With the project pilots, communities will be able to identify critical problems and future benefits sensitizing the community to take positive measures and actions. The following contents are proposed

1. Study for watershed management at Micro watershed
2. Promotion of the watershed management committee
3. Management and preservation plan of water resources at micro watershed

These actions will be directed to solve the following problems;

Organization and articulation of the institutional system for water management at Micro watershed

a) This cause is associated to a reality where the direct actors in charge of water management at micro basins are not properly organized or do not count on with management tools. Also it is considered that all actors of the micro basin are unaware of the water deficiency problem because many entities of the organized civil population do not have natural resources as their scope or concern, and do not assume the true impact that means the decrease of water at the main aquifers

b) This problem is accentuated with the ignorance about the legislation in force concerning water sources and watershed protection. There is not a consensus or an organization to apply the law, in some zones aquifers are destroyed or deteriorated by other activities such as agriculture, mining, forestry, among others

Loss of resources in the water collector of the watershed

a) This cause occurs due to the reduction of natural accumulators of rain water and infiltration process, that are connected with the vegetation the organic contents of soils because in time, said resources have been gradually disappearing both by anthropic and natural actions, so aquifers are loosing the water level because the demand for this resource increases due to the demographic and/or productive growth, requiring more quantity of water resources for other uses.

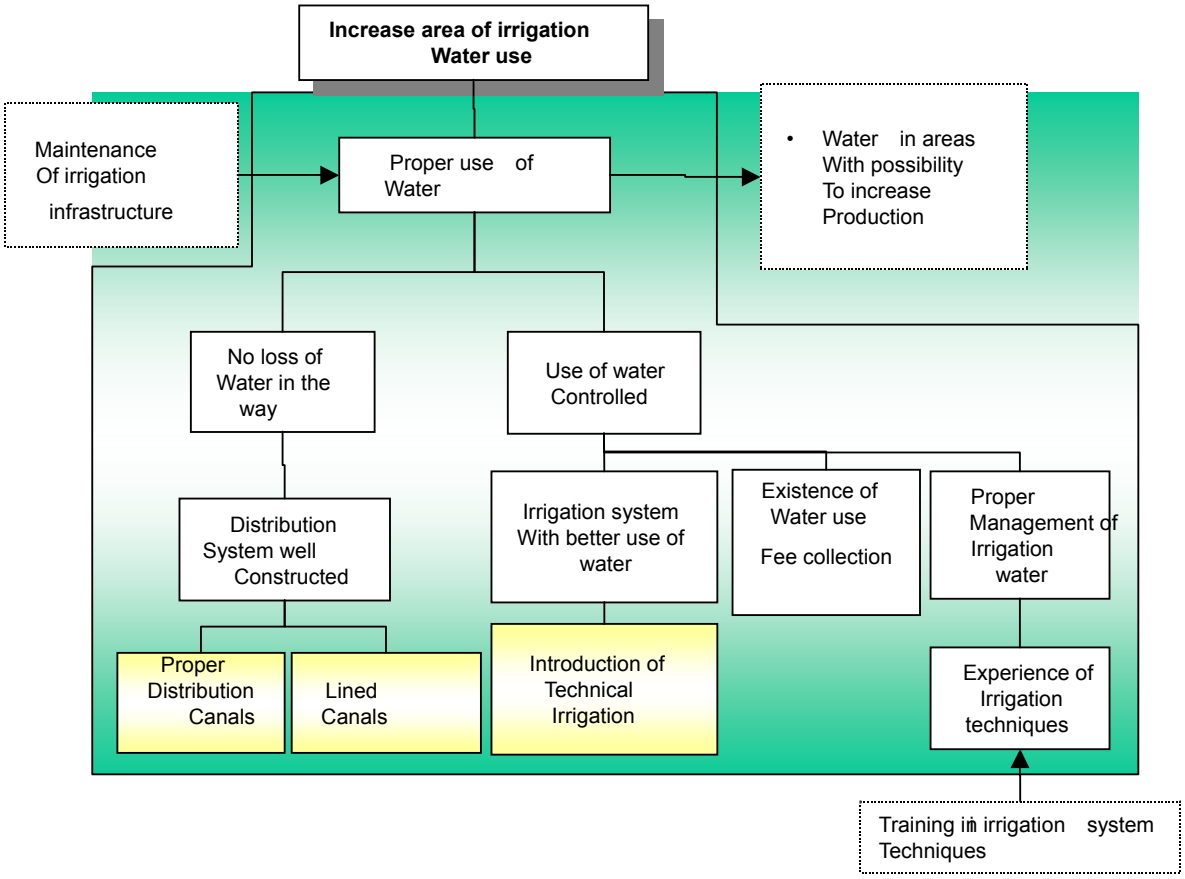
Bad prioritization of projects does not take territory into account

a) In the present participatory processes, it is proposed that projects or works to be executed be prioritized with the participation of the population. In this context, it has been observed that many of these processes do not take into account the integrality of the territory, and the adverse environmental processes. The population is unaware of the territory potentialities and their articulation to strengthen the development units. In most micro basins maps of natural resources, commercial articulation and the social flow inside the micro basin are unknown or inexistent. To this unawareness of territory potentialities, the weak collective capacity to plan actions and activities to achieve the integral development of the territory is added.

b) On the same way activities are conducted without an environmental support to back up the territory operation. Many times activities using natural resources without a program to recompose them are conducted, leaving the natural fauna and flora unprotected.

2) Improvement of existing systems

As indicated in the previous sections, the economy of use of water can benefit new irrigation areas. Most of the existing systems are traditional with great loss of water. It is estimated that with the improvement of the canal conveyance efficiency, approximately twice the existing irrigation area could be benefited. The following table shows as summary the tree of means and actions.



The effects of canals with lining and proper distribution canals have a great impact in saving water resources. This activity makes it possible to increase the irrigation areas to previously rain-fed land.

Besides this physical change, it is necessary to sensitize producers to save the use of water. Presently, the applied irrigation method is pounding irrigation, without restriction of water, causing the waste of water resources. In the long term, these actions will be much more important, due to unbalance between demand and supply of water resources. As actions to save water resources the following activities are proposed

1 Improvement of the irrigation system (Canal lining, proper distribution canal, etc.)

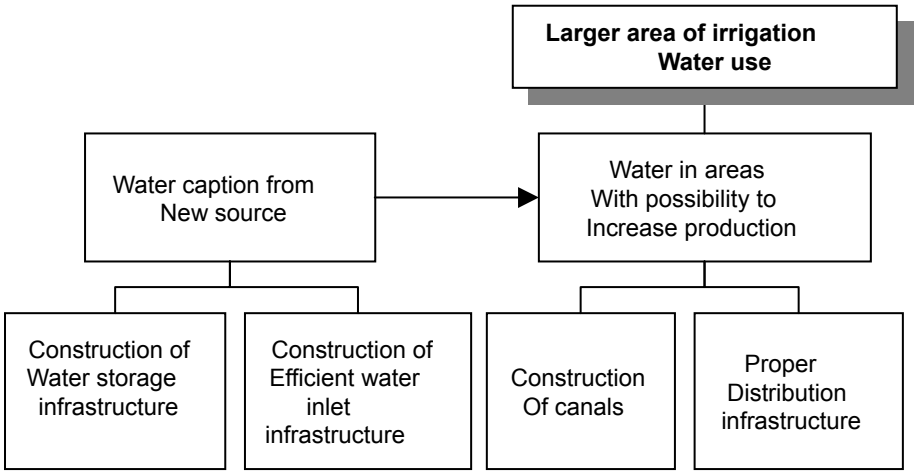
2 Introduction to technical irrigation

3 Training on irrigation system management

4 Irrigation system maintenance

3) Incorporation of irrigation at rain-fed land

The following table shows as a summary the tree of means and actions to incorporate irrigation at new rain-fed land.



Proposed actions are the following:

1. Construction of water storage infrastructure
2. Construction of water inlet infrastructure
3. Construction of new canals to incorporate new areas

4) Training of farmers in cultivation techniques

There are strategies to increase productivity of farmers: strengthening of technical assistance, credit, fertilizer application, among others. However, given the heterogeneity of the agricultural and rural zones at the Andes, these activities will vary and require specificity according to the place where the agriculture activities are developed. For that, specific studies for each region are required.

CHAPTER 3
FORMULATIOIN AND EVALUATION OF THE PROGRAM

Chapter 3 FORMULATION AND EVALUATION OF THE PROGRAM

3.1 Analysis of Demand

3.1.1 Basis for the Program Formulation

(1) Basis for the Program Formulation

In the previous Chapter, in order to achieve the Main Objective "Increase Agricultural Production of Families in Situation of Poverty with less socioeconomic development in the scope of the Program", the following measures and actions to increase production of farmers were proposed.

Basic measures	Actions
Improvement and construction of irrigation system	▪ Improvement of the irrigation system (Canal lining, etc.) ▪ Construction of dams and canals ▪ Construction of structure for water caption ▪ Construction of canals for incorporation of new areas ▪ Training in operation and maintenance management of irrigation systems ▪ Formation of Irrigation Committee ▪ Environmental Management
Technical irrigation installation	▪ Construction and installation of technical irrigation modules by sprinkler ▪ Training in irrigation systems operation and maintenance management ▪ Formation of Technical Irrigation Committee ▪ Environmental Management
Organizational reinforcement of water resources management for watershed conservation	▪ Studies of characterization for the micro-watershed management ▪ Formation of the Micro watershed management committees ▪ Development of Micro-watershed Management plans for water source conservation

Low agricultural production and productivity is consequence of lack of water, that in turns influence the existence of unexploited agricultural land; this contributes to the socioeconomic backwardness of the producers at the Program area. Through the previously pointed out measures and actions, the Program seeks to achieve the final effect of **"Poverty Mitigation in the Sierra"**, resulting from the increase of agricultural production for families in situation of poverty and extreme poverty in the scope of the Program, through the incorporation of actions to increase irrigation water, improve the use of irrigation water and improve productivity.

In this section, the possible measures and action to formulate the Program will be analyzed. Firstly, the contents of the existing demand will be analyzed; this will be contrasted with the existing supply, obtaining in this way, a balance where the Program will be positioned.

The same method, but with greater detail is developed in the examination of the demand and supply for the main components of the Program that are:

- Component A; Irrigation infrastructure.
- Component B; Technical irrigation.
- Component C; Institutional strengthening for the water resources management at Micro watershed.

A description of the contents of each component of the Program is presented is as follows:

1) Component A: Irrigation Infrastructure

This component is oriented to develop the activities of the program dedicated to maintain and increase the agricultural production for 38,732 ha, through the implementation of irrigation Infrastructure (Improvement and Construction of irrigation Systems: reservoir+canal, and channels) in the project area at 9 departments, among which 56 districts have been initially considered. It should be mentioned that there are other districts that fulfill the selection criteria such as: projects with more than 100 ha to be irrigated, located at less socioeconomically developed areas, expecting to be considered in the implementation. Also, it should be indicated that in areas where another program of the Agriculture Sector is being implemented, the same selection criteria of the sector will be considered in the present program, allowing beneficiaries to choose the program they want to participate, justifying it through the submittal of a document to the institution of the program.

2) Component B: Technical Irrigation

This component has the purpose of maintain under technical irrigation 1,120 ha distributed in the micro-watersheds and sub-projects of component A (Irrigation infrastructure), with the purpose of providing a proper and efficient use of water resource in the agriculture production; for that the implementation of technical irrigation has been considered for organized farmers who fulfill the selection criteria to be benefited with the technical irrigation project.

Initially, it is proposed the installation of irrigation system with sprinklers in an area of 20 ha for each subproject of Component A, which already considers the main canal; so water should be withdrawn only from lateral intakes for the implementation of technical irrigation.

3) Component C: Institutional Strengthening for Watershed Management

This component of the program has the purpose of strengthening social organizations for the effective action in the proper use and conservation of water resources at the micro-watershed, through the formation of Micro-watershed Management Committees, the same to be implemented according to the scope of components A and B. The Committee is important in order to have an active organization, to plan water resources in accordance to the capacity of agriculture production and conservation of the resource, having as objective the sustainability of the program. This Micro-watershed Management Committee is to be represented by the local authorities of the micro-watershed, users committee, farmers' communities and producers of the lower part. At the middle and upper parts of the micro-watershed the objective is awareness raising referred to the use of water without waste and contamination, as well as the conservation through natural recharge with activities of reforestation, pasture, filtration ditches to be sustained based on the contribution of water users, through daily work, and/or labor for the maintenance of such covers. Also, the collection of hydro-meteorological information data by the Micro-watershed Management Committee is been considered to verify the increase of water in the micro-watershed, measurement of rain and also activities' planning.

3.1.2 Irrigation Infrastructure (Component A)

(1) Improvement of Irrigation Systems

According to the Agricultural National Census Peru III (1994), in the Sierra region of the 9 Departments, there are approximately 444,000 ha, equivalent to 27 % of the cultivated land. Concerning Irrigation systems, the number of irrigation infrastructures identified for each Department is shown in the following table:

Table 3.1-1 Number of Irrigation Infrastructures Identified by Department

	Department	Population	Nº of Identified Irrigation Infrastructure
1	AMAZONAS	389,700	191
2	ANCASH	1,039,415	1,054
3	AYACUCHO	619,338	886
4	CAJAMARCA	1,359,023	825
5	HUANCAVELICA	447,054	918
6	HUANUCO	730,871	299
7	JUNIN	1,144,603	226
8	LA LIBERTAD	1,423,090	688
9	PIURA	1,630,772	860
TOTAL		**8,783,866**	**5,947**

Source: MINAG DGIH /PERPEC

In the 9 Departments there are approximately 5,900 irrigation systems. However, most of them are deteriorated due to lack of maintenance and in many cases it is not possible to convey water to the beneficiaries. Following, a sample of the bad condition of the irrigation canals;

Canal destroyed by the effect of rocky sliding in the structure.

Santa Ana-Piura

Obstructed irrigation canal, without capacity of water conveyance. The canal is unnoticed because it is closed by a lateral landslide Chantaco-Piura

The demand for works of Irrigation systems improvement is very high for most of the Irrigation systems are old and the infrastructure such as inlets, conveyance canals and culverts are deteriorated due to actions of nature and lack of maintenance making it difficult to distribute water; thus, there is a great loss of water resources. Besides, farming communities demand of irrigation water to increase production is high. It is estimated that around 90 % of the existing canals have no lining.

(2) Incorporation of Irrigation at Rain fed Agriculture area

Population at the Program Area is mostly classified as in poverty or extreme poverty. The majority of farmers survive farming in small lots that do not produce enough for self consumption. They require increasing the cultivated area and the solution is the introduction of irrigation that allows cultivation during dry seasons.

Producers at the Program area survive in a very rigid and narrow environment of resources and external conditions because job opportunities are very limited. Their logic is to minimize risks and costs to assure immediate subsistence. They cannot risk other options of crops nor distract their reduced resources, investing in the conservation of their means of survival. Their survival depends on their work, on what they produce and can extract from their lots at minimum costs in the short term. The irrigation system is a very important economic capital good for producers. The results of the survey conducted by the Program are shown in the following table.

Table 3.1-2 Producers' Income in the Program Area (Unit; S./ month)

	Acocro District Ayacucho	Tumbadem District Cajamarca	Sondor District Piura
Agriculture			
Production of Main Crops	617.3	82.2	183.2
Elaboration of Products or Sub-products	0.1	0.3	0.0

Forestry Products	1.0	5.5	0.1
Livestock			
Cattle trade and others	11.8	133.8	55.0
Dairy Production	4.7	222.3	84.1
Trade of Elaborated Products or Sub-products	26.5	2.6	0.4
Others			
Remittance	63.3	47.0	47.8
Other income	211.8	59.9	57.0
Expenses			
Agriculture Activities	535.4	23.2	35.1
Livestock Activities	8.2	37.9	45.0
Net Income by Household	392.9	492.4	347.5
Net Income per Capita	106.7	143.0	101.4

Source: Survey, Study Team

It should be noted that Acocro District is an agrarian zone, Tumbadem District is a animal husbandry zone and in Sondor District both activities are developed.

In the case of Acocro District, most of the income derives from other income differ from the activities in the land. Usually production is exclusively for self-consumption. The results of the Socio Economic Survey at the Program Area are shown in the following table:

Table 3.1-3 Agriculture Production per Household

CROPS	Acocro District, Ayacucho		Tumbadem District, Cajamarca		Sondor District, Piura	
	Harvested Area (ha)	Production (kg)	Harvested Area (ha)	Harvested Area (ha)	Production (kg)	Harvested Area (ha)
FISALIS	0.00	0	0.02	4	0.00	0
PEA	0.05	75	0.22	140	0.20	374
BARLEY	0.32	510	0.05	12	0.00	0
RED PEPPER	0.00	0	0.09	17	0.00	0
SUGAR CANE	0.00	0	0.00	0	0.10	25
BEANS	0.00	0	0.13	39	0.02	6
BROAD BEANS	0.08	118	0.00	1	0.01	7
LENTIL	0.00	0	0.01	2	0.00	0
MAD	0.00	0	0.22	373	0.00	0
AMILLACEOUS MAIZE	0.08	102	0.19	81	0.74	425
MASHUA	0.00	15	0.00	0	0.00	0
MANGO	0.00	0	0.01	2	0.00	0
OCA	0.01	55	0.00	0	0.00	0
OLLUCO	0.00	19	0.00	0	0.00	0
POTATO	1.42	12,991	0.05	78	0.14	352
BANANA	0.00	0	0.01	6	0.00	0
QUINUA	0.32	405	0.00	0	0.00	0
WHEAT	0.29	444	0.19	67	0.12	89
MANIOC	0.00	0	0.00	0	0.12	98
By producer	2.57	14,734	1.19	821	1.45	1,375

Source: Survey, Study Team

Rural Producers have in average a cultivated area from 1 to 3 hectares. However, household production is very low, excepting Acocro District. Usually, farmers produce approximately one ton of food per year. This quantity would be equivalent to the household consumption. It should be stressed that earnings is very low.

Table 3.1-4 Total area and average area of farm lots (ha)

	Surveyed Producers	Total Area (ha)	Average Area of Property (ha)
Acocro District, Ayacucho	66	244	3.70
Tumbadem District, Cajamarca	192	909.8	4.74
Sondor District, Piura	42	125	2.98

Source: Survey, Study Team

These data show that frequently areas are not cultivated because there farmers do not have access to credit and lack of water, conditioned by wasted irrigation with low efficiency. It is estimated that traditional irrigation method efficiency by gravity is 30%, so it can be figured out that the cultivated area could increase three times only by investing in infrastructure, organization and management of the irrigation districts. This is the basic of this component to save water resources and expand the

extension of water.

For these reasons, access to the Irrigation system is a long ancestral dream for Andean farmers. However, at Andes area, water resources easy to irrigate are already exhausted, existing only water resources which are difficult to access and highs costs to make them available. The results of the survey conducted to estimate the producers demand are shown; in it, the interest of producers in the issue of water is shown in the following table.

Table 3.1-5 Main Problems in Relation to Water (%)

PROBLEMS	Acocro District Ayacucho	Tumbadme District Cajamarca	Sondor District Piura	Condebamba District Cajamarca	San Luis District Ancash
Lack of infrastructure	39.1	66.7	87.5	36.6	87.5
Irrigation Infrastructure without maintenance	1.5	23.1	10.4	20.0	10.4
Inefficient water distribution in quantity and opportunity	24.1	5.5	2.1	24.8	2.1
Conflicts and Disagreements	35.3	4.7	0.0	18.6	00
TOTAL	100.0	100	100.0	100	100

Source: Survey, Study Team

The table shows the high interest of farmers in irrigation infrastructure. Moreover, such as the Tintaycocha Project that has not enough water resources show problems of conflicts in the use of water. The following table shows the interest of producers in the execution of new projects and improvement of Infrastructure.

Disposition to Participate in the Execution of New Project and Improvement of Infrastructure

	Tintaycocha	Rejo	Huayo	Chantaco	Sol Naciente
No	2%	5%	0%	0%	0%
Yes	98%	95%	100%	100%	100%
Total	100%	100%	100%	100%	100%

Source: Survey, Study Team

3) Water Resources

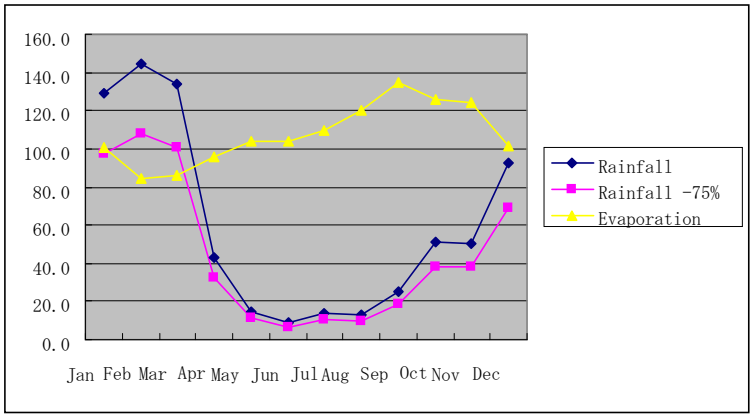
1) General Aspects

Peru, a privileged country by water supply, has an yearly average volume of 2,46,287 m^3 of water, being one of the 20 richest countries in water, with 72,510 m^3 / inhabitant/year; however, the orography defines three hydrographic drainage basins with imbalanced distribution, concentrating 97.7% of the volume at the Atlantic basin, where 30% of the population are located, producing 17.6% of the GNP, the 0.5% are located at the Titicaca basin, that have 5% of the population, producing 2% of the GNP and remaining 1.8% are located at the Pacific basin, where paradoxically, 65% of the population are concentrated, producing 80.4% of the GNP.

This unequal distribution of water and seasonal variation determine significant differences in the availability of the resource; extreme aridity in the south Pacific drainage basin, moderate stress at the north Pacific and abundant at the Atlantic drainage basin. It determines that the Pacific drainage basin has to face great limitations in the availability of water, generating more conflicts related to access to water, being more frequent as the demands of the productive sector increase. Moreover, the waste of water resources as well as water pollution caused by human activities could be added, to finally produce the exhaustion of the resource.

In the said context, it is fundamental to incorporate the social dimension to the problem, highlighting the need of a renewed and efficient management of water resources, affecting in the right knowledge of the hydrological cycle and its evaluation, to assure the maximum efficiency in the decision making process.

Among the factors affecting low productivity in agriculture production and related to rural poverty, shortage of irrigation water can be named, for sources are in the point of exhaustion, already committed or too far, requiring works of catchment, improvement and derivation that in many cases exceed the maximum limits of investments fixed by MEF.



On the other hand, besides the water shortage for cultivation in the area, the said situation is even more complicated due to the lack and/or insufficient irrigation infrastructure, low technological levels, ineffective water management, lack of organization, as well as minimum investments by public and private entities.

In the Program area located at the Andean Sierra, water resources are required during the well defined dry season. Rain is mainly concentrated during the months from December to April. Average yearly rainfall is approximately 700 mm.

The figure shows the relation between rainfall and evaporation at the influence area of the Cachi Project Cachi, in the Province of Huamanga, Department of Ayacucho.

Water deficit between the months of April to December is shown in the case of the Cachi Project. In this situation, there is an annual shortage of 790 mm, almost equivalent to the annual rainfall. It means that in order to develop crops during the months from April to December at the Sierra, it is necessary to look for water resources. The relation between rainfall and evaporation in the Cachi Project, Huamanga, Ayacucho is shown in the following table.

Table 3.1-6 Relation between Rainfall and Evaporation (Cachi Project, Huamanga, Ayacucho)

(unit; mm/month)

		1	2	3	4	5	6	7	8	9	10	11	12	Total
Rainfall	(a)	129.4	144.3	133.9	43.3	15.0	8.9	13.6	12.8	25.1	51.1	50.5	92.5	720.4
Rainfall-75%	(b)	97.1	108.2	100.5	32.5	11.2	6.7	10.2	9.6	18.8	38.3	37.9	69.4	540.3
Evaporation	(c)	100.4	84.4	86.4	95.5	103.9	104.1	109.9	120.5	135.2	126.2	124.7	101.4	1,292.4
Balance	(b)-(c)	-3.3			-63.1	-92.7	-97.4	-99.7	-110.8	-116.3	-87.8	-86.8	-32.0	-790.0

In terms of water resources, the month of September is critical. To incorporate new irrigation areas it is necessary to look for addional sources to avoid the loss of crops. It is estimated that the approximated volume of water resources required in the case of the Cachi Project would be 790 mm per year. It should be mentioned that said figure changes according to the regional characteristics. The said figure also varies according to the conditions of water conveyance infrastructure at the irrigation area.

2) Infrastructure Conditions

As pointed out about the irrigation systems conditions in the previous section, requirement of water resources depends on the infrastructure conditions. The following table shows the efficiencies in the Cachi Project. Water resources required by it, according to the conditions of the canal are estimated as follows:

Table 3.1-7 Irrigation Efficiency under Different Conditions

Item	Improper maintenance conditions	Present Condition	Condition with canal improvement
Conveyance efficiency	0.40	0.87	0.95
Distribution efficiency	0.50	0.55	0.77

Application efficiency	0.40	0.42	0.55
Irrigation efficiency (%)	0.08	0.20	0.40
Annual net demand for water resources (mm)	790	790	790
Annual gross requirement of water resources (mm)	9,875	3,950	1,975
Water requirement in relation to canal in improved conditions	5 times	2 times	-

Source: Survey, Study Team

As shown in the previous table, water resources requirements are in function of the irrigation efficiencies. Bad conditions of canals determine larger quantity of water resources. In order to attend a larger irrigation area, it is necessary to improve the conditions of the canals, distribution system and type of irrigation.

3) Water Demand Calculation

Irrigation water requirement has been calculated for each of the 9 Departments of the program, considering the cases with and without project (irrigation by gravity). The Hargreaves method has been used for the demand analysis, due to the availability of meteorological (temperature, relative humidity and rainfall), and agronomic (crops, vegetative period, area and Kc) information.

(a) Meteorological Information

The monthly average temperature (T°C), monthly effective rainfall (mm) at 75% (effective monthly average total rainfall was calculated with CROPWAT) and relative humidity (%) were employed, the said data were obtained from the representative stations of each Department and/or the closest to the project zones, by AGURORURAL.

The values of the monthly potential evapo-transpiration were determined with the said variables.

Table 3.1-8 Monthly potential evapo-transpiration (mm/month)

DEPT	Jan	Feb.	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Amazonas	112.8	103.0	107.3	96.0	104.5	99.0	105.4	113.8	114.6	118.7	121.5	116.3
Cajamarca	100.8	90.4	97.3	93.9	98.9	125.7	138.0	140.1	126.6	117.5	109.5	106.6
Piura	102.3	100.0	107.6	102.0	99.8	94.8	92.7	112.2	111.9	118.1	114.0	116.6
La Libertad	106.6	93.2	105.1	97.8	89.9	83.1	89.6	100.4	108.0	110.4	111.3	111.6
Ancash	106.6	93.2	105.1	97.8	89.9	83.1	89.6	100.4	108.0	110.4	111.3	111.6
Huánuco	123.4	103.3	113.8	106.5	106.0	97.8	103.2	113.5	120.9	127.1	127.2	128.0
Junín	103.5	93.0	94.9	86.1	79.1	72.3	93.3	103.2	111.9	123.7	120.6	110.1
Huancavelica	103.5	93.0	94.9	86.1	79.1	72.3	93.3	103.2	111.9	123.7	120.6	110.1
Ayacucho	134.9	115.9	113.5	111.3	105.7	96.0	100.1	118.7	130.8	146.0	152.7	142.9

Source: FAO, CLIMWAT 2.0

Table 3.1-9 Monthly effective rainfall (mm) at 75%

DEPT	Jan	Feb.	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Amazonas	66.8	79.9	100.0	68.3	40.0	20.3	18.4	20.3	50.2	72.7	66.8	63.7
Cajamarca	76.3	82.6	88.0	72.0	36.6	8.9	5.0	9.8	36.6	79.2	74.9	67.5
Piura	43.5	57.4	72.7	49.3	25.8	15.6	9.8	11.8	11.8	31.3	33.0	33.0
La Libertad	86.7	84.0	95.1	59.0	17.5	1.0	1.0	5.0	13.7	44.3	40.0	55.8
Ancash	86.7	84.0	95.1	59.0	17.5	1.0	1.0	5.0	13.7	44.3	40.0	55.8
Huánuco	46.8	58.2	55.8	27.7	9.8	4.0	3.0	5.9	13.7	30.4	40.0	53.4
Junín	100.0	105.8	91.3	50.2	23.1	7.9	5.9	16.5	44.3	61.4	63.7	78.5
Huancavelica	100.0	105.8	91.3	50.2	23.1	7.9	5.9	16.5	44.3	61.4	63.7	78.5
Ayacucho	93.8	91.3	81.9	29.5	12.7	7.9	5.9	11.8	25.8	37.4	40.0	63.7

Source: FAO, CLIMWAT 2.0

(b) Cultivated Area Information

The approximate cultivated area has been estimated as indicated in the following table, based on data of harvested area at the Program area.

Table 3.1-10 Lot Estimation (ha)

Crop	AMA	CAJ	PIU	LIB	ANC	HUANU	JUN	HUANCA	AYA	Total
Alfalfa	0	0	0	137	864	0	0	52	768	1,821
Potato	368	924	141	669	1,544	249	843	70	1,199	6,007
Barley grain	0	483	73	804	1,793	57	475	82	1,187	4,954
Amillaceous Maize	642	1,414	1,973	456	1,381	103	351	62	1,550	7,932
Green grain Pea	83	327	0	0	0	0	153	18	0	581
Wheat	91	1,075	1,101	853	2,285	68	275	30	891	6,669
Green broad bean	0	0	0	0	0	0	133	7	0	140
Dry grain pea	0	528	463	211	0	0	0	17	291	1,510
Choclo maize	95	0	0	0	900	0	305	0	0	1,300
Rice	2,942	0	0	0	0	0	0	0	0	2,942
Yellow hard maize	755	703	2,149	793	2,480	72	154	0	109	7,215
Manioc	888	302	135	0	0	29	188	0	0	1,542
Dry grain broad bean	0	0	0	116	203	24	0	22	443	808
Olluco	0	0	0	71	232	13	0	0	196	512
Sweet potato	0	0	111	0	0	0	0	0	0	111
Dry grain beans	681	525	354	119	190	32	0	8	0	1,909
Coffee	3,412	0	895	0	0	0	3,131	0	0	7,438
Total Area	9,958	6,281	7,395	4,230	11,872	649	6,008	370	6,634	53,397

Source; Study Team based on MINAG data (2002 a 2007)

(c) Agricultural Information

Concerning agricultural information, the knowledge about the cultivation products is basic for it provides details about the type of crops and the cultivation area for the base period, the same for the rotation crops as well as the vegetative periods.

Other information required is the crop coefficients (Kc) during the vegetative period. As in each project crops are different (maize, broad beam, pea, wheat, etc.), one weighted average Kc had to be calculated for each month. Kc values were obtained by the technical documents of the irrigation projects at national level of former PRONAMACHCS and from the CROPWAT database.

Table 3.1-11 Kc of crops during the vegetative period

Crops	Jan	Feb.	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Alfalfa	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Potato	1.12	1.00	0.90							0.36	0.63	1.00
Barley grain	0.48	0.80	1.05	0.85	0.40							0.35
Amillaceous Maize	0.62	0.94	1.08	1.02	0.40							0.40
Green grain Pea	0.50	0.97	0.96	0.46								
Wheat	0.59	0.96	1.18	0.90	0.46							0.40
Green broad bean	0.96	0.46									0.50	0.97
Dry grain pea	1.02	1.18	1.19	0.98	0.40						0.42	0.68
Choclo maize	1.08	1.02	0.40							0.40	0.62	0.94
Rice	1.10	1.00	0.85								0.90	0.98
Yellow hard maize	1.08	1.02	0.40							0.40	0.62	0.94
Manioc	0.55				0.58	0.61	0.64	0.66	0.70	0.72	0.68	0.60
Dry broad bean	0.90	1.00	0.90	0.65	0.45						0.40	0.55
Olluco	0.85	1.00	0.75	0.60	0.35						0.25	0.55
Sweet potato	1.12	0.90	0.81							0.36	0.63	1.00
Dry grain beans	0.84	1.00	0.95	0.75	0.28							0.36
Coffee	0.50	0.50	0.50	0.70	0.70	0.70	0.90	0.90	0.90	0.70	0.70	0.70

Source: AGRORURAL

Crop coefficient (Kc) for rotation crops are:

Table 3.1-12 Crop coefficient (Kc) for rotation crops

Crops	Jan	Feb.	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Potato				0.36	0.63	1.00	1.12	1.00	0.90			
Amillaceous maize						0.40	0.62	0.94	1.08	1.02	0.40	
Green grain pea						0.40	0.66	1.10	0.80			
Green broad bean						0.50	0.97	0.96	0.46			
Choclo maize								0.40	0.62	0.94	1.08	1.02
Yellow hard maize				0.40	0.62	0.94	1.08	1.02	0.40			

Source: AGRORURAL

(d) Demand Calculation

The monthly water demand volume (m^3) was calculated for each month considering the monthly data of potential evapo-transpiration, weighted Kc and the effective rainfall of 75% of the average rainfall at the respective area for obtaining the corresponding flow (l/s/ha).

Also, the following conditions were considered:

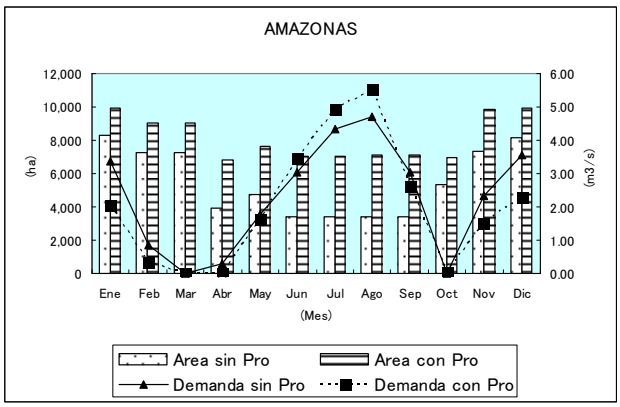
- Efficiency of irrigation at 20% (without project) and 40% (with irrigation project by gravity).
- Irrigation Period of 24 hours.
- No technical irrigation is considered

Summary of demand for the 9 Departments for irrigation by gravity with and without project conditions can be computed in the following table:

Table 3.1-13 Water demand for the 9 Departments with Project.

DEPT	Unit	Jan	Feb.	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Amazonas	L/s/ha	0.20	0.04	0.00	0.00	0.21	0.49	0.70	0.78	0.37	0.01	0.16	0.23
	Ha	9,958	9,071	9,071	6,806	7,610	7,041	7,041	7,129	7,129	6,928	9,871	9,917
	m3/s	2.03	0.32	0.00	0.00	1.61	3.46	4.92	5.53	2.62	0.04	1.53	2.29
Cajamarca	L/s/ha	0.01	0.06	0.07	0.08	0.05	0.54	0.91	1.06	0.67	0.00	0.00	0.00
	Ha	6,281	5,979	5,979	4,703	4,678	2,591	2,591	3,292	3,292	3,135	3,662	6,118
	m3/s	0.08	0.37	0.41	0.36	0.26	1.40	2.36	3.49	2.20	0.00	0.00	0.00
Piura	L/s/ha	0.34	0.37	0.14	0.31	0.21	0.44	0.66	0.86	0.80	0.37	0.32	0.38
	Ha	7,395	7,260	7,260	6,060	6,195	4,108	4,108	4,658	4,658	4,409	4,872	7,395
	m3/s	2.54	2.67	1.02	1.86	1.33	1.81	2.71	4.00	3.73	1.62	1.56	2.81
La Libertad	L/s/ha	0.00	0.06	0.02	0.21	0.23	0.47	0.66	0.81	0.82	0.25	0.21	0.13
	Ha	4,230	4,230	4,230	3,059	3,059	1,722	1,757	2,184	2,184	2,582	2,886	4,230
	m3/s	0.00	0.25	0.10	0.63	0.71	0.80	1.15	1.76	1.80	0.64	0.59	0.56
Ancash	L/s/ha	0.02	0.06	0.00	0.16	0.28	0.62	0.76	0.82	0.80	0.23	0.26	0.18
	Ha	11,877	11,877	11,877	9,414	9,414	5,112	5,228	6,371	6,371	8,143	8,361	11,877
	m3/s	0.24	0.73	0.00	1.46	2.66	3.19	3.99	5.19	5.09	1.87	2.18	2.18
Huánuco	L/s/ha	0.57	0.43	0.45	0.46	0.39	0.63	0.80	0.93	0.73	0.35	0.32	0.34
	Ha	649	620	620	459	488	310	324	358	358	467	467	649
	m3/s	0.37	0.27	0.28	0.21	0.19	0.19	0.26	0.33	0.26	0.16	0.15	0.22
Junín	L/s/ha	0.00	0.00	0.00	0.10	0.23	0.42	0.72	0.70	0.49	0.17	0.15	0.00
	Ha	6,008	5,820	5,753	5,102	5,290	4,450	4,450	4,664	4,596	5,071	5,206	5,932
	m3/s	0.00	0.00	0.00	0.49	1.24	1.87	3.22	3.27	2.25	0.86	0.81	0.00
Huancavelica	L/s/ha	0.00	0.00	0.04	0.21	0.19	0.36	0.65	0.70	0.53	0.41	0.10	0.00
	Ha	370	370	370	336	317	257	257	306	297	282	309	370
	m3/s	0.00	0.00	0.02	0.07	0.06	0.09	0.17	0.21	0.16	0.12	0.03	0.00
Ayacucho	L/s/ha	0.11	0.21	0.32	0.64	0.39	0.55	0.73	0.95	0.84	0.69	0.50	0.22
	Ha	6,634	6,634	6,634	5,980	5,980	3,158	3,256	3,701	3,701	3,326	4,046	6,634
	m3/s	0.72	1.36	2.12	3.83	2.35	1.73	2.36	3.53	3.10	2.30	2.00	1.46

Source: Study Team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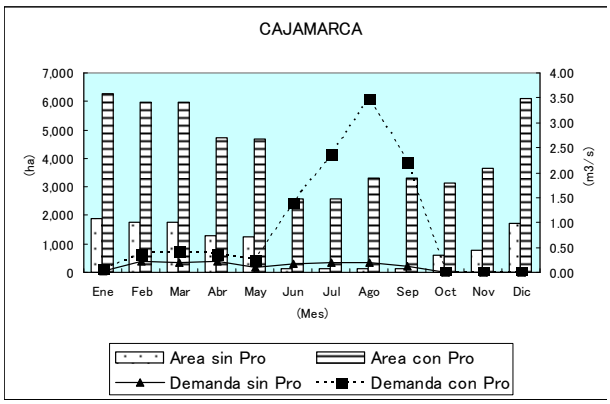
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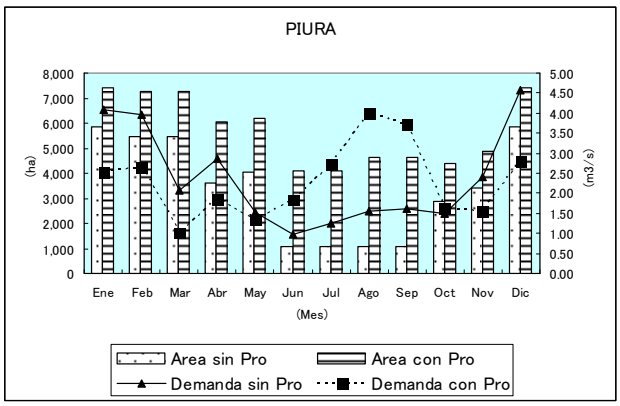
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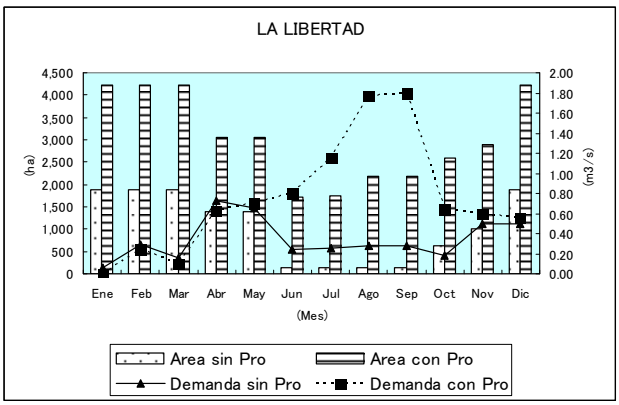
LA LIBERTAD
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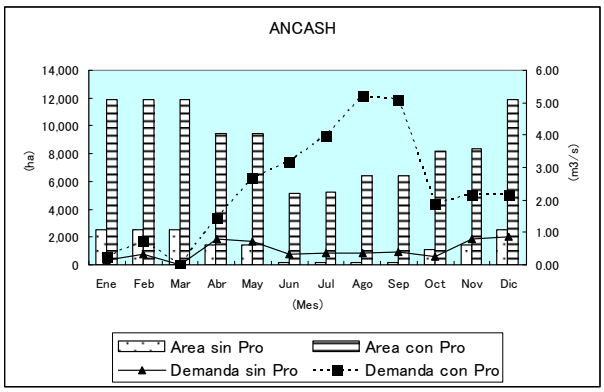
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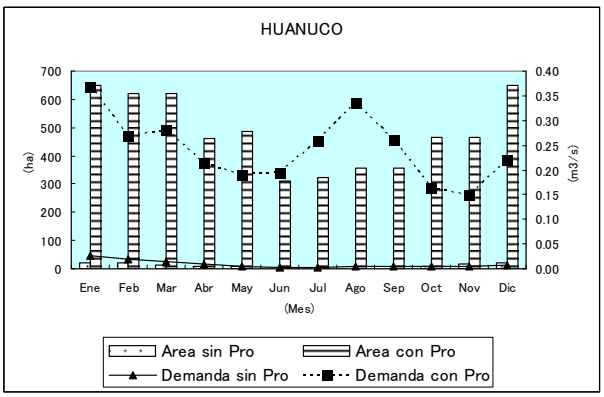
HUANUCO
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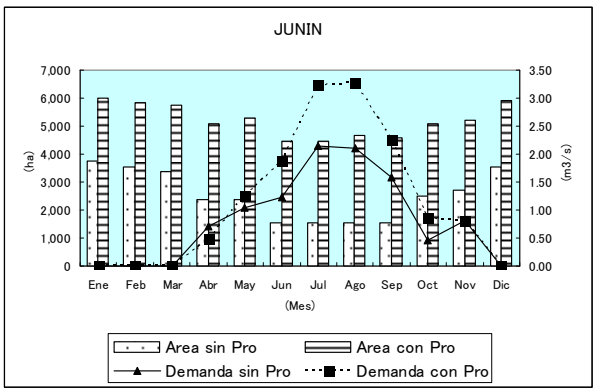
JUNIN
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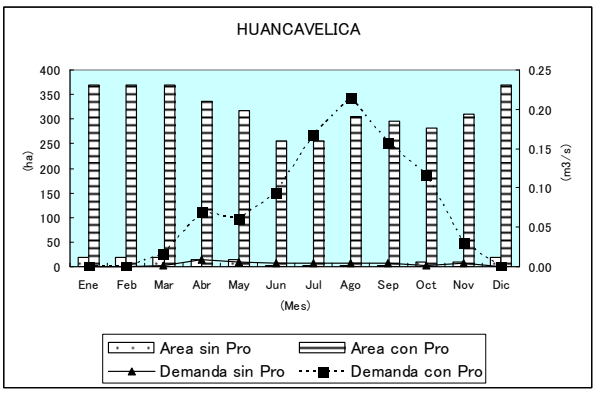
HUANCAVELICA
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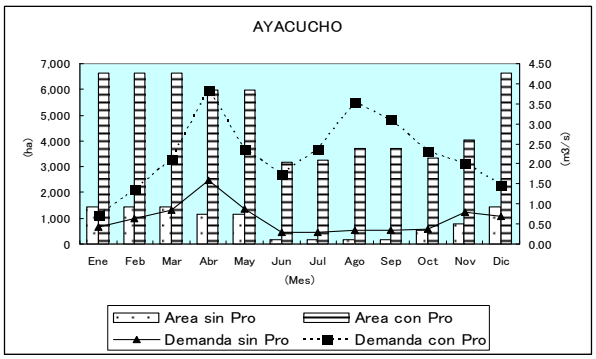


(4) Training in Maintenance and Management of the Irrigation System

The Board of Users and the Irrigation Committees, responsible for the distribution of irrigation water, have low technical capacity and equipment and also have no access to trustful information about irrigation water availability and use, generating disorder, chaos and low efficiency in the management of the resource.

By 2004, only 8,405 licenses of irrigation water use had been registered at the coastal valleys of the Pacific drainage basin; of those, only 4,263 were in force, representing approximately 0.5% of the existing properties, generating informality and disorder in the distribution of water. On the other hand, from 1990 on, the State gradually transferred water management to the Board of Users, granting them the power to distribute water; they approve, collect and manage the funds intended to finance operation and maintenance of the hydraulic infrastructure they operate. This transfer in water management has not been successful in relation to technical and economic efficiency, because it resulted in low tariffs, impeding proper maintenance of measurement infrastructure, fundamental for the delivery and control of the assigned volumes, causing the irrational use of water, with irrigation efficiencies in the order of 35% and salinization at the low lands by increasing the water ground level due to the excessive use of water.

The usual irrigation system in the Sierra is surface irrigation. The type of irrigation method applied to the survey area is shown in the following table:

Table 3.1-14 Irrigation Method at the Survey Area

Type	Acocro District Ayacucho	Tumbadem District Cajamarca	Sondor District Piura	San Luis District Ancash	Condebamba District Cajamarca
Furrow flooding	51.1 %	41.6 %	65.6 %	65.6 %	37.5
Gravity by ditch	20.7 %	9.5 %	34.4 %	34.4 %	62.5
Dripping	0.0	0.0	0.0	0.0	0.0
Sprinkler	0.0	11.1 %	0.0	0.0	0.0
Others	28.1 %	37.8 %	0.0	0.0	0.0
TOTAL	100 %	100 %	100 %	100 %	100 %

Source: Survey, Study Team

Efficiency of the irrigation method by furrow flooding is very low. However it is the predominant type of irrigation.

The following table indicates the willingness to pay the water charge for Infrastructure operation and maintenance.

Table 3.1-15 Willingness of pay a tariff in cash for the irrigation infrastructure operation and maintenance

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	40.9%	8.9%	0.0%	5.0%	28.6%
Yes	59.1%	91.1%	100%	95.0%	71.4%
Total	100.0%	100.0%	100%	100%	100%

Source: Agricultural Survey by Study Team

The answer shows that the majority is in willingness to pay the tariff in cash. In the following table, the answers of persons that cannot pay in cash and that are disposed to pay either with labor force or with communal jobs, are shown. Only 8% is not in accordance with paying for the water tariff.

Table 3.1-16 Another way to contribute to the Infrastructure Operation and Maintenance

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
Labor Force	59%	3%	0%	0.0%	28.6%
Communal jobs	15%	1%	0%	1.3%	0.0%
No Answer	26%	96%	100%	98.8%	71.4%

Source: Agricultural Survey by Study Team

Concerning the water fee collecting system, it also shows a high acceptance.

Table 3.1-17 Willingness to pay the water fee collection system

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	41%	24%	4.8%	3.8%	64.3%
Yes	59%	76%	95.2%	96.3%	35.7%
Total	100%	100%	100%	100%	100%

Source: Survey, Study Team

Concerning the interest in the water source conservation, producers showed a high level of acceptance.

Table 3.1-18 Interest in Water Source Conservation

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	9%	8%	2.4%	3.8%	97.1%
Yes	91%	92%	97.6%	96.3%	2.9%
Total	100%	100%	100%	100%	100%

Source: Agricultural Survey by Study Team

About the way to conserve and improve water sources, they point out the following.

Table 3.1-19 Ideas for water source conservation and improvement

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
Reforestation	3%	29%	100%	71.3%	4.3%
Cleaning the canal	8%	0	0	17.5%	54.3%
Canal piping	3%	0	0	0	0
Construct dams	0	47%	0	0	0
Improve infrastructure	0	6%	0	0	0
Technical Irrigation	0	6%	0	0	10
Do not know	86%	13%	0	11.3%	31.4%
Total	100%	100%	100	100%	100%

Source: Agricultural Survey by Study Team

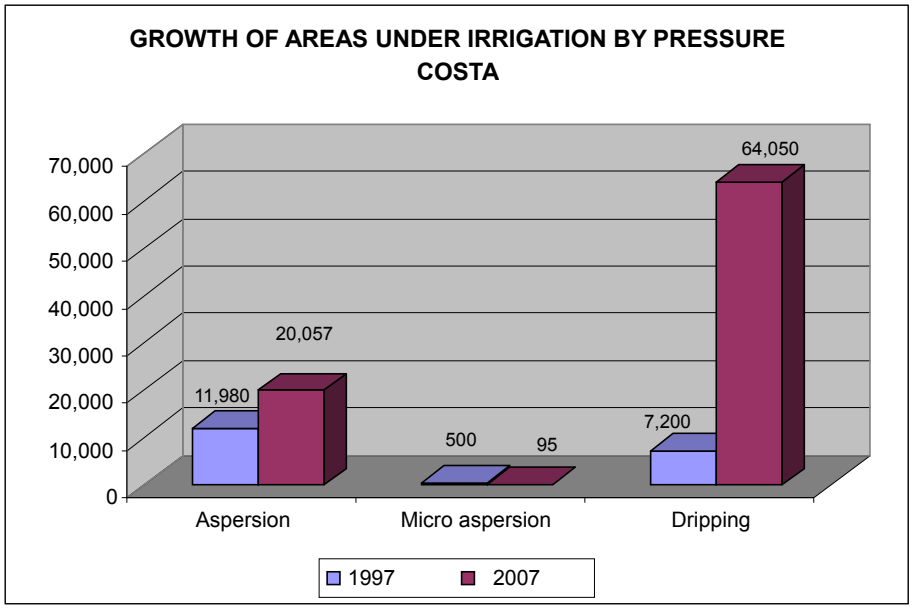
These results show the interest in maintaining the irrigation system. However, producers do not have enough information and knowledge about the system management. By such reasons, it can be estimated that there is an important demand on the producers' side to be trained in irrigation systems management and maintenance.

3.1.3 Technical Irrigation (Component B)

(1) Introduction of Technical Irrigation

According to Laguna T. (2009), relatively large projects have been developed in the last thirty years, directed to expand agricultural land, especially in the costa, because the Pacific and Titicaca river basins have less availability of water by area unit or inhabitant, different from the Atlantic basin. In the costa, Pacific river basin, the characteristics of aridity, climate and low water availability conditioned the perfection or change of irrigation technology, being the technology of irrigation by pressure an alternative for irrigation water management, and an increase in areas under irrigation by pressure can be noticed. The most common methods of irrigation by pressure are sprinkler and dripping. Presently, the irrigation method by pressure represents 7% of the total area under irrigation at national level; although it is a very low number, it has been growing rapidly. Only in the costa, it reaches an area nine times larger than year 1997, besides, areas under sprinkler irrigation are being replaced by drip irrigation.

Fig. : Areas according to irrigation methods- 2008



Technical irrigation has the advantage of saving around 40% to 60 % of water use, a scarce resource in great part of sierra and the costal area, allowing water and nutrients to reach the property in the proper time at the necessary quantity.

In the sierra where water resources are not abundant it is very important to save it. The introduction of technical irrigation system allows the expansion of cultivated area. Producers are aware of the importance to introduce technical irrigation. The following table indicates the interest in the introduction of technical irrigation at the surveyed areas.

Table 3.1-20 Interest in Technical Irrigation (%)

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	33.3 %	28.1 %	40.5 %	6.3 %	11.4 %
Yes	66.7 %	71.9 %	59.5 %	93.8 %	88.6 %
Total	100.0 %	100.0 %	100.0 %	100 %	100 %

Source: Agricultural Survey by Study Team

The results of the survey show an interest of around 60 to 70%. of the total surveyed. In the case of El Rejo project (Cajamarca), farmers show a high interest (72%) in the introduction of technical

Irrigation. However, in the case of Project Chantaco (Piura) the interest is moderate (60%).

The interest to change from traditional irrigation practices to technical irrigation reaches more than 88% producers interested in the introduction of technical irrigation.

Table 3.1-21 Interest to change from traditional irrigation practices to technical irrigation

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	3.0%	7.3%	11.9%	0.0%	24.3%
Yes	97.0%	92.7%	88.1%	100%	75.7%
Total	100.0%	100.0%	100.0%	100%	100%

Source: Agricultural Survey by Study Team

The demand for the introduction of technical irrigation by producers can be identified. According to the detected interest, there is not enough supply of technical irrigation to cover the demand. However, in areas of agriculture at small lots and without capital, it is almost impossible to have access to irrigation equipment that requires high investments, with the additional inconvenience that there are no irrigation modules of technical irrigation for small areas available in the market.

The following table shows the willingness to pay for 20% of the cost to introduce technical irrigation.

Table 3.1-22 Disposition to pay 20% to introduce technical irrigation

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	3.0%	17.7%	0.0%	6.3%	11.4%
Yes	97.0%	82.3%	100.0%	98.3%	88.6%
Total	100.0%	100.0%	100.0%	100%	100%

Source: Agricultural Survey by Study Team

To improve infrastructure, producers are also in disposition to request credit.

Table 3.1-23 Interest in asking for credit to improve irrigation systems

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	33.3%	28.1%	40.5%	45%	57.1%
Yes	66.7%	71.9%	59.5%	55%	42.9%
Total	100.0%	100.0%	100.0%	100%	100%

Source: Agricultural Survey by Study Team

However, producers are not aware of the system of Competitive Grants.

Table 3.1-24 Awareness about competitive grants

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	97.0%	82.3%	97.6%	81.3%	92.9%
Yes	3.0%	17.7%	2.4%	18.8%	7.1%
Total	100.0%	100.0%	1.0%	100%	100%

Source: Agricultural Survey by Study Team

(2) Technology innovation training

In this context, training, technical assistance and agricultural extension oriented towards technology transfer for the efficient use of irrigation and fertilization, applying new methods and techniques for water and nutrients management and promoting the application of the same by farmers in their properties is proposed.

Producers are aware of technical irrigation advantages, as indicated in the following table;

Table 3.1-25 Awareness about the advantages of technical irrigation

	Acocro	Tumbaden	Sondor	San Luis	Condebamba
No	27.3%	10.4%	45.2%	11.3%	38.6%
Yes	72.7%	89.6%	54.8%	88.3%	61.4%
Total	100.0%	100.0%	1.0%	100%	100%

Source: Agricultural Survey by Study Team

Table 3.1-26 Awareness about irrigation by sprinkler

	Acocro	Tumbaden	San Luis	Condebamba
	31.8	21.4	22.5	42.9
No	68.2	78.6	77.5	57.1
Yes	100.0	100.0	100.0	100.0

Source: Agricultural Survey by Study Team

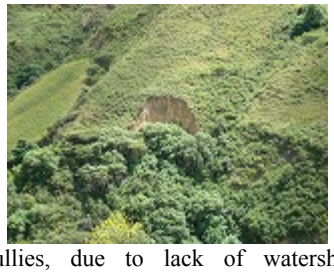
Transfer of technology for the proper management of water for irrigation and fertilization, should cause a multiplier effect in production, with optimum productivity and better quality of products, to make supply competitive when considering the increasingly demanding market for higher quality products.

Training, technical assistance and agricultural extension are important and transversal for the whole stage of project execution with the purpose of consolidating and providing sustainability to the actions executed by the project as well as to provide the sustainable use of water and soil resources and infrastructure in harmony with the environment and so lead to a sustainable rural development.

3.1.4 Conservation of the River Basin (Component C)

(1) Conduction of Studies for Watershed Management

Demographic expansion in sierra as well as the division of properties in small lots has caused permanent pressure to increase the fragmentation of farming land. Also, generalization of extensive type livestock breeding of sheep, cattle and specially goat, impedes the rotation of pasture according to the capacity. So, the massive erosion of soils at Andean slopes is not a surprise and it can be perceived at sight as well as the relative desertification of the highlands due to excessive pasturing. In the following pictures, the situation at the high watersheds can be appreciated.



Gullies, due to lack of watershed conservation

Uncovered High Watershed

Over pasturing in the high watershed

The said phenomena cause the following problems:

- Erosion of the high watershed and sedimentation in the low watershed (many times, sedimentation increases maintenance costs and sometimes prevents water conveyance)
- Lack of water resources during dry season and lack of storage capacity and retention at the high watershed
- Soil quality degradation

Landslide due to sedimentation in the low watershed

Conveyance canal totally obstructed by sedimentation.

Not habilitated intake works. It does not work as intake due to sedimentation

Fragility of ecosystems in the Program area is the basis for this Component (C). Andean slopes soil erosion is a permanent phenomena that can be aggravated or mitigated by cultivation and pasturing practices, soil, water systems and reforestation management techniques, among others.

In relation to degradation and depredation of natural resources and improper management of productive activities mainly conducted by farmers having small land, deforestation is conducting to an increasing desertification, causing a reduction of water resources, in face of a greater demographic pressure. However, Andean slopes are the most affected by potato cultivation methods and in less measure, by the cultivation of cereals that are the basic source of food for farmer families. To assure water sources are a basic measure to make agriculture sustainable. Producers are aware about the need to preserve water resources. In the following table, the experience in practices of protection and conservation of the watershed in Chantaco Project, Piura is shown. 81% of the producers have some kind of experience in conservation practices.

Table 3.1-27

Experience in Protection and Conservation

	Frequency	Percentage
No	8	19.0
Yes	34	81.0
	42	**100.0**

Source; Chantaco Project Survey, Piura

Concerning the knowledge about how to conserve the watershed, the majority expresses that they do not know how to do it. The following table indicates the results of the social survey by the Survey Team.

Table 3.1-28

Experience in Protection and Conservation of the Micro-watershed

	Frequency	Percentage
No	35	83.3
Yes	7	16.7
	42	**100.0**

Source; Chantaco Project Survey, Piura by Survey Team

About the question “How to conserve the watershed?” answers varies. There is no consensus as shown in the following table;

Table 3.1-29

Knowledge on practices of Protection and Conservation of the Micro watershed

	Frequency	Percentage
FILTRATION DITCHES	12	13.2
DITCHES IN CONTOUR	28	30.8
ABSORBING TERRACES	7	7.7
CONTROL OF GULLIES	0	0.0
REFORESTATION	42	46.2
CLOSING OF PASTURE	2	2.2
TOTAL	**91**	**100.0**

Source; Chantaco Project Survey, Piura

(2) Promotion for the Formation of Watershed Management Committees

In the following table, the interest of producers to participate in the protection and conservation of the watershed is shown. Most of the producers show interest.

Table 3.1-30

Interest to participate in Protection and Conservation

	Frequency	Percentage
No	1	2.4
Yes	41	97.6
Total	42	100.0

Source; Chantaco Project Survey

The following table shows the interest to participate in the Watershed management committee. It also shows a high level of acceptance

Table 3.1-31

Interest to participate in the watershed management committee

	Frequency	Percentage
No	4	9.5
Yes	38	90.5
Total	**42**	**100.0**

Source; Chantaco Project Survey

3.2 Analysis of Offer

3.2.1 Program

The government of President Alan Garcia Perez has specially emphasized the fight against poverty. The Multi-year Macroeconomic Framework 2010-2012 approved in May of the present year points out that: "the core of the government policies is constituted by the achievement of social objectives. Among them, the most important constitutes the goal to reduce poverty up to a 30% in the year 2011. This goal is fundamental to assure the economic development in the medium term and the government's upmost efforts are directed towards it both in terms of short term alleviation policies as well as structural reform".

Thus, the role of PRONAMACHCS that has been absorbed by AGRO RURAL, one of the regulating entities of agriculture sector, consists in "Preferably attend farmers in situation of poverty and extreme poverty at the Andes highland zones …", and was put in charge by the Ministry of Agriculture to develop the Program of Small and Medium Infrastructure in the Sierra, with the objective of contributing to the increase of agricultural production and productivity through rehabilitation/construction of irrigation infrastructure, introduction of technical irrigation and the strengthening of institutional framework for the watershed management and thus, increase income of farmer families in the Peruvian Sierra.

In consequence, the Program area is the Sierra and specifically the rural sierra, and AGRO RURAL determines the use of a methodology for the selection of Departments and the organization for the intervention in the problem.

Based on the previously mentioned about the Program origin, departments were selected according to the following concepts:

a) AGRO RURAL Office in a Department

   For the proper implementation of subprojects, there should be an AGRO RURAL office ain the department to be selected.

b) The department to be selected should have proposed subprojects in the program.

c) Economically active population in agriculture (PEAA)
   Agriculture should be the main productive economic activity in the department, and the selected department should have more than 30% of PEAA.

d) Poverty Indicators

   In order to identify the level of poverty, all departments to be selected should be under level 3 of poverty, equivalent to 43% of the poverty indicators of 2007.

Besides, the following aspects were considered for the selection.

e) By the nature and purpose of AGRO RURAL (focus in the sierra), departments exclusively of the orient or Selva were excluded.

f) It was decided to exclude the Departments of Apurímac, Cusco and Puno, for at the moment they were considered separately because there were other two programs that included them: Plan Meris, Programa Sierra (includes Apurimac) and Puno (Program of Titicaca Lake), integrating in them said departments that are culturally and geographically adjacent.

All departments were evaluated based on the above mentioned criteria and summarized in the following selection matrix:

Table 3.2-1 Selection Matrix of 9 Departments

No.	Department	Agro Rural Office	Proposed Subproject	Agricultural population		Poverty Indicator		Sierra Zone	Out of the Sur Progam
				Value (%)	>30%	Value (%)	>42%		
1	Tumbes			12		18.1			○
2	Piura	○	○	37	○	45.0	○	○	○
3	Lambayeque			22		40.6	○	○	○
4	Amazonas	○	○	65	○	55.0	○	○	○
5	Loreto			34	○	54.6	○		○
6	Cajamarca	○	○	60	○	64..5	○	○	○
7	San Martin			52	○	44.5	○		○
8	La Libertad	○	○	31	○	62.1	○	○	○
9	Ancash	○	○	36	○	56.6	○	○	○
10	Huanuco	○	○	51	○	64.9	○	○	○
11	Pasco	○		38	○	63.4	○	○	○
12	Ucayali			36	○	45.0	○		○
13	Junín	○	○	34	○	43.0	○	○	○
14	Lima	○		4		19.4		○	○
15	Callao			N.D		18.8			○
16	Huancavelica	○	○	65	○	85.7	○	○	○
17	Cusco	○		45	○	57.4	○	○	
18	Madre de Dios			25		15.6			○
19	Ica			20		15.1		○	○
20	Ayacucho	○	○	51	○	68.3	○	○	○
21	Apurímac	○		63	○	69.5	○	○	
22	Puno	○		44	○	67.2	○	○	
23	Arequipa	○		17		23.8		○	○
24	Moquegua			21		25.8		○	○
25	Tacna			14		20.4		○	○

Comments:

Selected departments were marked in all items

Source: Agricultural Population: Rural Economy in the Last Decade, 2002
Poverty indicator: Poverty Map 2007
Coast zone of La Libertad and Ancash departments were excluded from the poverty indicator.

In this way, the program is integrated by 9 departments in the sierra: Huancavelica, Amazonas, Cajamarca, Ayacucho, Huánuco, Piura, Ancash, Junín and La Libertad, all with marks in the matrix items. It is important to point out that only zones at the sierra were considered for the departments of Amazonas, Ancash and La Libertad.

(1) Political Framework

The aid policy by International Organizations and donor countries toward developing countries is based on the "Development Objectives of the Millennium", that unifies the purposes of the Millennium Statement of the United Nations of September, 2000 and the most important international Summits and meetings during the decade of 1990. Likewise, JICA in accordance to said objectives and considering the results of the Toyako Summit, of July 2008, proposes as vision "A dynamic development for all persons, without exception". In order to make this vision effective, it counts on with four missions:

1. To globally face the problems concerning climate change, water, food and infectious diseases;
2. Equitable growth and fight against poverty;
3. Improve government systems and policies in developing countries

4. Materialize the security of humankind

In respect to these four missions, JICA acknowledges that the fight against poverty is the problem that most affects developing countries. Likewise, considering that most farmers in developing countries live in situation of poverty and therefore, agriculture is an important factor for the economic and political stability, support to agriculture is considered a fundamental measure in the fight against poverty and a tool of economic development for the countries. As the Program of Small and Medium Irrigation Infrastructure in the Sierra is a program to fight extreme poverty through the improvement of agriculture production and productivity, it certainly is a Program that fits precisely in JICA's aid policy.

Complementarily, the Peruvian State has defined its water resources policy in accordance with the International Decade for the action "Water, source of life", established by the United Nations for the period 2005-2015, with the purpose of contributing to the achievement of the millennium development goals. This initiative of awareness rising has as purpose, to stress the importance of water in order to consolidate the relation of the national policy and strategy of water resources with the sustainable development, the eradication of extreme poverty and hunger, equity between genders, reduction of children mortality, health, education and environmental sustainability.

This integral design of policies is in accordance with the social and economic policies to be developed in the country for a period of three years as a short term policy tool, contained in the Multi-annual Macroeconomic Framework (MMM, in Spanish initials), prepared by the Ministry of Economy and Finance, MEF. Thus, in the field related to poverty and quality and destination of public investment, the MMM (2009-2011, number III) points out that: "Improve quality of public expenditure and management of public policies, giving priority to activities and projects with higher social cost-effectiveness and with the main objective of improving life quality of the poorest as long as they achieve the total inclusion in the regular dynamics of economic growth". Likewise, in number IV related to the progress in social issues it points out that "Fight against poverty and improvement of several social indicators such as malnutrition, access and quality to education, health and sanitation services are the fundamental objective of the macroeconomic policy.

According to the National Institute of Statistics and Information (INEI), Peru has an extension of 1,285,215 km^2 and in the year 2007 the population accounted for 28.2 million, with an urban population of 21.4 million, representing 75.9% of the total population. In said year, 39.3% of the total was in situation of poverty; meaning that the level of expenditure was scarce and insufficient to acquire basic consumption goods. In this proportion it was found out that 13.7% of the total population is in extreme poverty; that is, said persons have a per capita income inferior to the cost of the staple food.

As it is know, population in situation of poverty are the most vulnerable in situations of economic instability. During the last years, economy has been growing in a sustainable manner, explained by the dynamics of labor intensive industries. As a result, poverty and extreme poverty rates have been presenting important reductions. Complementarily, the action of focused social expenditure allows improvement in the income and expenditure of families at national level, mainly the traditionally less favored. According to official statistics of INEI, the poverty rate in year 2007 was 39.3% (5.2 percent less than 2006" and extreme poverty rate accounted for 13.7% (2.4 per cent less than 2006). Said figures would indicate a greater rigidity in extreme poverty, in a context of 92 months of continuous economic growth of the Peruvian economy until February 2009.

The State is interested in assuring equity of economic and social opportunities, fight discrimination of gender, ethnics, race, age, creed or disability; privilege the assistance to groups in extreme poverty, excluded and vulnerable; strengthen capacities of management to promote the access to information, training, technological transfer and a greater access to credit; promote the execution of productive infrastructure projects as part of the comprehensive plans of local and regional strategic development with the intervention of private sector.

In this sense, and with the objective of achieving sustainable services, the following lines of action,

among others, were designed:

- Capacity development both at community (Sanitation Services Administration Board) and at local governments levels for technical assistance, follow up and supervision of the implemented services.
- Co-finance infrastructure, both by the Municipality and the population, differentiating construction of new works from rehabilitation works, providing a higher subside for the construction of new works.
- Increase the commercial articulation of products with higher value, in order to face the small economies of scale that are presented, due to the difficulty to generate greater volumes of production in rural zones because of climate and topography conditions.
- Strength economic integration through the formation of economic corridors to allow face up difficulties of accessibility and connectivity between the distinct productive centers at rural areas; and at the same time to optimize the logistic chains for internal and external transaction costs between production, storage, conservation and distribution centers with the demand markets.
- Improve production infrastructure, mainly with irrigation works (to timely provide the water resource) and with communication roads (to reduce transportation costs).

The said actions are complemented with other programs oriented to create commercial chains for products and/or services with high value, such as:

Program for Poverty Reduction and Alleviation (PRA), executed by USAID since 1998 with the objective of contributing to poverty reduction through the generation of sustainable income and employment, mobilizing for that, private investment with economic potential towards the interior of the country, and which dynamics influence positively in areas with a strong presence of poverty and extreme poverty.

Sierra Exportadora, oriented to the execution of projects that generate products and services with added value at rural areas, giving priority to the agriculture, agribusiness, animal husbandry, fish farming, handicraft, textiles, jewelry, reforestation, agro forestry and tourism, both for the local market and for exports.

Program for the Support of Productive Rural Alliances in Sierra, ALIADOS, the objective is to improve social and economic wellbeing of population at rural Sierra in the scope of the project, through the good use of income generation opportunities by promoting alliances for productive diversification, development of rural business and strengthening regional and local capacities for management of rural territorial development.

In this framework of social policies, the Program of Small and Medium Irrigation Infrastructure in the Sierra will decisively contribute to the reinforcement of actions to improve income for an important portion of rural producers in the most run-down zones of the country, directly benefitting 35,302 families of the said sector, and as consequence, improving their life conditions. Indirectly, it will benefit all population in the distinct areas of influence of the projects to be executed, through the multiplier effect of the investments contained in the Program of Small and Medium Irrigation Infrastructure in the Sierra.

In Peru, several entities besides AGRORURAL conduct projects of irrigation infrastructure, such as Program of Irrigation Subsector (PSI), MARENASS, and others. The following Table indicates the main programs financed by the several international institutions (2008).

(2) Scope of the Project

1) According to the Budgetary Capacity of Agro Rural

AGRO RURAL was established as consequence of the fusion of Decentralized Public Organisms (OPD) and active Programs of MINAG such as PRONAMACHCS, PROABONOS, PROSAAMER MARENASS, ALIADOS, CORREDOR PUNO CUZCO, PROJECT SIERRA NORTE and PROJECT SIERRA SUR.

The budgetary analysis can be conducted by examining PRONAMACHCS's budget till 2008, for its budget is largely superior to the other set of grouped entities and it is the entity that was is charge of developing irrigation projects attending farmers in poverty and extreme poverty at the Andes highlands. AGRO RURAL is part of the national budget only from 2009.

In 2008, the Modified Institutional Budget (PIM) of PRONAMACHCS increased to S./ 194 million, superior in 5,9% to year 2007 that reached S./183.1 million. In the budget, more emphasis is given to the item "Promotion of Agricultural Production" and 47% of the budget is assigned to it; in second place is the item "Conservation of renewable natural resources" with 28.3% of the budget, directed to the development of water watershed conservation activities. The third activity is the "Promotion and Rural Extension" with 24.6% of the budget.

Table 3.2-2 PRONAMACHCS BUDGET: EXECUTION OF EXPENDITURE (S./)

	2007			2008		
Program	PIM	Executed	Progress %	PIM	Executed	Progress %
Agrarian						
Agrarian Promotion	45,295,567	33,021,891	72.9	91,323,703	64,658,153	70.8
Livestock						
Renewable Natural Resources Conservation	44,999,623	31,572,664	70.2	54,842,312	48,678,293	88.8
Irrigation						
Rural Extension and Dissemination	92,779,290	64,311,407	69.3	47,693,647	43,777,075	92.1
Total	183,074,480	128,905,961	70.4	193,859,662	157,113,522	81.2

Source: MEF Home page for economic transparence

The activity of agricultural production promotion implies: Prepare, promote, coordinate and supervise the Programs and Projects connected to the post-harvest handling, local products commercialization and transformation of agricultural products and the articulation to the market, as a part of the sustainable management of natural resources in micro watersheds in the sierra, in order to improve the income and level of living of the population in the Andes.

The activity of renewable natural resources conservation implies: Promote, coordinate and supervise the programs and projects related to soil conservation, reforestation, rural and irrigation infrastructure, as well as basic actions for territorial ordainment of watersheds, in harmony with the environment and to fight the effects of climate change. This activity is also articulated with the responsibility of promoting the organization and functioning of micro-watershed management committees, as instances of management for the watershed integral development.

The activity of promotion and rural extension is related to the technical assistance directed to agricultural activity and support to promote agribusiness, as well as the promotion of technological change related to the efficient use and management of water resources.

In the column "Progress", also knows as expenditure effectiveness, the level of effectiveness is respectively 71% and 81 % for the years 2007 and 2008; they are insufficient, showing at the same time the possibilities of the Institution to increase the expenditure level.

2) According to Investment in Irrigation

We did not have access to the amount of investments assigned by PRONAMACHCS to irrigation projects in the Andean zone for previous year to 2009; however, this item appears in the 2009 budget, corresponding to the new entity AGRO RURAL conformed by the fusion of the other entities before mentioned. For 2009 an amount of S./30 million has been assigned at the Initial Opening Budget, that

was reduced to only S./16.6 million in the PIM (July 2009), equivalent to the 8.3% of the total PIM of 2009.

However, in the framework of the Economic Incentive Program (PEE) that amount to 3.2% of GNP, the government has assigned S./153 million, for one time, to the Program of Irrigation Infrastructure Maintenance (PMIR). It is a program executed by the Ministry of Agriculture with the objective of financing the maintenance of irrigation infrastructure in the country, in order to activate the agriculture sector. This Program is directly executed by the district municipalities, as a part of the actions of the anti-crisis plan being implemented by the central government.

This program will finance:

- Maintenance of canals
- Maintenance of catchments
- Maintenance of intakes
- Maintenance of gauging devices
- Maintenance of micro dams
- Maintenance of outlets

It will benefit the population of 1,288 districts of the country located in zones of poverty and extreme poverty, generating temporary jobs at the rural area and reestablishing the installed infrastructure capacity.

3.2.2 Irrigation Infrastructure (Component A)

The perception of the magnitude and distribution of water use allow the organization, planning and improvement of water use in the country. In this context, many inventories and basic studies have been prepared such as the one prepared by the former ONERN in 1984 and the National Direction of Water and Soils in 1992, where the national water consumptions is constituted by the consumption use that amounts to 20.072 m^3 /year, comprised by the agriculture sector with 80%, human and industrial use 18% and the mining sector with the remaining 2%; while the non consumption use reaches 11.139 m^3 /year, constituted by the energy sector..

The general guidelines of the water resources policy in Peru is in a critical situation in terms of lack of proper infrastructure and a weak regulation and national control

As supply from the government there are two Programs;

- Irrigation Infrastructure Project (PRONAMACHCS/AGRORURAL)
- Project for the Rehabilitation and Improvement of Irrigation Systems

(1) Project of Irrigation Infrastructure (AGRORURAL)

In the Andean Sierra there is a project conducted by the MINAG.

This project is executed by PRONAMACHCS who assigns most of investment towards the execution of small irrigation infrastructure works identified and prioritized by the farmers' communities; with the purpose of optimizing caption, use and management of water resources available in the micro-watershed.

The general strategy of intervention for the execution of these works is based in the following elements: i) Organization of users (beneficiaries) in "work committees", irrigation or users committees, etc.; ii) Provision of construction material, tools and equipment, as well as the corresponding technical guidance; iii) Contribution of users, through unpaid communal labor; iv) Training for users in the stage of construction, operation and maintenance of works and v) Participation of the "work committee" in the

joint administration of resources assigned for the works.

Table 3.2-3 Irrigation Infrastructure Project MINAG -2007

Project Goal	Physical Goal			Budget (thousand S./)	
	Unit	Prog./Mod		Unit	Prog./Mod
Construction and Improvement of Irrigation Systems					
Purchase of Vehicles	Unit	51	51	146,7	146,7
Advisement and Consultancy	Report	30	30	731,8	412,0
Technical Assistance	Report	4	4	9 052,2	9 052,2
Construction of small irrigation systems	Work	23.06	23.07	2 674,5	454,4
Coordination and Advisement	Report	3	3	371,8	371,8
Technical guidance, Supervision and Administration.	Report	14	14	6 336,0	6 334,3
Preparation of Studies and Detail Design Update	Study	741.05	52.05	1 890,2	1 792,3
Improvement of small irrigation systems	Work	90.06	90.06	11 014,3	1 505,9
Construction of multi-purpose water systems	Work	2.06	0	41,1	0,0
TOTAL				32 258,6	20 069,6

Source; General Accounts of the Republic 2007

(2) Water Resources

The Program of Small and Medium Irrigation Infrastructure in the Sierra, subject of the present Study, is located in the central and northern sierra in 9 Departments of the country and hydrographically will be developed in 20 watersheds, as shown in the following table.

Table 3.2-4 List of Sub-project and Watersheds

	PROJECT NAME	Benefited Area (ha)	Sub-watershed	Intake (km2)	Micro-watershed Area (km2)
Amazonas	Improvement Intake section communal canal Huarangopampa	770	Utcubamba	6,249	6,249
	Improvement Irrigation system San Juan Marañón-La Papaya	1,477	MARANON	19,029	19,272
	Improvement intake and Limonyacu Bajo canal	515	JATUNCASPI	6,579	6,579
	Improvement Irrigation canal La Peca Baja - Canal Brujopata	340	LA PECA	93	112
	Improvement Canal San Roque Watson	871	COPALLIN	75	76
	Improvement Irrigation system Higuerones-San Pedro	779	JATUNCASPI	6,579	6,579
	Improvement Irrigation system El Pintor - Canal Abad.	577	El Pintor	98	130
	Improvement Irrigation system El Pintor - Canal Santa Elena	737	El Pintor	26	39
	Improvement Irrigation system Goncha Morerilla - Canal Gonchillo Bajo	284	Goncha	90	91
	Improvement Irrigation system Lumbay Balsas	350	Jahuay	124	126
	Improvement Irrigation system Naranjitos - Canal Naranjitos Nº. 02	554	Naranjitos	104	116
	Improvement Irrigation system Naranjos - Canal El Tigre	1,237	Naranjos	85	136
	Improvement Irrigation system Naranjos - Canal Naranjos	893	Naranjos	104	136
	Improvement Irrigation system Utcuchillo - Canal Aventurero	574	Utcuchillo	42	72
Ancash	Irrigation Canal Desembocadero – San Miguel	120	San Miguel	56	196
	Construction Irrigation canal Aynin-Huasta	525	Rio Pativilca	321	494
	Construction Irrigation system Jatun Parco	625	Rio Achin	97	147
	Construction Irrigation system Gorioj Rapayan	303	Rio Huancato	27	34
	Construction Irrigation canal Casablanca- Jocosbamba – Quiches	563	Llama	162	223
	Construction Canal Cordillera Negra	1,300	Rio Santa	708	1,048
	Construction Irrigation canal Sol Naciente de San Luis	1,066	Rio San Luis	56	130
	Construction Irrigation canal Luis Pardo de San Nicolas	500	San Nicolas		
	Construction Canal Rupawasi – Rosamonte	550	Andaymayo	56	62
	Improvement and Extension Irrigation canal Quishquipachan	250			
	Improvement Canal Chuayas-Huaycho	650	Jancapampa	92	94
	Improvement Irrigation Molinopampa Auquipampa	230	Rio Santa		
	Improvement Canal Rurec	800	Rio Orellos	147	179
	Improvement Canal Tucu-Chiquián	560	Ragra cocha	80	173
	Improvement Chinguil – Cruzpampa	600			
	Improvement Irrigation canal Paron II	510			
	Improvement Irrigation canal Quinta Toma	250	Rio Ranrahirca	144	150
	Improvement and Extension Canal Arma Santa Cruz	1,000	Rio Ruricocha	42	56
	Irrigation system Chira - Flor de Cantu	930			
	Irrigation system Mancan Aija	540			
Ayacucho	Construction Canal and Dam Huancallama	1,000	Huancachacra	49	109
	Construction Canal and Dam Tintayccocha-Acoro	600	Ventanillayoc	18	58
	Construction Dam and Irrigation system Chito-Sachabamca y Quishuarcancha, Chiara	2,000	TOJIASCCA	17	126
	Construction Dam and Irrigation system Chaqllani-Pucapampa	1,040	Cchoccuihua.		
	Construction Irrigation system Ccocha-Huayllay	439	Pacchamayo	119	238
	Construction And Improvement integral Irrigation system Churropallana – Pacopata	660			
	Irrigation Papatapruna – Ccochalla	495			
	Construction And Improvement Irrigation system Putacca Ccatun Pampa	400	Concepcion	20	47
Cajamarca	Construction Irrigation canal El Rejo	1,510	Jequetepeque	206	228
	Construction Canal La Samana – Ushusqui	400	Yanahuanga	327	670
	Irrigation Cochán Alto	600	Llapa	49	84
	Improvement Canal Coloche	343	Rio Rocoto	2	25
	Improvement Irrigation canal La Poblacion	500	Qda. Quitasol	8	20
	Rehabilitation Canal El Huayo	1,428	Crisnejas	1,397	1,936
	Dam Laguna Chochoguera	1,500	Colpa - Cañaris	43	63
Huancavelica	Irrigation Chaynabamba	130	Chaynabamba	28	33
	Irrigation Cusicancha-Huayacundo-Arma-Huaytará.	240	Rio Tincoc	40	41
Huánuco	Construction Irrigation canal Caracocha	249	Q. Ragracancha	1	22
	Construction Irrigation canal Sogoragra Rondobamba	400	Q. Sogopampa	7	25
Junín	Irrigation canal Ninatambo	115			
	Construction Irrigation system Pomamanta Comas	681	Rio Huambo		
	Construction Irrigation system Rupasha - Vista Alegre	1,281		330	416
	Irrigation Aywin	400	MINELIQUE	4	4
	Irrigation Cotosh II Etapa	1,101	PALCA	2	2
	Improvement Canal Sector Atocsaico	200	Atosaycco	35	126
	Improvement Canal Achamayo	1,520	CHIA	241	241
	Improvement Canal Mayuhuato - Huaracaya	160			
	Improvement canal Ranra Antabamba	100	RANRA	17	19
	Improvement Irrigation system of Yauli and Jajapaqui	450	Canipaco	125	68
	Irrigation system				
La Libertad	Construction Irrigation systemHuacatina	715			
	Improvement Irrigation canal Chuquillanqui-Shushipe	1,000	Chicama	834	911
	Improvement. Irrigation canal Mollepata	900	Rio Sarin	23	84
	Improvement Canal Sute Putute	529	Rio Sute	292	310
	Improvement Irrigation systemCanal Yamot – Huayobamba	250			
	Dam Laguna Collasgon-Const Canal Collasgon-Querobal	236	Q.. C.-Totorilla	4	11
	Dam Laguna Negra-Const Irrigation canal Chugay	600	Laguna Negra	10	109
Piura	Irrigation canal Espíndola	500	Río Espíndola	13	29

3.2.3 Technical Irrigation (Component B)

(1) Implementation of Technical Irrigation by other Institutions

REGIÓN	PROVINCIA	DISTRITOS	JUNTA DE USUARIOS	COMISIONES REGANTES	COMITÉS REGANTES	USUARIOS	ÁREA RIEGO
Nombre	Nombre (s)	Nombre (s)	Nombre	Número	Número	Número	Hectárea
Piura	Huancabamba	Huancabamba, Sondor, Sondorillo, Carmen de la Frontera, Canchaque y San Miguel del Faique	Huancabamba	12	49	8,200	12,543
Cajamarca	Cajabamba	Cajabamba, Condebamba, Cachachi y Sitacocha.	Cajabamba	4	166	11,730	7,315
	Cajamarca	Cajamarca	Rio Mashcon	8	47	4,163	2,083
	Cajamarca	Baños del Inca, La Encañada y Jesus	Rio Chonta y Cajamarquino	16	34	9,793	7,786
Ancash	Recuay, Huaraz, Carhuaz, Yungay, Huaylas, Caraz y Corongo	Comprende 35 distritos	Callejón de Huaylas	33	366	46,978	52,140
Junín	Jauja, Concepción, Huancayo, Chupaca	El Tambo	Mantaro	21	129	19,164	14,686
	Tarma	Tarma	Tarma	32	262	15,300	4,935
Huancavelica	Huancavelica, Churcampa, Angares.	Churcampa: 7 distritos; Huancavelica	Huancavelica	11	227	10,302	5,747
Ayacucho	Huamanga, Huanta, Sucre, Huacasancos, Vilcashuamán, Fajardo, Cangallo, Lucanas	Ayacucho	Ayacucho	41	565	34,805	39,357
Cusco	Anta, Acomayo, Calca, Cusco Chumbivilcas, Paucartambo, Quispicanchi, Urubamba	Varios	Cusco	144	700	23,697	11,041
Arequipa	Caylloma	Callalli, Sibayo, Tuti, Chivay, Yanque. Coporaque, Ichupampa, Lari, Madrigal, Achoma, Maca, Cabanaconde, Tapay y Huambo	Valle del Colca	31	10	6,477	9,639
Puno	San Roman	Juliaca	Juliaca	47	141	3,782	2,988
TOTAL				400	2,696	194,391	170,260

Presently, the PSI, through the Sub-sector Program of Irrigation, plans to implement the following;

- Component A; Rehabilitation and maintenance works for irrigation systems (14,600 ha)
- Component B; Technical Irrigation in Lots (approximately 3,500 has)

The goal of PSI Program is to attend the following board of users.

Provinces to be attended by the Program PSI Sierra in the present Program area are the following;

- Department of Cajamarca; Province of Cajabamba
- Department of Ancash; Provinces of Huaraz, Carhuaz, Yungay, Huaylas, Caráz
- Department of Ayacucho; Huamanga, Huanca Sancos, Vilcashuaman, Fajardo, Cangallo and Lucanas

It should be stressed that this Program is not enough to cover the potential demand.

(2) Technological Training

One of the most important challenges of the Andes highland agricultural sector is to develop and introduce knowledge and production processes at the different levels of the agricultural chain to allow the sustainable growth of profitability and environmental sustainability of production units. For this purpose, agricultural technological innovation is necessary.

However, producers at the Program area practice a traditional agriculture with low productivity and production. It is necessary to change this scenario to overcome this poverty condition. For this purpose, it is necessary to attract investments from the public and private sectors in terms of technological innovations proper for the region.

The introduction of new technology requires a long and sustainable period. For that, the intervention of local and regional governments is necessary.

(3) Supply of the Program

This component offers two modules of technical irrigation for each Subproject. This Project proposes to carry out the following:

a. Construction of two modules of technical irrigation

b. Awareness raising and training toward irrigation users

3.2.4 Conservation of the River Basin (Component C)

(1) Conduction of Studies for Watershed Management

The main objective of the watershed management study is to diagnose and plan the watershed as a

water resources integrator body. The diagnosis will allow knowing the existing situation of all components of the watershed including the physical, biological and social aspects. According to the results, it will be possible to plan the watershed management in all its aspects, looking for the best use of all potentialities and natural resources.

The actors in the watershed have to be identified so they have a promoting role in the watershed management. An integrated management by watershed will articulate the social, economic and environmental aspects for a sustainable development, in order to achieve the interaction of demand and offer, supported in the rational and efficient use of water.

1) Institutions that offer actions and programs

As the area covers Provinces, Departments and also intra border spaces, watershed can be studied by different sectors and at different levels. Among the most important we have:

AGRO RURAL. (Program of Productive Rural Development)	Agro Rural. Through the Sub-Management of Watershed Management, it has many functions related to the watershed, including: • Promote the design of strategies and generation of methodologies of intervention to achieve the integral management of natural resources under the approach of micro-basins • Support, supervise and evaluate the establishment of pilot areas in managing micro-watersheds, with the purpose of developing an integral and participative management to contribute to the sustainable development, so as to achieve the construction of a model to be replicated for similar spaces. • Promote, support and coordinate the identification and prioritization of micro-watersheds as strategic spaces of planning for the sustainable management and rural development of the sierra. • Promote the organization and functioning of micro-watershed management committees, as spaces for the integral management of micro-watershed development, aiming the maximum participation of organizations and local actors. Activities conducted by this unit are the following: • Management of the Pilot Watershed Vilcanota (Cusco) • Management of the Pilot Watershed San Juan Chincha (Ica and Huancavelica) • Management of the Pilot Watershed Ramis (Puno) • Promotion of the sustainable development of Andes Highland Micro-Watershed • Intensive management Andes Highland Micro-Watershed (MIMA)
ANA (National Authority of Water)	Entity in charge of conducting necessary actions for the multi-sectored and sustainable use of water resources by watershed, in the frameworks of the integrated management of natural resources and the management of the national environmental quality, establishing strategic alliances with regional and local governments and the set of social and economic actors concerned. Main functions are the formulation of a national policy and strategy for natural resources, administer and formalize the rights for use of water, distribute it with equity, quality control and facilitate the solution of conflicts. The new entity regulates the acts of the Executive Power entities and the private actors in the integrated and multi-sector management of water resources, establishing as management unit the watersheds and aquifers of the country. The Water Resources Law promulgated in March, in its article 24 establishes that the watershed councils are by permanent nature integrant of the National Authority of Water, created through Supreme Decree, with the objective to participate in the planning, coordination and arrangement of the natural resources water use.
Regional Governments	Regional governments can prepare studies for watershed management with specific objectives such as the "Integral Management of water, soils, reforestation and agro-ecology in Supe river watershed", with the specific objective for the Master Plan of the Caral Archeological Site".
INGEMMET	The Institute of Geology, Mining and Metallurgy (Ingemmet) has conducted studies of two watersheds, as part of the annual investigation program, with the support of many private companies; they were conducted at the watersheds of Jequetepeque and Chancay rivers in Lambayeque
Private Institutions	There are different experiences in the study of watershed management or intents to systematize them as experiences of Territorial Ordainment, such as IPROGA (Institute for the promotion of water management) and several NGOs.

(2) Promotion for the Formation of the Watershed Management Committee

In Peru and at the Andean sierra watershed management is necessary for the importance of the actions at the high watersheds and the repercussions at the medium and low parts.

Integral management of watersheds, as strategy of intervention, requires training the personnel, knowledge of the watershed characteristics, and clear proposition of purposes, methodology and strategy of intervention to promote the consented participation of the actors. It also requires a previous analysis of Strengthings, Weaknesses, Opportunities and Threats to propose work plans.

The watershed development can be achieved with the use of capacities building to the main actors, the use of natural resources and with a proper policy of investment at the three level of the Local, Regional and National governments.

3.3 Balance of Offer and Demand

3.3.1 Program

The Andean Sierra, specially the rural zone with a high level of poverty, requires proper actions to increase agricultural production of families in situation of poverty and extreme poverty. Rural population depends strongly on their properties and production to increase their economic and thus, left behind the conditions of poverty.

Presently, due to lack of production infrastructure, farmers produce only for their consumption. In many cases, they cannot produce food due to the vulnerability to climate and draught. Farmers have a long desire to assure irrigation water and make the agricultural production secure.

In this manner, the main objective of the Program is proposed to be “sustainable increase of agricultural productivity in the Sierra based in a greater supply of products with higher productivity”; and the said purpose would be oriented to the conduction of integrated and planned interventions in the areas of:

I. *Improvement and Construction of Irrigation Infrastructure*, through the rehabilitation and/or improvement of irrigation systems to allow the expansion of irrigation areas in the dry season and reduce water conveyance loss by concrete lining on canals and construction of inlet works to reduce caption losses.
II. *Implementation of the Technical Irrigation System*, oriented to improve efficiency in the use of water at lot level, through the installation of irrigation modules by sprinkler and the corresponding technical assistance.
III. *Institutional Strengthening for Watershed Management*, with the objective of strengthening the management capacity of the watershed actors for the improvement of water load zones of the micro-watersheds where irrigation projects are to be executed. It should be stressed the labor of organizational structure reinforcement and capacity development through two great lines of action: awareness raising and training directed to the Board of Uses, irrigators commissions and committees, to improve management of irrigation systems and conservation of water resources.

The importance of the agricultural sector consists in the feasibility to conform a scenario of high production and productivity in agriculture, reflected in better income for farmers at the Central and Northern Sierra, in a sustainable framework.

During the last years, rural population has not received enough support from the Central Government and irrigation infrastructures have been deteriorating. It means higher social costs and determines the loss of water resources and reduction of agricultural production.

Offer and Demand Balance of the Program

<table>
<tr><th>DEMAND</th><th>OFFER</th></tr>
<tr><td>Program Area

Poverty in Peru is heterogeneously distributed: (2008)

<table><tr><td>National</td><td>Urban</td><td>Rural</td></tr><tr><td>36.2%</td><td>23.5%</td><td>59.8%</td></tr></table>
The present government aims to reduce poverty to 30% in 2011. AGRO RURAL policy is to “Attend farmers in poverty and extreme poverty at Andes highlands. In consequence the greatest demand for the Program is rural Sierra departments with large economically actively population in agriculture, (PEAA); and high indicators of extreme poverty and Human Development is low.
Departments in the scope of the Program are the Andean zones of: Amazonas, Ancash, Ayacucho, Cajamarca, Huancavelica, Huánuco, Junín, La Libertad and Piura</td><td>In order to face the magnitude of poverty and its economic and social geography, the State develops the following programs, among others:

▪ Program JUNTOS.
▪ Program for poverty reduction and alleviation - USAID
▪ ALIADOS. Program to support productive rural alliances in the Sierra
▪ FONCODES. Fund for cooperation and social development
According to Budgetary Capacity of Agro Rural: During 2008, PRONAMACHCS budget increased to S./194 million. Major item is “Promotion of Agriculture Production” with an assignment of 47% of the budget. Renewable Natural Resources conservation includes irrigation, with an assignment of 31 % of the budget.</td></tr>
<tr><td>According to land and irrigation needs: In the set of the determined departments there are 1,658,431 ha of cultivation land and only 27% has irrigation. 73% has no irrigation and demands it.

According to demand for irrigation projects in the SNIP. There were 1,576 irrigation projects registered in the SNIP by April 2009 at the 9 departments of the Program area. Agro Rural has received requests for 158 projects at the nine departments, by an investment amount of 462 million soles to irrigate 58,000 ha.</td><td>Program of Economic Incentive: In the framework of this Program (PEE) that amounts to 3.2% of the GNP, the government has assigned S./153 million, for one time, for the Program of Irrigation Infrastructure Maintenance (PMIR). It is a program executed by the Ministry of Agriculture with the objective of financing the maintenance of irrigation infrastructure in the country, in order to activate the agriculture sector. This Program is directly executed by the district municipalities, as part of the actions of the anti-crisis plan being implemented by the Central Government.</td></tr>
<tr><td colspan="2">BALANCE

Geographic, economic and social balance.

Statistics show a greater rigidity for reduction of rural poverty. In consequence, the State selects this problem to focus solutions in this issue. Recovery and increase of installed capacity for Andean agriculture production should be attended through small and medium infrastructure works, where poverty is deeper and less elastic to programs of assistance aid.

Program of Small and Medium Irrigation Infrastructure in the Sierra

The PMIR is a program of relatively minor magnitude in investments but of greater extension. In the context, precedes the Program presently in study. Consists in 56 small and medium Projects and a set of technical irrigation modules to incorporate approximately 28,000 ha.</td></tr>
</table>

3.3.2 Irrigation Infrastructure (Component A)

(1) Improvement of Irrigation System and Incorporation of Irrigation (Irrigation Infrastructure)

Farmers in the Andean Sierra have low income and insufficient production of food for self-consumption, requiring improvement of their life conditions. Most farmers at the Program area, where there are no job opportunities, have only way to improve the level of life by increasing their agricultural production, producing surplus of food to be taken to the market. For this end, it is necessary to increase productivity and production by expanding irrigation area. Producers are willing to participate in the conservation and maintenance of the irrigation system as well as contributing to the water fee collection.

For a long time, no programs for the rehabilitation and improvement of irrigation systems were conducted, especially in the Sierra zone and the existing systems are more and more worn out, requiring quick attention.

(2) Training for Irrigation Systems Management

The Irrigation system management is very important to attend a larger area of irrigation. Maintenance conditions of the canal strongly affect the area to be attended. In the Sierra, where geographic and climate conditions vary, conservation and maintenance of the Canal are necessary. The following figure shows the canal maintenance conditions.

Canal covered by vegetation due to lack of maintenance

Communal work to construct the canal

Canal maintenance to avoid sedimentation

The interest of producers in maintaining the canal and contribute to the irrigation system operation and maintenance is known. However, due to lack of knowledge and maintenance practices water resources are not fully used.

It is estimated that there is a great demand by producers for training in irrigation system management.

(3) Water Resources

The following table shows the balance between demand and offer of water resources as well as the recommendations based on this analysis:

Category	Evaluation	Necessary Actions	Criteria
A	No problems	Enough water resources	Water resources to satisfy water requirements without intervention are assured
B	Less Problem	Review cultivation products and area	More than 50% of the necessary flow is assured
C	Review the Plan	1. Review with more detail the watershed and the availability of water resources 2. Study the need of water dam 3. Revise the beneficiary area	Cannot assure the 50% of the required flow
SD	Without data	-	
Dam	With dam	1. Review with more detail the watershed and the availability of water resources study the water balance	

Source: Study Team

The result of the water balance analysis is the following;

Table 3.3-1 Water Balance

Category	Nos.
A	30
B	5
C	13
SD	12
DAM	16
Total	76

Source: Study Team

There are problems to cover the demand in 13 A type sub-projects (only canal) classified in category C, meaning that the required flow cannot be assured. Also, it was not possible to analyze 12 sub-projects by lack of data. For the said 13 sub-projects the supply is much lower than the demand so they should be revised.

Symbol	PROJECT NAME	Max. Demand (l/s/ha)	Min. Flow by perfil, Register (l/s/ha)	Min flow by watershed (SIG) (l/s/ha)
AMA-7	Improvement Irrigation System El Pintor - Canal Santa Elena	0.78	0.25	3.5
CAJ-3	Improvement Canal Coloche	1.06	0.06	0.7
CAJ-4	Improvement Irrigation Canal La Poblacion	1.06	0.15	1.6
PIU-1	Irrigation Canal Espíndola	0.86	0.20	2.5
PIU-3	Improvement Canal Santa Ana	0.86	0.27	3.5
PIU-4	Improvement Dam and Canal Cascapampa	0.86	0.10	1.3
PIU-5	Improvement Canal Chantaco Huaricanche	0.86	0.19	2.4
PIU-6	Improvement Canal Chorro Blanco Nancho	0.86	0.04	0.5
LIB-8	Improvement Irrigation Canal Mollepata	0.82	0.25	2.6
ANC-7	Improvement and Ampliation Canal Arma Santa Cruz	0.82	0.39	4.2
HUA-1	Construction Irrigation Canal Caracocha	0.93	0.05	0.6
HUA-2	Construction Irrigation Canal Sogoragra Rondobamba	0.93	0.16	1.7
AYA-9	Improv. and Const. Irrigation System Putacca Ccatun Pampa	0.95	0.44	5.0

Source: Study Team

Also, sub-projects CAJ-5, CAJ-6, LIB-4, could not be analyzed by lack of data. On the other hand, excepting sub-projects PIU-3, ANC-2, ANC-6, AYA-14, the other projects show little divergence between demand and supply so they could be implemented after further analysis. For the former 4 excepted sub-projects, the supply is much lower than the demand so they should be revised.

Balance of Offer and Demand by Irrigation Infrastructure

<table>
<tr><th>Demand</th><th>Offer</th></tr>
<tr><td>Irrigation Infrastructure: in the 9 Departments there are 5,947 irrigation infrastructures. Most of them are deteriorated. It is estimated that 90% have no lining</td><td>Improvement of Irrigation. There are two projects at the supply side:
▪ Project of irrigation infrastructure Agro Rural
▪ Project of rehabilitation and improvement of irrigation systems</td></tr>
<tr><td>By incorporation of irrigation in dry land. In the 9 Departments there are 1,658,431 ha of cultivation land and only 27% is irrigated. 73% is dry land with important demand for irrigation Average monthly income of farmers at the project area is very low. Survey conducted at three different Departments show the following income per month in nuevos soles (2009).
<table>
<tr><th>Acocro Ayacucho</th><th>Tumbadem Cajamarca</th><th>Sondor Piura</th><th>San Luis Ancash</th><th>Condebamba Cajamarca</th></tr>
<tr><td>106.7</td><td>143.0</td><td>101.4</td><td>91.1</td><td>161.8</td></tr>
</table>
In the same survey, it could be identified that lack of infrastructure was pointed out as the main problem by 39; 67 and 88% of the surveyed districts, respectively. In one of them, Acocro, 35% pointed out the lack of water as the origin of conflicts.</td><td>Increase in the availability of water resources. The Program of small and medium infrastructure in the sierra will be developed at 9 Departments, including 20 watersheds.</td></tr>
<tr><td>Infrastructure conditions. Irrigation quality is determined by the efficiency of: Conveyance, distribution, application and Irrigation. Presently, irrigation infrastructure is worn out, causing losses of water resources</td><td>The Program includes improvement in conveyance, distribution, application and irrigation.

The exam of the agriculture situation in the 9 Departments indicates an insufficient supply.</td></tr>
<tr><td>Training. The predominant irrigation system is furrow flooding that has low efficiency
<table>
<tr><th></th><th>Acocro %</th><th>Tumbaden %</th><th>Sondor %</th><th>San Luis %</th><th>Conde-bamba%</th></tr>
<tr><td>Furrow flooding</td><td>51.1</td><td>41.6</td><td>65.6</td><td>2.2</td><td>37.5</td></tr>
<tr><td>Gravity</td><td>20.7</td><td>9.5</td><td>34.4</td><td>66.8</td><td>62.5</td></tr>
<tr><td>Dripping</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.0</td><td>0.0</td></tr>
<tr><td>Sprinkler</td><td>0.0</td><td>11.1</td><td>0.0</td><td>31.0</td><td>0.0</td></tr>
<tr><td>Others</td><td>28.1</td><td>37.8</td><td>0.0</td><td>0.0</td><td>0.0</td></tr>
</table>
The survey identified that 90% of the surveyed persons was interested in the conservation of water sources. Also, more than 59% have a disposition to pay for the use of water.</td><td>Training in irrigation system management is a content of the Program, but insufficient compared to the existing demand.

There is no sufficient offer to transfer knowledge and training in management of irrigation systems.</td></tr>
<tr><td colspan="2">Balance
• Balance indicates an insufficient supply (Governmental Programs) in relation to the demand of the Andean Highlands producers to obtain water
• Considering the dimension of land without irrigation, the offer (the Program) will cover a marginal magnitude. The government goal is to reach year 2011 with 30% of average poverty in the country.
• There is insufficient irrigation infrastructure offer on the side of the Ministry of Agriculture and the decentralized entities. Also it is valid for the case of regional and local governments.
• Training is part of change and technological transfer. There is demand for it at the area of the Program, according to the results of the survey.</td></tr>
</table>

Considering that there is a high demand for the rehabilitation of irrigation infrastructure and also to incorporate new irrigation systems, the following actions have to be taken;

- Improve existing irrigation infrastructure conditions to increase irrigation area with a higher number of beneficiaries.
- Incorporate new irrigation systems in areas with water availability and higher demand for

the construction of irrigation systems.

- Achieve high efficiency in the use of water resources through the improvement of irrigation infrastructure
- Exploit the increase of water resources through the construction of dams and intakes
- Promote the management of the irrigation system by users, training them
- Promote maintenance of Irrigation Systems

Through these actions, the efficiency in the use of water should improve, attending a higher number of farmers and extending areas. The Program would be attending approximately 56 sub-projects in 9 Departments and the following results are expected;

- Double the irrigation area with more water resources (approximately 18,100 ha of improved irrigation system and 20,600 ha of new irrigation areas)
- Larger number of beneficiaries (approximately 24,800 farmer families)
- Increase food production for the 24,800 farmer families

Works to be constructed are;

- Rehabilitation of Main Canals
- Rehabilitation of Pipes
- Rehabilitation/Construction of Water Inlet
- Dam
- Culverts, etc.

Previously, the following issues will be cleared;

- Obtaining of the Agreement Statement from farmers communities and producers for the operation and maintenance of the irrigation system, including the watershed conservation
- Define the contribution policy of beneficiaries
- Define the participation policy (Construction of Infrastructures, Technical Irrigation, Watershed Conservation)
- Define the objective areas of technical Irrigation for the participation in the Competitive grants
- Obtain the Agreement Statement from farmers communities concerning the producers contribution
- Define the type of water fee collection

3.3.3 Technical Irrigation (Component B)

Producers are interested in introducing the system; however the high cost of technical irrigation infrastructure (approximately US$3,000 /ha) is a restriction to accede to it.

Concerning resources, Andean Sierra does not count on with much water or land resources. There are restrictions in water and soil availability as well as demographic pressure for more land. Besides, high population density conditions increase the frequency of conflicts for water.

Considering these restrictions, the only way to improve living conditions of farmers in the Sierra is to increase agriculture production by increasing the value of land and water by introducing technical irrigation systems.

Rainfall in the regions is approximately 700 to 800 mm per year, having very low during the months from April to October. It means that in the future, if no technical irrigation is introduced to save water,

the lack of it would cause huge social conflicts among the population of the same zones. For this reason, the introduction of technical irrigation has an important role to alleviate possible social conflicts.

To expand the technical irrigation system by sprinkler, it is necessary to show the advantages through the technical irrigation system module by conducting field days, demonstration of methods, technical seminars, field visits for follow-up – evaluation of the system and demonstration of technical and economic results, taking advantage of the existing social capital existing in the Project area.

Although producers are interested in the introduction of technical Irrigation, it still is a challenge. Water and land resources are not enough to fulfill producers' wishes, besides the available area of each producer is much limited. Under this reality, the introduction of technical irrigation is very important as a strategy of social inclusion for farmers in poverty and extreme poverty. Considering that the future of agriculture in the Sierra is the introduction of innovative agriculture with sufficient irrigation infrastructure that allows the introduction of cultivation products with better economic efficiency, it is very important to start the introduction of technical irrigation for the future of agriculture. The introduction of technical irrigation modules would allow obtaining the following results;

- Show the importance of technical irrigation by introducing agricultural innovation
- Build the investigation foundations for the introduction of innovative agriculture with added value
- Build leadership for the introduction of technical irrigation

Considering the importance of technical irrigation agriculture, modules of technical irrigation systems will be introduced in this program. The group of farmers participating in this system will be used as the basic group of agricultural development, conforming Users' Committees, commissions and boards.

This Program, of which purpose is to introduce an innovative and economic irrigation model will not use any type of conventional power source (electricity or fuel), making use of the soil gravity to provide the necessary water pressure that will be conveyed through a pipeline network.

Balance Offer and Demand: Technical Irrigation

<table>
<tr><th>Demand</th><th>Offer</th></tr>
<tr><td>Introduction of Technical Irrigation saves around 40% to 60% of water. Farmers demand for this technology is reflected in the answer to the question if they have or not have interest in this type of irrigation, obtained from the survey applied in the three districts of the Program area.
<table><tr><td></td><td>Acocro%</td><td>Tumbaden%</td><td>Sondor%</td></tr><tr><td>No</td><td>33.3</td><td>28.1</td><td>40.5</td></tr><tr><td>Yes</td><td>66.7</td><td>71.9</td><td>59.5</td></tr></table>The interest to use technical irrigation instead of traditional irrigation is shown in the following table.
<table><tr><td></td><td>Acocro%</td><td>Tumbaden%</td><td>Sondor%</td></tr><tr><td>No</td><td>3.0</td><td>7.3</td><td>11.9</td></tr><tr><td>Yes</td><td>97.0</td><td>92.7</td><td>88.1</td></tr></table>The answer to the disposition to pay for 20% of the technical irrigation cost was positively answered by 82 % (Tumbaden) to 100 % (Sondor) of the surveyed persons in the three districts.</td><td>The National Institute of Agriculture Innovation INIA – plans to create a fund to finance technical irrigation in 100,000 ha/year. The goal is to achieve 1 million ha in 10 years.

The Irrigation Sub-sector Project (PSI) has a Program under process of approval with components for:

a) Rehabilitation and Maintenance works for irrigation systems: 14,600ha.

b) Technical irrigation in lots for 3,500 ha.

Program for small and medium irrigation infrastructure in the Sierra, (Agro Rural) proposes a conglomerate of 1 technical irrigation modules for each of the 56 projects in the sierra of 9 Departments..</td></tr>
<tr><td>Technological training. Producers are aware of the advantages of technical irrigation, but also are aware that their knowledge is limited, requiring training.</td><td>INIA conducts technical training in technical irrigation. It has not been done at program level yet

There is a deficit of supply in this issue</td></tr>
<tr><td colspan="2">Balance

There is interest among producers concerning technical irrigation. High costs and low agriculture profitability make difficult the access to it. Inefficient use of water with the present technology determines increased seasonal shortage causing an increase in frequency and number of conflicts due to water. The process of technical irrigation is necessary but requires to be conducted together with technical, economic and technological innovation measures. The Program proposes modules (field examples) to conduct field days, demonstration of methods, technical seminars, field visits for follow-up – evaluation of the system and demonstration of technical and economic results.

Deficit in this aspect goes together with the previous. The system and process of introduction has to be organized and systematic, meaning a planning according to the tendencies of the market.

Need to Avoid Future Social Conflicts; As water and land resources in the Sierra are not sufficient for farmers to produce their food, there is a need to increase the potentiality of soils. Introduction of technical irrigation systems would allow the increase of production and to reach a larger number of producers, alleviating future social conflicts due to “fights for water”.</td></tr>
</table>

3.3.4 Conservation of the River Basin (Component C)

The fundamental pillars of the Andean system are: watershed, productive chain, organization of farmers, the platform of productive services and social services, justice administration and the local government. A system with said qualities corresponds to the Andean geography and the need to capitalize the economy and society to promote an equitable growth that uses natural resources in an integrated and sustainable manner.

Its feasibility will largely depend on the cohesion, responsibility and dynamics of the base organizations, both public and private. The effectiveness however, will be directly related to the capacity of social actors, entrepreneurs and organizations of the civil society to arrange and create consensus directed to the preparation and conduction of the local development plans.

One of the pending challenges is to launch the approach from the most relevant and manageable unit and by the local actors (named “finca” and that socially operates based on the family) towards a wider territorial space like the watershed.

As example, the alternative investment consists in strengthening users’ organizations towards a good management and use of water. It means updating the register of irrigators, the inventory of irrigation

infrastructure; preparation of an operation and maintenance regulation for the irrigation district; the formulation of the cultivation plan and irrigation demand; program of water distribution; hydrometry of integrated operation; identification of improvement and expansion works of the system; coordination between planning and water management of dams and canalss; determination of operative costs of the system and investment in works and training; fixing tariffs and fee collecting system; regulation of penalties by delay and non payment of fees; creation of instances for conciliation and resolution of conflicts and organization of the negotiation table to regulate and supervise use of water transfer. From the Communities and farmers are required:

- Prepare the Agreement Statement of Joint Responsibility for the contribution of beneficiaries (Irrigation Infrastructure, Technical Irrigation and Watershed Conservation)
- Prepare the Participation Agreement in the Competitive Grant (in case of interest)
- Prepare the Statement of the Irrigation System Operation and Maintenance, including the watershed conservation

Balance of Availability and Requirement: Watershed Management

<table>
<tr><th>Offer</th><th>Demand</th></tr>
<tr><td><u>For studies and practices for watershed management</u>

Frailty of the predominant ecosystems in the Program area is fundamental for this component. However each watershed is specific in the conformation and characteristics of ecosystems, as well as particular problems to be solved.

Micro properties, animal husbandry practices, demographic pressure that determine deforestation and cultivation practices and improper use of soils are combined, determining different realities for each watershed. It requires knowledge by the social actors concerned.</td><td><u>For studies and practices for watershed management</u>

Main institutions to develop the studies are:
▪ AGRO RURAL, that conducted the following studies: Pilot watershed Vilcanota (Cusco), Pilot watershed San Juan (Chincha), Pilot watershed Ramis (Puno).
▪ National Authority of Water ANA.
▪ Regional and local governments
▪ Institute of Geology, Mining and Metallurgy INGEMMET
▪ NGOS
▪ Agrarian Universities</td></tr>
<tr><td>Promotion for the Formation of Watershed Management Committees. To the question “Are you interested to participate in the watershed management committee?, the answers were the following:

Interest to Participate in the Watershed Management Committee
<table><tr><th></th><th>Frequency</th><th>%</th></tr><tr><td>No</td><td>4</td><td>9.5</td></tr><tr><td>Yes</td><td>38</td><td>90.5</td></tr></table></td><td>This experience is developed by AGRO RURAL.

AGRO RURAL is working at 5 pilot watersheds: San Juan (Chincha,Huacavelica-Ica); Chancay-Huaral (Lima); Vilcanota (Cusco); Ramis (Puno); Casma (Ancash). All have Watershed Management Committees

National Authority of Water (ANA) is empowered by law to create the Watershed Councils, which are multi-sector commissions depending on ANA, at each watershed or group of watersheds.</td></tr>
<tr><td colspan="2">Balance
Economic resources are not available. Also, some local and regional governments do not show sufficient interest.

There are institutions with the respective knowledge. Also there is evidence of interest by the farmers to participate in the Watershed Management Committees. In this case, the deficit concerns economic resources. Besides, a very strong awareness raising and motivation campaign towards the communities and other actors of the watershed about the water issue, the importance of rain water filtration at the watershed “crown”, the meaning of managing a watershed basin and the role of the Watershed Management Committees is necessary.

From the organization point of view, it is convenient to interest and to incorporate the local and regional governments in the structure of the Management Committees, as well as NGO’s and private companies to provide the sustainability they need. This Program proposes that the Irrigation Boards play a major role in the fulfillment of the Management Committee functions, for their capacity to call the population, especially activities concerning the water recharge of the reception watershed.</td></tr>
</table>

3.3.5 Alternative Solution

In order to prepare the necessary alternatives and achieve the central objective proposed in the tree of objectives, it is necessary to consider the possibilities of implementation from the point of view of impacts: economic, social, needs for the future, AGRO RURAL capacity and the possibility of implementation by other institutions. The following table indicates a tentative evaluation for the alternatives of solutions.

Evaluation for Alternatives of Solution

		Economic Impact	Social Impact	Needs for the future	AGRO RURAL capacity	possibility of implementation by other institutions	Necessity by this program
Watershed conservation	Studies for Watershed Management	M	A	A	A	B	A
	Promotion of the Watershed management committee	B	A	A	A	M	A
	Collecting watershed management	M	A	A	A	M	A
Improvement of the Existing System	Improvement of the irrigation system (Canal lining, Arrangement of distribution canals, etc.)	A	A	A	A	B	A
	Introduction of Technical Irrigation	A	A	A	M	M	A
	Training on irrigation system management	A	A	A	M	A	M
	Maintenance of the Irrigation system	A	A	A	B	A	M
Incorporation of Irrigation in Dry Cultivation Areas	Construction of water dam infrastructure	A	A	A	A	B	A
	Construction of water caption infrastructure	A	A	A	A	B	A
	Construction of news canal for areas to be expanded	A	A	A	A	B	A
Training of Producers in Cultivation Technology	Use of improved seeds	A	A	A	B	A	M
	Use of organic/chemical fertilizers	A	A	A	A	A	M
	Strengthening lines of credit	A	A	A	B	A	M
	Strengthening of technical assistance	A	A	A	B	A	M
	Use of chemical supplies	A	M	A		A	M
	Others						

Score; A; High, M; Medium, B; Low
Source: Study Team

As the Program covers 9 Departments, it will not be possible for AGRO RURAL to conduct all actions; in consequence it is necessary to share responsibilities with other institutions, especially Regional and Local Government and Users Boards. Actions expected to be carried out by other institutions are: (actions excluded from the Program):

1. Use of Improved Seeds
2. Use of organic/chemical fertilizers
3. Availability of Credit Lines
4. Use of chemical agricultural supplies
5. Others

(1) Priority Programs (Small and Medium Irrigation Infrastructure in the Peruvian Sierra)

As priority actions of the Program, three components were selected: a) Improvement and Construction of Irrigation Infrastructure b) Technical Irrigation and c) Institutional Strengthening for Watershed Management.

1) Component A: Irrigation infrastructure

The Component of Irrigation Infrastructure is oriented to recover the productive capacity reduced by the use, environmental phenomenon and poor maintenance. Rehabilitation and improvement of dams, intakes and canals, allow reducing losses in intake and conveyance and at the same time, expanding the irrigation areas. The construction of irrigation infrastructure allows the incorporation of agriculture land increasing availability of water resources.

2) Component B: Technical irrigation

The Component of Technical Irrigation is oriented to increase productivity of crops in the area defined for the improvement and construction of irrigation infrastructure. It constitutes of the installation of irrigation systems for the rational and efficient use of water and increase agriculture productivity.

The importance of Technical Irrigation in the policies of the government is manifested through Law Nª 28585 and its Regulation D. S. Nª 004-2006-AG (21/01/06) that creates and regulates the National Program of Technical Irrigation. Said program introduces incentives up to 50 % of the investment in the Costal area and up to 80% in Sierra and Selva.

3) Component C: Institutional Strengthening for Watershed Management

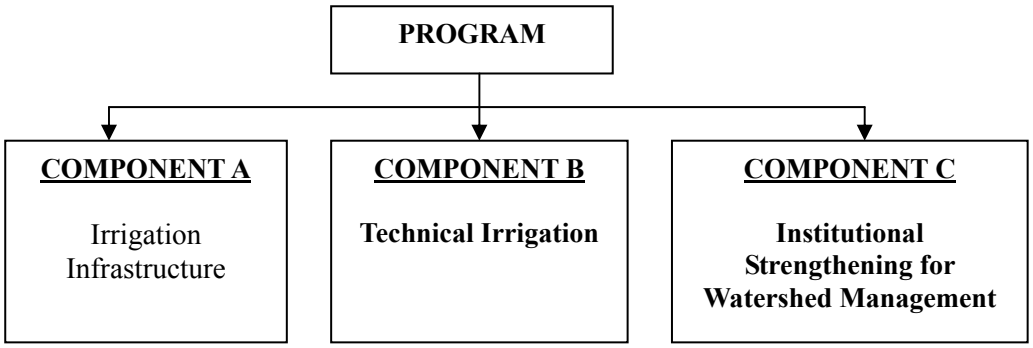
The objective proposed by AGRO RURAL constitutes of strengthening management capacity of the watershed actors to improve the zones of the micro-watershed water recharge where irrigation projects are going to be implemented, with the institutional strengthening for watershed management.

It deals with the institutional strengthening of the watershed management process and to incorporate conservation practices in the zones of water recharge to assure the quantity and quality of irrigation water.

3.3.6 Definitive Program

(1) Typology of the Program

The Program has three components:



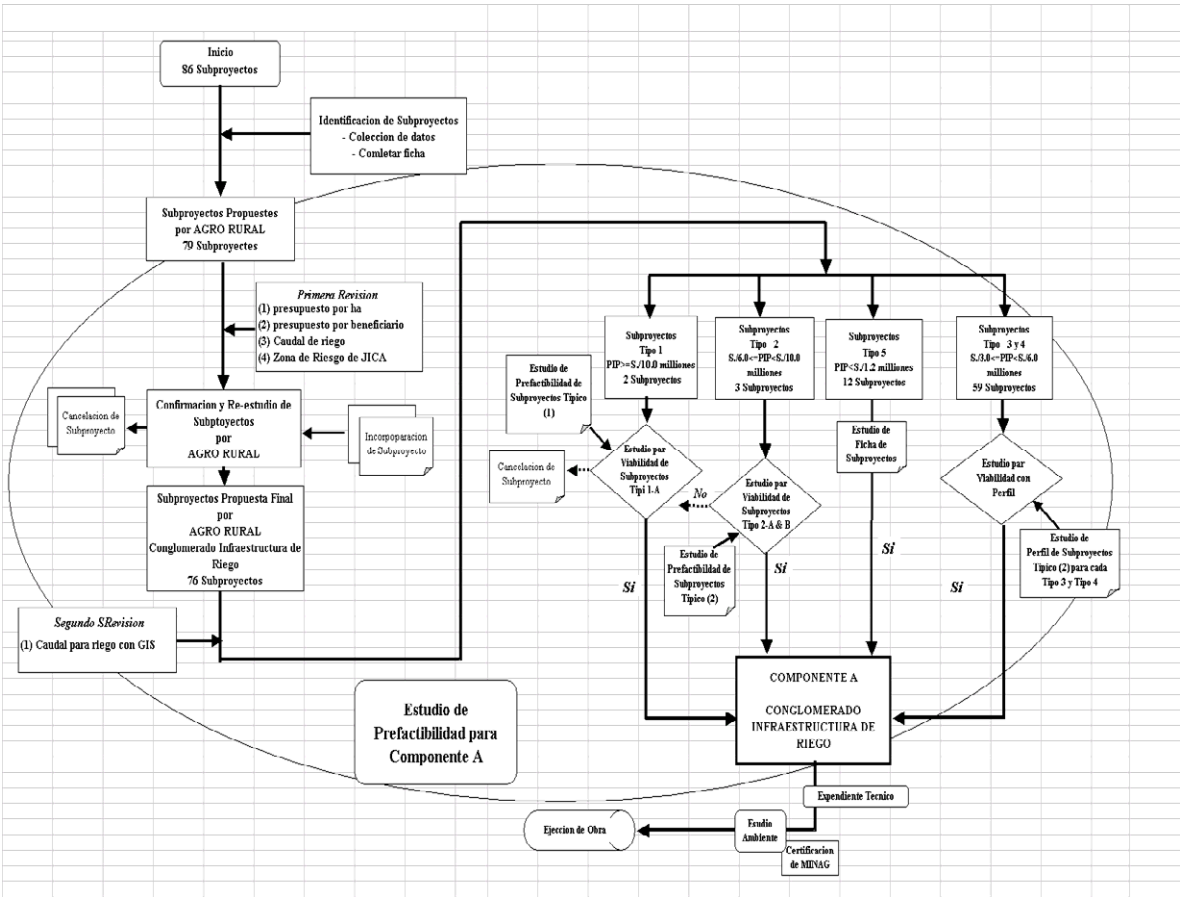
Component A is integrated to irrigate area of 3,732 ha by the irrigation works such as: canal lining, canal construction, intake, dams, etc., benefiting a great number of producers. Component B is composed by the technical irrigation system to save the use of water resources and increase the number of beneficiaries and productivity, objecting to make infrastructure of 1,120 ha. Component C will be implemented with the objective of providing sustainability to water resources from their sources through the assistance for the organization of micro watershed management committee.

Recommendations of the MEF's technical reports propose to structure the Program in the following three components: a) Improvement and Construction of Irrigation Infrastructure; b) Technical Irrigation by Lots; and c) Institutional Strengthening for Watershed Management.

Through official letters No 2058-2006-AG-OGPA-OI of March 25, 2006 and 336-2007-AG-DM of May 24, 2007, the MINAG requested the Ministry of Economy and Finance (MEF) to start negotiations of external loan to finance the program with JBIC. The DGPM-MEF, through technical reports No 127-2006-EF/68.01 and 104-2007-EF/68.01, made observations to the program perfil, suggesting that negotiations for external loan should start after the conducting of pre-feasibility studies.

(2) Selection of Subprojects in the Program Area

The selection of Subprojects at the Program area was conducted as follows:



1) List of Proposed Sub-project

The list of Sub-projects proposed by AGRO RURAL is the following:

Table 3.3-2 List of Subprojects

No	Prov.	No	NOMBRE DEL PROYECTO	ÁREA TOTAL	FAM. BENEF.	PRESUPUESTO (S/.)
1	AMAZONAS	AMA-1	Mejoramiento del Sist. Riego Higuerones-San Pedro	779	132	2,355,114
2		AMA-2	Mejor. del Sist. Riego San Juan Marañón-La Papaya	1,477	224	3,216,278
3		AMA-3	Mejoramiento Bocatoma y Canal Limonyacu Bajo	515	132	1,805,411
4		AMA-4	Mejoramiento del Sistema de Riego Utcuchillo - Canal Aventurero	574	101	1,776,666
5		AMA-5	Mejoramiento del Sistema de Riego Naranjitos - Canal Naranjitos Nº. 02	554	97	1,206,035
6		AMA-6	Mejoramiento del Sistema de Riego Naranjos - Canal El Tigre	1,237	226	3,017,895
7		AMA-8	Mejoramiento del Sistema de Riego Goncha Morerilla - Canal Gonchillo Bajo	284	77	737,433
8		AMA-9	Mej.Boc.Rev.Tramo Canal Comunal Huarangopampa	770	113	1,713,111
9		AMA-10	Mejoramiento del Sistema de Riego Lumbay Balsas	350	350	1,433,840
10		AMA-11	Mejoramiento del Sistema de Riego Naranjos - Canal Naranjos	893	193	1,946,242
11		AMA-12	Mejoramiento del Sistema de Riego El Pintor - Canal Abad.	577	113	1,296,274
12		AMA-13	Mejoramiento Canal San Roque Watson	871	306	1,341,466
13		AMA-14	Mejoramiento Canal Riego La Peca Baja - Canal Brujopata	340	100	1,438,926
			Sub-Total	**9,221**	**2,164**	**23,284,691**
14	CAJAMARCA	CAJ-1	Construcción Canal de Irrigación El Rejo	1,510	560	12,055,925
15		CAJ-2	Rehabilitación Canal El Huayo	1,428	321	3,672,818
16		CAJ-6	Construccion Canal La Samana - Ushusqui	400	309	850,000
17		CAJ-7	Irrigacion Cochán Alto	600	450	4,290,151
			Sub-Total	**3,938**	**1,640**	**20,868,894**
18	PIURA	PIU-1	Canal de Irrigación Espíndola	500	150	1,457,430
10		PIU-2	Mejoramiento Canal Sanguly	900	350	808,356
20		PIU-5	Mejoramiento Canal Chantaco Huaricanche	1,345	785	1,436,386
			Sub-Total	**2,745**	**1,285**	**3,702,172**
21	LA LIBERTAD	LIB-1	Mejoramiento del Canal Sute Putute	529	250	1,977,500
22		LIB-4	Mejor. Canal Riego Chuquillanqui-Shushipe	1,000	250	2,823,059
23		LIB-6	Represa Laguna Negra-Const Canal de Riego Chugay	600	150	2,172,870
			Sub-Total	**2,129**	**650**	**6,973,429**
24		ANC-2	Mejoramiento del Canal de Irrigacion Paron II	510	350	1,059,041
25		ANC-3	Construcción Canal de Irrigación Casablanca- Jocosbamba – Quiches (Joquillo)	563	660	4,035,420
26		ANC-4	Construcción Canal Rupawasi - Rosamonte	550	2,050	3,036,496
27		ANC-5	Construcción Canal de Irrigacion Sol Naciente de San Luis	1,066	719	6,600,000
28		ANC-6	Mej. Y Amploacion del Canal de Irrigacion Quishquipachan	250	160	997,248
29		ANC-9	Mejoramiento del Canal de Riego Quinta Toma	250	90	612,864
30		ANC-10	Const. Canal de Riego Aynin-Huasta	525	320	4,090,507
31		ANC-11	Construcción Canal Cordillera Negra	1,300	2,117	11,399,144
32		ANC-12	Mejoramiento Canal Rurec	800	180	2,717,741
33		ANC-16	Const. Sistema de riego Jatun Parco	625	280	5,248,108
34		ANC-17	Mejoramiento Canal Chuayas-Huaycho	650	600	4,758,790
35		ANC-18	Mejoramiento Chinguil - Cruzpampa	600	820	3,193,284
36		ANC-19	Sistema de Riego Mancan Aija	540	418	2,500,000
37		ANC-20	Canal de Irrigación Desembocadero – San Miguel	120	162	730,904
			Sub-Total	**8,349**	**8,926**	**50,979,547**
38	HUÁNUCO	HUA-2	Construcción Canal de Riego Sogoragra Rondobamba	240	76	1,687,965
			Sub-Total	**240**	**76**	**1,687,965**
39	JUNIN	JUNIN-1	Mejoramiento Canal Achamayo	1,520	1,306	1,591,747
40		JUNIN-2	Irrigación Aywin	400	1,110	2,789,776
41		JUNIN-3	Irrigación Cotosh II Etapa	1,101	1,081	3,811,524
42		JUNIN-4	Mejoramiento canal Ranra Antabamba	100	66	288,896
43		JUNIN-5	Mejoramiento Canal Sector Atocsaico	200	616	954,527
44		JUNIN-6	Construccion del Sistema de Riego Rupasha - Vista Alegre	1,281	202	3,211,885
45		JUNIN-7	Mejoramiento del Sistema de Riego de las Localidades de Yauli y Jajapaqui	450	501	3,975,471
46		JUNIN-9	Mejoramiento Canal Mayuhuato - Huaracaya	160	229	358,448
47		JUNIN-10	Canal de Riego Ninatambo	115	80	559,003
			Sub-Total	**5,327**	**5,191**	**17,541,276**
48	HUANCAVELICA	HUANCA-2	Irrigación Chaynabamba	249	120	1,846,305
49		HUANCA-3	Irrigación Cusicancha-Huayacundo-Arma-Huaytará.	400	157	1,523,211
			Sub-Total	**649**	**277**	**3,369,515**
50	AYACUCHO	AYA-1	Construcción y Mejoramiento del Sistema de Riego Cangallo	660	532	7,238,039
51		AYA-2	Construcción Sistema de Riego Ccocha-Huayllay	439	550	2,961,411
52		AYA-5	Construccion de Presa y Sistema de Riego Chaqllani-Pucapampa	1,040	300	5,799,999
53		AYA-6	Irrigacion Papatapruna - Ccochalla	495	90	2,311,977
54		AYA-9	Mej y Const. Sistema Riego Putacca Ccatun Pampa	400	168	1,349,658
55		AYA-12	Const. presa y sistema de riego Chito-Sachabamca y Quishuarcancha, Chiara	2,000	2,000	5,760,000
56		AYA-13	Const. Canal y Represa Tintayccocha-Acoro	1,100	1,000	8,996,000
			Sub-Total	**6,134**	**4,640**	**34,417,083**
			GRAN TOTAL	**38,732**	**24,849**	**162,824,573**

(a) Analysis of the Program contents

In the Program there are 56 sub-projects divided in sub-projects of canal improvement, canal improvement and construction and construction of new canal. Also, in the irrigation infrastructure item not only canal improvement and/or construction are considered but also there are sub-projects of improvement and construction of canal and dam (including reservoirs). In the following table the

classification by Departments is shown.

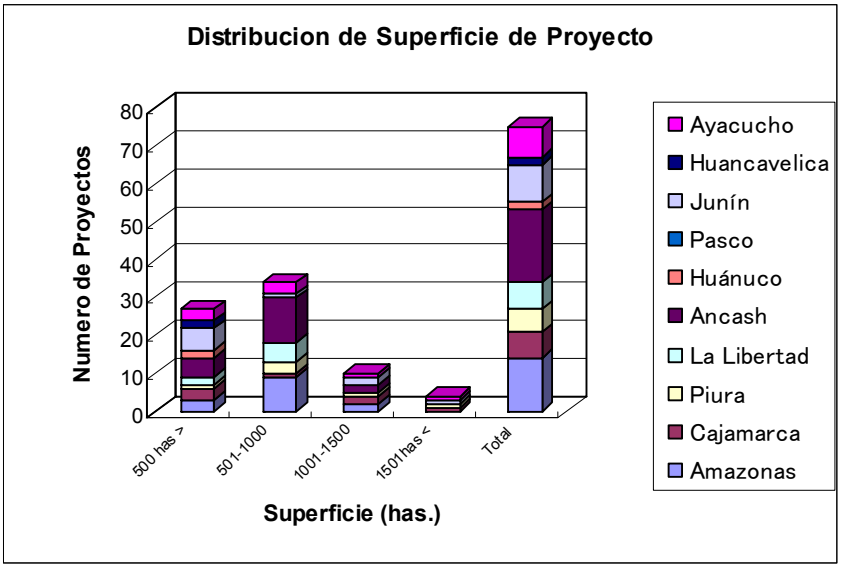
Table 3.3-3 Type of Works for the subprojects

Department	Only Canal				Canal & Presa			Total
	Improve/Upgrade.	Improve & new	All New	Total	Canal Improve. New & New Dam	New Canal & Dam	Subtotal	
Amazonas	0	13		13				13
Cajamarca	0	1	3	4				4
Piura		2	1	3				3
La Libertad	1		1	2	1		1	3
Ancash	3	7	3	13		1	1	14
Huánuco		2		2				2
Pasco				0				0
Junín	5			5	3	1	4	9
Huancavelica		1		1				1
Ayacucho		2		2	4	1	5	7
Total	9	28	8	45	8	3	11	56

Source: Study Team

(b) Analysis of Irrigation Area and Beneficiaries

b-1 Irrigation Areas



Irrigation areas ranges from sub-projects of 3,000 ha (Improvement Canal Chorro Blanco Nancho, Piura) to the smallest with 100 ha (Improvement Canal Ranra Antabamba, Junin), with an average of 703 ha. Irrigation areas by Department are shown in the following figure:

CTable 3.3-4 Distribution of the Project Area

Departament	500 has >	501-1000	1001-1500	1501has <	Total
Amazonas	3	8	2		13
Cajamarca	1	1	1	1	4
Piura	1	1	1		3
La Libertad		3			3
Ancash	3	9	2		14
Huánuco	2				2
Pasco					0
Junín	6		2	1	9
Huancavelica	1				1
Ayacucho	3	1	2	1	7
Total Numero de Subproyectos	20	23	10	3	56

Source: Study Team

b-2 Number of beneficiaries

Sub-projects whose totality of beneficiaries is less than 500 families represent 69% of the Program (39

sub-projects). On the other hand, sub-projects with more than 1000 beneficiaries represent 11% (6 sub-projects).

Table 3.3-5 Distribution of Number of Beneficiaries

Departament	Number of Beneficiaries						Total
	100Benef >	101-500	501-1000	1001-1500	1501-2000	2001Benef <	
Amazonas	3	10	0	0	0	0	13
Cajamarca		3	1				4
Piura		2	1				3
La Libertad		3					3
Ancash	1	7	4	0	0	2	14
Huánuco		2					2
Pasco							0
Junín	2	2	2	3			9
Huancavelica	1						1
Ayacucho	1	2	3		1		7
Total	8	31	11	3	1	2	56
Porcentaje	14%	55%	20%	5%	2%	4%	100%

Source: Study Team

b-3 Analysis of the Investment Amount

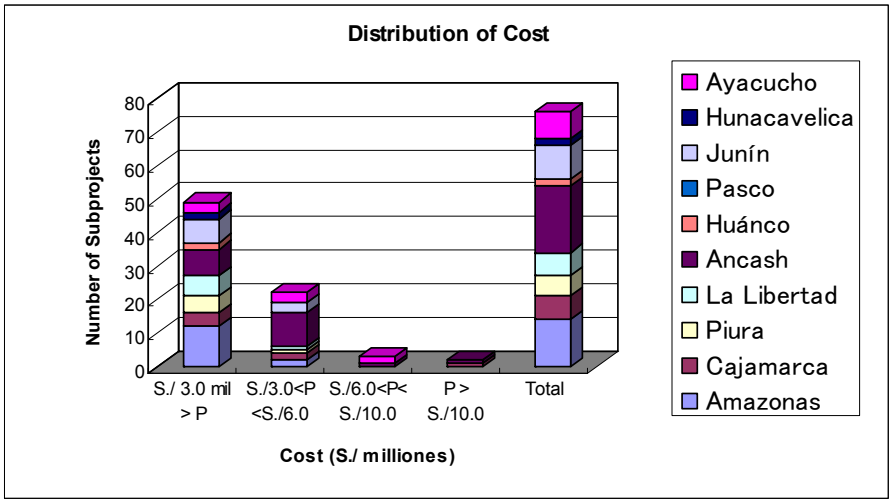
b-3.1 Classification of sub-projects according to the investment amount by Department.

The following table shows the sub-projects by investment amount divided according to SNIP indications and by Department.

Table 3.3-6 Cost and Number of Subproject

Departamento	Budget and Number of Subproject				
	S./ 3.0 mil > P	S./3.0<P <S./6.0	S./6.0<P< S./10.0	P > S./10.0	Total
Amazonas	11	2			13
Cajamarca	1	2		1	4
Piura	3				3
La Libertad	3				3
Ancash	6	6	1	1	14
Huánuco	2				2
Pasco					0
Junín	6	3			9
Huancavelica	1				1
Ayacucho	3	2	2		7
Total	36	15	3	2	56

Source: Study Team



b-3.2 Investment Amount by area unit (ha.)

The following table shows the investment amount by area unit of each subproject, classified by Departments, being the average US$1,500/ha per project. 37 sub-projects (66%) have an investment amount less than US$ 1,500/ha. In 7 sub-projects (13%) the investment amount is US$ 2,000, and 12 sub-projects (22%) whose amount ranges from US$ 2,000 – US$ 3,000 need to be reviewed. Also, projects whose investment amount is more than US$3,000/ha should be revised from the same formulation.

Table 3.3-7 Distribution of Investment per Hectare

Departamento	**<US$ 1000**	**1000 - 1500**	**1500 - 2000**	**2000 - 3000**	**3000 - 5000**	**US$5000<**	Total
Amazonas	10	3	0	0	0	0	13
Cajamarca	2	0	0	2	0	0	4
Piura	3	0	0	0	0	0	3
La Libertad	1	2	0	0	0	0	3
Ancash	3	2	4	5	0	0	14
Huánuco	0	1	0	1	0	0	2
Pasco	0	0	0	0	0	0	0
Junín	4	3	1	1	0	0	9
Huancavelica	0	0	0	1	0	0	1
Ayacucho	2	1	2	1	1	0	7
Total Numero de Subproyectos	**25**	**12**	**7**	**11**	**1**	**0**	**56**
	45%	**21%**	**13%**	**20%**	**2%**	**0%**	**100%**

Source: Study Team

b-3.3 Investment Amount by Beneficiary

The following table shows the investment amount corresponding to the sub-projects beneficiaries. There is a lot of variation in the amount of investment, depending on each sub-project. The average investment amount is US$ 1,784/beneficiary; for 8 sub-projects (14%) the investment amount is less than US$1,000/beneficiary; on the other hand, there are 3 sub-projects (6%) whose amount of investment is more than US$3,000/Beneficiary. The corresponding investment amount has direct relation with the economic capacity so it is necessary to study the existing situation of land possession, capacity of contribution in labor force and maximum economic contribution of each one.

Table 3.3-8 Cost by Beneficiary

Departament	Cost by Beneficiaries (S./ /Benef.)						Total
	<US$ 1000	1000 - 1500	1500 - 2000	2000 - 3000	3000 - 5000	US$5000<	
Amazonas	3	10	0	0	0	0	13
Cajamarca		3	1				4
Piura		2	1				3
La Libertad		3					3
Ancash	1	7	4	0	0	2	14
Huánuco		2					2
Pasco							0
Junín	2	2	2	3			9
Huancavelica	1						1
Ayacucho	1	2	3		1		7
Number of Subprojects	8	31	11	3	1	2	56
%	14%	55%	20%	5%	2%	4%	100%

Source: Study Team

3.4 Technical Description of the Alternatives Proposed

3.4.1 Program

(1) Program Design Matrix (PDM)

The Program Design Matrix is the following:

PDM

Summary of the project	Objectively verifiable indicator	Sources of verification	External conditions
Superior Objective Increase agricultural production of families located at the less developed areas of the sierra	Cultivation area and volume of production at the irrigation area	Record of cultivation area, statistic records	
Objective of the Program Improve the availability, conservation and offer of water resources to favor the increase of agriculture production of families located at the less developed area of the sierra.	Irrigation Area 24,849 families of farmers, 38,732ha of land under irrigation) * 1120 ha under technical irrigation * 50 Committees of Water Resources Management of Micro Watershed	Monitoring report (Number of Executed works, conservation areas) Ackowledgment of Management Comittee of Micro Watershed of ANA	Availability of participation by the community and Regional/Local Government Technical assistance by the local Government
Results ・ Increase agriculture production by increase of irrigation area ・ Incorporation of Technical irrigation ・ Sustainable development to assure natural resources self-managed by farmers	Improvement of Irrigation Area of 18,103 ha and Incorporation of Irrigation Area of 20,629ha). 1,120 ha with tecnical irrigation system. Preparation of 50 Plans of managements and Appropriate use of the Water resources in 50 Micro Watershed.	Monitoring report ▪ Number of beneficiaries ▪ Number of committees conformed ▪ Implemented works ▪ Number of Irrigation Users Board conformed	Motivation of Farmers Organizations and other agents Efficient Maintenance Start of watershed conservation activities
Activities ・ Implementation of Irrigation infrastructure **(Component A)** ・ Incorporation of Technical irrigation **(Component B)** ・ Institutional strengthening for the watershed management **(Component C)** ・ Program Management **(Component D)**	・ Improvement and construction of Channels and Dam. ・ Improvement and construction of lateral channels. ・ The investment budget for the component A. ・ Number of Tecnical Irrigation System: 56 projects. ・ Number of Micro Watershed for component C: 50 micro watershed.	・ Monitaring Report ・ Evaluation Report ・ Minuts of Work Reception and liquidation of Contracts ・ Supervision Reports ・ Each Activities Expenditure ・ Register of Ejecution Unit, Users Unit and of Agro Rural ・ Interview with Director or Manager of Users Association ・ GIS report ・ Interview	・ Timely Avaliability of Financial Resources ・ Efficient Administration of Financial Resources of Users Association ・ Good Supervision ・ Willingnes to participate Users Association ・ Willingnes of Local Regional Governments for the participation to the Seminor, Workshop, Public Audience etc.

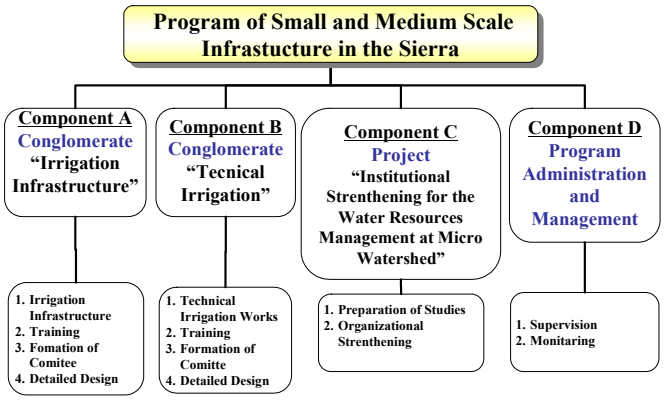
The objective of the Program is to structure the basis for the Irrigation infrastructure and the watershed conservation to increase agricultural production of families in situation of poverty and extreme poverty located at the Sierra. The superior objective is to contribute to poverty mitigation through the increase of agriculture production of families in situation of poverty and extreme poverty located at the Sierra.

(2) Program Area

Departament	Provinces	Districts
AMAZONAS	3 Provinces（Utcubamba, Chachapoyas, Bagua）	5 Districts(La Peca, Balsas, Bagua Grande, Cajaruro, El Milagro)
ANCASH	10 Provinces(Aija, Bolognesi, Carhuaz, Carlos Fermin Fitzcarrald, Huaráz, Huaylas, Mariscal Luzuriaga, Pomabamba, Sihuas, Yungay)	17 Districts(Aija, Huasta, Pacllòn, San Luis, Huaraz, Olleros, Caraz, Llumpa, Chingalpo, Quiches, San Juan, Ranrahirca, Acompampa, Aqvio, Reway, Ticapampa, Catac, Romabamba)
AYACUCHO	5 Provinces(Cangallo, Fajardo, Huamanga, Lucanas, Vilcashuaman)	10 Districts(Maria Prado de Bellido, Los Morochucos, Cangallo, Huancapi-Huancaraylla, Acocro, Chiara, Vinchos, Puquio, Concepción)
CAJAMARCA	4 Provinces(Cajabamba, Chota, San Miguel, San Pablo, Santa Cruz)	6 Districts（Condebamba, San Silvestre Tumbaden, San Pablo, Yauyucán, San Luiz)
HUANCAVELICA	1 Provinces(Huaytará)	2 Districts（Cusicancha,Huaytara）
HUANUCO	2 Provinces(Huánuco,Yarowilca)	2 Districts（Quisqui, Aparico Pomares）
JUNÍN	5 Provinces(Concepción, Huancayo, Jauja, Junin, Tarma)	8 Districts（Sta Rosa de Ocopa, Comas, S.J. Quero, Chicche Yauli, Acobamba, Tarma, Japo, Junín)
LA LIBERTAD	3 Provinces（Bolivar, Gran Chimú, Sanchez Carrión）	3 Districts（Ucuncha, Lucma, Chugay)
PIURA	2 Provinces(Ayabaca, Huancabamba)	3 Districts（Ayabaca, Montero, Sondor,）
9 Departaments	35 Provinces	56 Districts

(3) Component of the Proposed Program

The Objective of the Program is to "Increase agriculture production of families in situation of poverty and extreme poverty in the Sierra area". For this purpose, four components will be synergically implemented: Component A; Implementation of Irrigation infrastructure, Component B; Incorporation of Technical irrigation, Component C; Institutional Strengthening for watershed management, described in the3 following sections and Component D; Program Management.

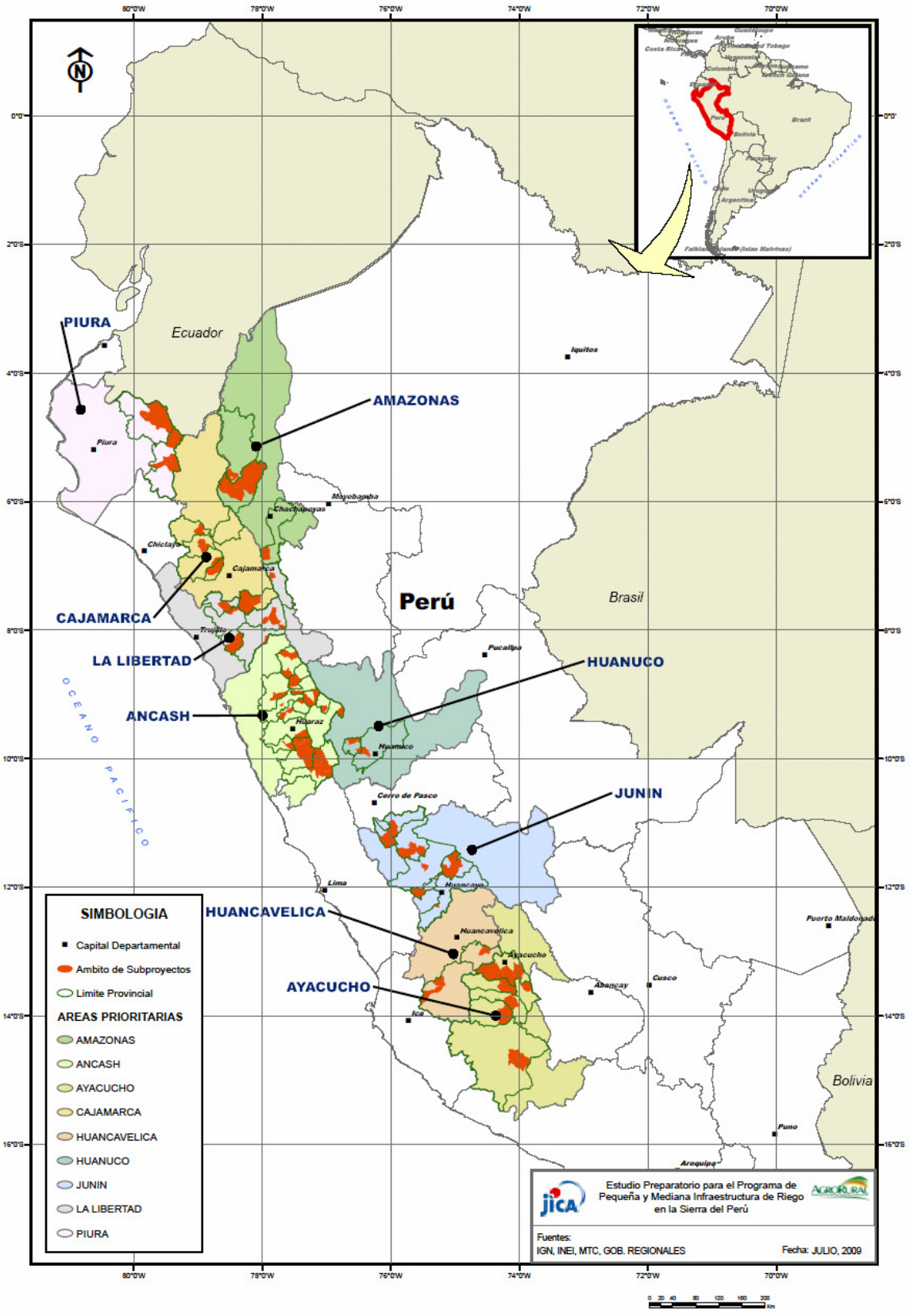


These four components will be implemented to favor the agriculture production of farmers. As result of this Program, it is expected an increase of production for approximately 36.4 thousand families that are not capable to produce enough food for their self-consumption.

The following results are expected;

- Increase of production for approximately 24.8 thousand farmers presently in situation of poverty and extreme poverty
- Increase cultivation area from 27,529 ha (1.1 ha per producer) to 55,141 (2.2ha per producer) improving earnings. It is planned to double the reach of water through improvement of irrigation infrastructure.
- Increase agriculture production and improve income.
- Construct the basis for the introduction of technical agriculture through modules of Technical irrigation Systems
- Structure the fundaments of actions for watershed conservation

Program Area



The contents of the Proposed Program are indicated in the following Chart;

Table 3.4-1 Contents of the Program

Componet	Number
A Conglomerate "Infrastructure de irrigation"	
Type 1: Subprojects (More than 10 million)	2 Sub projects
Type 2-A: Subprojects (Between 6 to 10 million) only Canal	1 Sub projects
Type 2-B: Subprojects (Between 6 to 10 million) with dam	2 Sub projects
Type 3-A: Subprojects (Between 3 to 6 million) only Canal	10 Sub projects
Type 3-B: Subprojects (Between 3 to 6 million) with dam	5 Sub projects
Type 4-A: Subproject (Between 1.2 to 3 million) only dam	21 Sub projects
Type 4-B: Subproject (Between 1.2 to 3 million) with dam	4 Sub projects
Type 5: Subprojects (less than 1.2 million)	11 Sub projects
B Conglomerate "Technical irrigation"	
Works of Technical irrigation	56 Modules
Training & Technical Assistance	
C Project" Institutional Strengthening for Watershed Management" Total Component	
Study	50 Watersheds
Promotion of Watershed Committee	50 Watersheds
D Program Management	
Administration & Supervision	1 Unit
Program Managements	1 Unit
TOTAL	1 Program

Note: Conglomerates A and B consider Technical Training

3.4.2 Component A : Irrigation Infrastructure

This component will be implemented to achieve an appropriate offer and technical level for the use of the irrigation water for the improved crop area of 38,732 ha. With the improvement and construction of canals, and with the construction of canals, dam and headworks, the irrigation efficiency will be improved and a bigger area of rainfed crop area will be converted to irrigated area.

(1) PDM of Component A

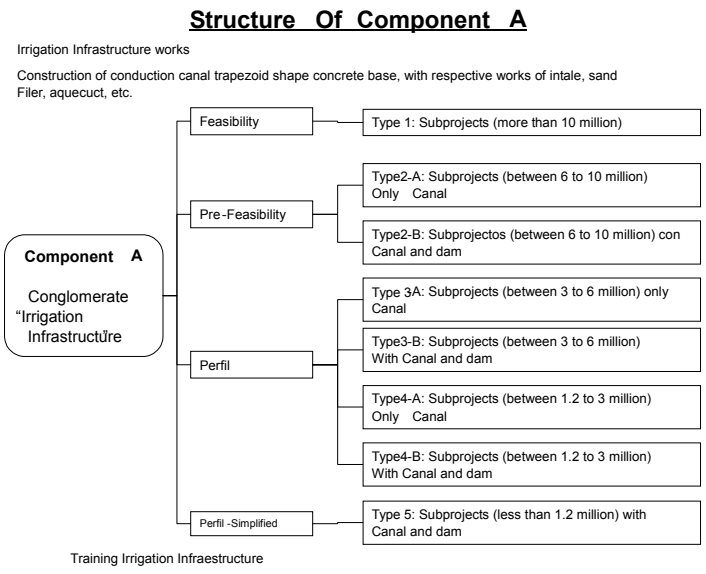
PDM of Component A is the following:

PDM of Component A: Irrigation Infrastructure

Summary of the project	Objectively verifiable indicator	Sources of verification	External conditions
Superior Objective Improve availability and offer of water resources of the irrigation area for families located at the less developed areas.	Irrigation area	Record of cultivation area and statistic data	
Objective of the Program Achieve the proper offer and technical level in the use of superficial irrigation water to improve production	Dimension of improved canals Dimension of constructed canals Number of intakes constructed Number of dams constructed Incorporated irrigation areas	Monitoring report	Disposition to participate by the community and the Regional/Local Government Technical assistance by the local Government
Results • Increase and improvement of agriculture production areas • Improvement of life quality of the population benefited with irrigation water • Sustainable development • Contribution to water ordainment in the Program area • Reduction of irrigation water loss	Work implementation monitoring Situation of water control by farmers Variation of cultivation areas		Motivation of farmers organizations Efficient Maintenance Start of activities for watershed Conservation
Activities • Rehabilitation of Canal (Lining) • Construction of concrete canal • Construction of intake • Construction of dam • Maintenance of canals	Investment **1. Agro Rural** Pre-investment Detailed Design Implementation of Works Input **2. Local Governments** Technical Assistance	Farmers • Participation in Works • Investment contribution • Operation and maintenance of the irrigation system • Administration of water	Capacity of the executing entity Previous conditions Pre-investment of subprojects by the formulators (Perfil, Prefeasibility, etc)

(2) Structure of Component A

The structure of Component A is shown in the following figure:



Component A: Considering the similarity and requirements of SNIP, they were typified and grouped as follows:

Group Type 1 is conformed by subprojects requiring Feasibility Study, according to SNIP rules, due to the investment amount.

Group Type 2A is conformed by Subprojects requiring Pre-feasibility studies and the major works are the construction of canals. Group Type 2B is conformed by Subprojects requiring Pre-feasibility studies and the major works are: irrigation system with construction of dam. Budget varies from 6 to 10 million soles

Group Type 3A is conformed by Subprojects with budget between 3 to 6 million soles; SNIP approval is at Perfil level and main works are: rehabilitation and construction of canals. Group Type 3B is conformed by Subprojects with budget between 3 to 6 million soles; SNIP approval is at Perfil level and consists in the construction of canal and dam.

Group Type 4A is conformed by Subprojects with budget between 1.2 to 3 million soles; SNIP approval requirement is at Perfil level and main works are: rehabilitation and construction of canals. Group Type 4B is conformed by Subprojects with budget between 1.2 to 3 million soles; SNIP approval requirement is at Perfil level and main works are canal and dam construction.

Group Type 5 is conformed by Subprojects less than 1.2 million soles. This group only requires a simplified Perfil for SNIP approval and can include canal and dam.

The quantity of proposed subprojects, by type and department for Component A are the following;

Table 3.4-2 Type of Subprojects (Nos.)

Category	Type 1	Type 2-A	Type 2-B	Type 3-A	Type 3-B	Type 4-A	Type 4-B	Type 5	Total
Amazonas				2		10		1	13
Cajamarca	1			2				1	4
Piura						2	1		3
La Libertad						2	1		3
Ancash	1	1		6		1	1	4	14
Huanuco						2			2
Junin					3	1	1	4	9
Huancavelica						1			1
Ayacucho			2		2	2	1		7
Total	2	1	2	10	5			**10**	**56**

(3) Plan of Agriculture Development

1) Basic Information

In this Component, the following objectives are proposed;

- Maintain and Increase irrigation area of 38,732 ha, through the improved and constructed irrigation infrastruture
- Increase production by increasing number of crops (2 crops a Year)

Goal of the Program area and the families to be benefited are;

Table 3.4-3 Area of benefit and beneficiary families of the Program

Number of Project/Departments	Number of Sub projects	Area(ha)			Beneficiaries Families
		Improv.	New	Total	
Tipo 1					
Construcción Canal de Irrigación El Rejo	1	0	1,510	1,510	560
Construcción Canal Cordillera Negra	1	0	1,300	1,300	2,117
Subtotal	2	0	2,810	2,810	2,677
Tipo 2-A					
Construcción Canal de Irrigación Sol Naciente de San Luis	1	0	1,066	1,066	719
Tipo 2-B					
Construcción y Mejoramiento del Sistema de Riego Cangallo	1	555	105	660	532
Const. Canal y Represa Tintayccocha - Acocro	1	600	500	1,100	1,000
Subtotal	2	1,155	605	1,760	1,532
Tipo 3-A					
Departamento Amazonas	2	2,374	340	2,714	450
Departamento Ancash	6	525	2,988	3,513	4,730
Departamento Cajamarca	2	535	1,493	2,028	771
Subtotal 3-A	10	3,434	4,821	8,255	5,951

Tipo 3-B					
Departament Ayacucho	2	540	2,500	3,040	2,300
Departamento Junin	3	1,639	1,193	2,832	1,784
Subtotal 3-B	5	2,179	3,693	5,872	4,084
Tipo 4-A					
Departamento Amazonas	10	5,044	1,179	6,223	1,637
Departamento Ancash	1	250	550	800	180
Departamento Ayacucho	2	157	738	895	258
Departamento Huancavelica	1		240	240	76
Departamento Huanuco	2	21	628	649	277
Departamento Junin	1	1,520		1,520	1,306
Departamento La Lebertad	2	1,000	529	1,529	500
Departamento Piura	2	707	1,138	1,845	935
Tipo 4-B					
Departamento Ancash	1	0	540	540	418
Departamento Ayacucho	1		439	439	550
Departamento Junin	1		400	400	1,110
Departamento La Libertad	1	300	300	600	150
Subtotal Tipo 4-A	4	300	1,679	1,979	2,228
Tipo 5					
Departamento Amazonas	1	241	43	284	77
Departamento Ancash	4	1,020	110	1,130	762
Departamento Cajamarca	1		400	400	309
Departamento Junin	4	575	0	575	991
Departamento Piura	1	500	400	900	350
Subtotal Tipo 5	11	2,336	953	3,289	2,489
Gran Total	56	18,103	20,629	38,732	24,849

Source: JICA Study Team

The Program area is distributed in the following altitudes;

Table 3.4-4 Altitude Distribution of agricultural land in the Districts at the Program Area

Unit: (ha)

Departments	< 1000m	1000 to 2000m	2000 to 3000m	3000 to 4000m	>4000m	Total
Amazonas	1,120.83	1,293.76	1,087.55	293.59	5.39	3,801.11
Ancash	0.00	39.73	353.59	1,158.04	1,644.36	3,195.72
Ayacucho	65.27	345.25	746.41	2,824.34	2,069.27	6,050.54
Cajamarca	6.94	235.87	1,003.44	891.68	34.72	2,172.64
Huancavelica	0.00	42.72	248.80	476.69	373.63	1,141.83
Huánuco	0.00	0.00	57.62	171.02	119.91	348.55
La Libertad	82.58	335.42	469.34	650.28	91.69	1,629.31
Junín	0.00	0.00	8.53	280.51	761.10	1,050.15
Piura	105.94	1,062.77	1,337.90	481.97	0.00	2,988.58
Total	1,381.55	3,355.52	5,313.18	7,228.12	5,100.07	22,378.45
Percentage	6.2%	14.9%	23.7%	32.3%	22.8%	100.0

Source: JICA Study Team

According to this result, relative distribution of agricultural land by altitude (< 4,000m) is the following;

Less than 1.000 m	6.2%
1,000 to 2,000 m	14.9%
2,000 to 3,000 m	23.7%
3,000 to 4,000 m	32.3%

Concerning efficient use of agriculture land, the relation between transitory crop and harvested area is indicated; it is estimated that irrigation area has double harvest.

2) Basis for the Formulation of the Agriculture Plan

General guidelines to take into account during the stage of plan formulation are the following:

- Agriculture campaign program will be prepared based in the use of a medium technology, considering traditional products adapted to the zone. (Achieve the national average productivity).
- It will tend to the intensive use of land by the introduction of irrigation in dry land.
- Substantial changes in the present land property system are not proposed for the short time.
- The social criteria will be present through the attention of technical assistance to the beneficiaries in coordination to be conducted with several institutions concerned with the social aspects.
- Improvement of technological level through the technical assistance proper to the conditions of the zone and the socio economic characteristics of the project's beneficiaries.

3) Cultivation Products

The establishment of the cultivation products is based in the analysis and balance of the following criteria:

- Rational use of water and soil resources with the purpose of obtaining double harvest in a year and to maximize production and productivity.
- Progressive changes in the existing structure of products, incorporating permanent irrigation to dry land.
- Give priority to products that adapt to the zone.
- By estimating production, the increase in yielding will be taken into account, as results of the receptivity to the technical assistance at the consolidation stage.
- The cultivation products could be altered by the incorporation of cultivation land and by effect of the following campaign program.
- Orientation towards the market: Investments in irrigation infrastructure projects are not justified if the products considered by it are not feasible in a context of market strategy.

The Program proposes cultivation products including the following: Potato, alfalfa, cereal, (wheat, barley, quinua), dry broad bean, fresh broad bean, choclo maize, and vegetables (onion, carrots, cabbage, lettuce, celery). These products serve as base, on one hand, to determine the water demand and the size of works; and, on the other hand, to provide production and agricultural profitability as expression of the proposed irrigation systems by gravity together with the training and extension services.

Considering the before mentioned products, an infinity of combinations or possibilities of production can be presented, both for products and for assigned areas for each. However, it is important to take in consideration, the interest, level of acceptation and knowledge of products by the farmers, that in turn, should be in accordance to the technological level or with the technical assistance services they will be provided. In this case, it is defined the convenience to work preferably with products whose production and areas would be representative and optimal within each department of the Program. In this sense, the following methodology was followed for each department to select the products and respective cultivation areas.

(a) Process for the selection of products

a. Analysis, processing and systematization of information about production and crop area between years 2003 and 2007, at the nine departments of the Program. (Source: SISAP-MINAG)

b. Determination of the average production and harvested area of products and corresponding arrangement in decreasing order.

c. Selection of products with larger cultivation area and common products in the majority of departments and at the area of influence of the sub projects.

d. Exception for cultivation of rice in the department of Amazonas, that shows high production and high harvested area but is not present in other departments of the Program.

e. Selected products with larger harvest area and large production, common to most of the Program's departments are:

Table 3.4-5 Selected products with larger area

PRODUCTS	Presence in Departments	PRODUCTS	Presence in Departments
POTATO	9	ALFALFA	4
AMILLACEOUS MAIZE	9	FRESH PEA	4
WHEAT	9	OLLUCO	4
BARLEY	8	CHOCLO MAIZE	3
HARD YELLOW MAIZE	8	FRESH BROAD BEAN	2
DRY BEANS	7	RICE	1
COFFEE	6	SWEET POTATO	1
DRY BROAD BEAN	5		
DRY PEA	5		
MANIOC	5		

According to this selection, potato, amillaceous maize and wheat are present in the nine departments of the Program; barley and hard yellow maize are present in eight departments; dry bean in seven departments; coffee is present in six departments but only three at the area of influence of the subprojects; dry broad bean, dry pea and manioc are present in five departments, alfalfa, fresh pea and olluco are present in four departments; choclo maize is present in three departments; fresh broad bean in two departments and rice and sweet potato in only one department.

(b) Determination of areas to estimate water demand

a. The percentage that each selected product represents in the total production and harvested area of the department was calculated.

b. The percentage of area that said product represents in the department, area of influence of the Program.

c. For each department areas for irrigation improvement and extension of farming area were added.

(c) Determination of Cultivation Area for each Department.

Based on statistic data (2003 – 2007) of each department, the following products have been estimated;

a) Department of Amazonas

Table 3.4-6 Department of Amazonas

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Area	Area of Cultivation (ha)
COFFEE	29.1%	37,301	34%	3135
RICE	25.1%	32,165	30%	2674
MANIOC	7.6%	9,700	9%	830
HARD YELLOW MAIZE	6.4%	8,255	8%	738
DRY BEAN	5.8%	7,444	7%	645
AMILLACEOUS MAIZE	5.5%	7,017	6%	553
POTATO	3.1%	4,029	4%	369
CHOCLO MAIZE	0.8%	1,033	1%	92
WHEAT	0.8%	1,004	1%	92
FRESH PEA	0.7%	903	1%	92
OTHERS	15.2%	19,547	-	-
TOTAL	100.0%	128,399	100.0%	9,221

In this department, the Program has projected to expand farming land in 1,562 ha and improve irrigation in 7,659 ha, totaling 9,221 ha. According to the agriculture production indicated before, the programming of areas for cultivation was conducted as follows: coffee 3,135 ha, rice 2,674 ha, manioc 830 ha, hard yellow maize 738 ha, dry bean 645 ha, amillaceous maize 553 ha, potato 369 ha, choclo maize 92 ha, wheat 92 ha and fresh pea 92ha.

b) Department of Cajamarca

In this department it is important to stress that the average harvested area of amillaceous maize is 14 % of the 40,325 ha of harvested area. The harvested area of wheat (30,666 ha) represent 10%, potetos, amillaceous maiz, bens represent27% of harvested area.

Table 3.4-7 Department of Cajamarca

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
AMILLACEOUS MAIZE	14%	40,325	23%	887
WHEAT	10%	30,666	17%	674
POTATO	9%	26,355	15%	579
HARD YELLOW MAIZE	8%	20,078	11%	441
DRY PEA	7%	15,043	8%	330
DRY BEAN	5%	14,975	8%	329
BARLEY GRAIN	5%	13,778	8%	303
FRESH PEA	5%	9,318	5%	205
MANIOC	3%	8,616	5%	189
OTHERS	14%	40,325	23%	
TOTAL	34%	119,211	-	
AMILLACEOUS MAIZE	100%	298,364	100.0%	**3,938**

In this department, the Program has projected to expand the farming area in 3,403 ha and to improve irrigation in 535 ha totaling 3,938 ha. According to the agricultural production before indicated, the programming of cultivation products has been distributed as follows: amillaceous maize 887 ha, wheat 674 ha, potato 579 ha, hard yellow maize 441 ha, dry pea 330 ha, dry bean 329 ha, barley in grain 303 ha, fresh pea 205 ha and manioc 189 ha, as shown in the chart below.

c) Department of Piura

In this department it is important to stress that the average harvested area of hard yellow maize is 16,357ha, representing 11 % of the total area; amillaceous maize with an average harvested area of 15,017 ha, wheat with 8,383 ha and coffee with 6,812 ha. See chart below.

Table 3.4-8 Department of Piura

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
HARD YELLOW MAIZE	11%	16,357	29%	798
AMILLACEOUS MAIZE	10%	15,017	27%	732
WHEAT	5%	8,383	15%	409
COFFEE	4%	6,812	12%	332
DRY PEA	2%	3,527	6%	172
DRY BEAN	2%	2,690	5%	131
POTATO	0.7%	1,072	2%	52
MANIOC	0.7%	1,029	2%	50
SWEET POTATO	0.5%	841	1%	41
BARLEY GRAIN	0.4%	559	1%	28
OTHERS	63%	96,962	-	-
TOTAL	**100%**	**153,250**	100.0%	**2,745**

In the sierra of Piura, the Program has projected to expand the farming land in 1,207 ha and improve irrigation in 1,538 totaling 2,745 ha. According to the agriculture production indicated before, the program for the area for cultivation products was conducted with the following: yellow hard maize; 798 ha, amillaceous maize; 732 ha, wheat; 409 ha, coffee; 332 ha, dry pea; 172 ha, dry bean; 131 ha, potato: 52 ha, manioc; en 50 ha, sweet potato; 41 ha and barley in grain 28 as shown in the previous chart.

d) Department of La Libertad

In this department average harvested area of wheat with 26,308 ha, equivalent to 12 % of the total area is outstanding as well as the average harvested area of barley with 24,824 ha, representing 11%, yellow hard maize with 24,500 ha representing 11%, potato with 20,634 ha, amillaceous maize with 14,064 ha, and other crops as shown in the following chart:

Table 3.4-9 Department of La Libertad

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
WHEAT	12%	26,308	20%	429
BARLEY GRAIN	11%	24,824	19%	405
YELLOW HARD MAIZE	11%	24,500	19%	400
POTATO	9%	20,634	16%	337
AMILLACEOUS MAIZE	6%	14,064	11%	230
DRY PEA	3%	6,507	5%	106
ALFALFA	2%	4,222	3%	69
DRY BEAN	2%	3,680	3%	60
DRY BROAD BEAN	2%	3,583	3%	58
OLLUCO	1%	2,204	2%	36
OTHERS	40%	88,166	-	-
TOTAL	**100%**	**218,692**	100.0%	**2,129**

In La Libertad, the Program has projected to expand the farming land in 829 ha and to improve irrigation in 1,300 ha, totaling 2,129 ha. According to the agriculture production and the average harvested area before indicated, the programming of areas for cultivation products was conducted with

the following distribution: wheat 429 ha, barley in grain 804 ha, yellow hard maize 405 ha, potato 337 ha, dry pea 106 ha, alfalfa 69 ha, dry bean 160 ha, dry broad bean 58 ha and olluco in 36 ha.

e) Department of Ancash

In the department of Ancash it is important to stress that the average harvested area of yellow hard maize with 16,855 ha equivalent to 16 % of the total Area and wheat with an average harvested area of 15,533 ha, representing the 15 %, barley in grain with 12,183 ha representing 11%. The following chart shows the details.

Table 3.4-10 Department of Ancash

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
YELLOW HARD MAIZE	15.8%	16,855	20.9%	1,744
WHEAT	14.6%	15,533	19.3%	1,607
BARLEY IN GRAIN	11.4%	12,183	15.1%	1,260
POTATO	9.9%	10,496	13.0%	1,086
AMILLACEOUS MAIZE	8.8%	9,386	11.6%	971
CHOCLO MAIZE	5.7%	6,118	7.6%	633
ALFALFA	5.5%	5,877	7.3%	608
OLLUCO	1.5%	1,576	2.0%	163
DRY BROAD BEAN	1.3%	1,376	1.7%	143
DRY BEAN	1.2%	1,289	1.6%	134
OTHERS	24.2%	25,776	-	-
TOTAL	100.0%	106,464	100.0%	8,349

In this department, the Program has projected to expand the farming land in 6,554 ha and to improve irrigation in 1,795 ha totaling 8,349 ha. According to the agriculture production and the average harvested area, the programming of cultivation areas has been conducted with the following distribution: yellow hard maize; 1,744 ha, wheat ; 1,607 ha, barley in grain ; 1,260 ha, potato; 1,086 ha, amillaceous maize; 971 ha, choclo maize ; 633 ha, alfalfa; 608 ha, olluco; 163 ha, dry broad bean ; 143 ha and dry bean ; 134 ha.

f) Department of Huánuco

In this department the average harvested area of potato is outstanding with 33,665 ha, equivalent to 26 % of the total area, followed by amillaceous maize with an average harvested area of 14,038 ha representing 11 %, hard yellow maize 9,846 ha representing 8%. The following chart shows the details:

Table 3.4-11 Department of Huánuco

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
POTATO	26%	33,665	38%	249
AMILLACEOUS MAIZE	11%	14,038	16%	104
HARD YELLOW MAIZE	8%	9,846	11%	73
WHEAT	7%	9,232	11%	68
BARLEY GRAIN	6%	7,627	9%	56
DRY BEAN	3%	4,373	5%	32
MANIOC	3%	3,961	5%	29
DRY BROAD BEAN	3%	3,261	4%	24
OLLUCO	1%	1,844	2%	14
OTHERS	31%	39,325	-	-
TOTAL	**100%**	**127,172**	**100%**	**649**

In this department the Program has projected to expand the farming land in 628 ha and improve

irrigation in 21 ha totaling 649 ha. According to the agriculture production indicated above, the program for cultivation area was conducted with the following distribution: potato 249 ha, amillaceous maize 104 ha, hard yellow maize 73 ha, wheat 68 ha, barley in grain 56 ha, dry bean 32 ha, manioc 29 ha, dry broad bean 24 ha and olluco 14 ha.

g) Department of Junín

In this department the average harvested area of coffee is 81,636 ha representing 36 % of the total area, followed by potato with an average harvested area of 21,969 ha representing 10 % of the area, barley in grain 12,371 ha representing 5%. The following chart shows the other products.

Table 3.4-12 Department of Junín

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
COFFEE	36%	81,636	23%	2,776
POTATO	10%	21,969	23%	747
BARLEY GRAIN	5%	12,371	13%	420
AMILLACEOUS MAIZE	4%	9,164	9%	311
CHOCLO MAIZE	4%	7,954	8%	270
WHEAT	3%	7,182	7%	244
MANIOC	2%	4,914	5%	167
HARD YELLOW MAIZE	2%	4,018	4%	137
FRESH PEA GRAIN	2%	3,986	4%	136
FRESH BROAD BEAN GRAIN	2%	3,475	4%	120
OTHERS	31%	69,016		
TOTAL	**100%**	**225,685**	**100%**	**5,327**

In Junín the Program has projected to expand the farming land in 1,593 ha and to improve irrigation in 3,734 ha totaling 5,327 ha. According to agriculture production indicated above, the program for cultivation area was conducted with the following distribution: coffee 2,776 ha, potato 747 ha, barley in grain 420 ha, amillaceous maize 311 ha, choclo maize 270 ha, wheat 244 ha, manioc 167 ha, yellow hard corn 137 ha, fresh pea in grain 136 ha and fresh broad bean 120 ha.

h) Department of Huancavelica

In Huancavelica the average harvested area of barley is 15,832 ha equivalent to 21 % of the total area, followed by potato with an average harvested Area of 13,308 ha representing 18 %, amillaceous maize with an average harvested Area of 11,901 ha representing 16%, alfalfa with an average harvested Area 10,036 ha. See following chart.

Table 3.4-13 Department of Huancavelica

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
BARLEY GRAIN	21%	15,832	22%	52
POTATO	18%	13,308	18%	44
AMILLACEOUS MAIZE	16%	11,901	16%	40
ALFALFA	13%	10,036	14%	34
WHEAT	8%	5,597	8%	19
BROAD BEAN DRY	6%	4,348	6%	15
FRESH PEA GRAIN	5%	3,530	5%	12
DRY PEA GRAIN	4%	3,241	5%	12
DRY BEAN GRAIN	2%	1,717	3%	6
FRESH BROAD BEAN GRAIN	2%	1,500	2%	6
OTHERS	5%	3,363		
TOTAL	**100%**	**74,373**	100%	240

In this department the Program has projected to increase farming land in 240 ha. According to agriculture production indicated above, the program for cultivation area was conducted with the

following distribution: barley in grain 52 ha, potato in 44 ha, amillaceous maize in 40 ha, alfalfa in 34 ha, wheat 19 ha, dry broad bean 15 ha, fresh pea in grain 15 ha, dry pea grain 10 ha, fresh broad bean in grain 15 ha. See chart.

i) Department of Ayacucho

In this department, amillaceous maize with average harvested area of 14,854 ha occupies the first place, representing 17 % of the total area, followed by potato with an average harvested area of 11,495 ha, representing 13 % and barley in grain with 11,379 ha equivalent to 13% of the Area. See following chart.

Table 3.4-14 Department of Ayacucho

PRODUCTS WITH LARGER HARVESTED AREA	Department		Area of the Program	
	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)	% Harvested Area (ha)	Average Harvested Area (ha) (2003- 2007)
AMILLACEOUS MAIZE	17%	14,854	23%	1,433
POTATO	13%	11,495	18%	1,109
BARLEY IN GRAIN	13%	11,379	18%	1,098
WHEAT	9%	8,535	13%	823
ALFALFA	8%	7,364	12%	710
COFFEE	0%	0	0%	0
DRY BROAD BEAN	5%	4,251	7%	411
DRY PEA IN GRAIN	3%	2,791	4%	269
OLLUCO	2%	1,874	3%	181
HARD YELLOW MAIZE	1%	1,044	2%	101
OTHERS	29%	26,403		
TOTAL	100%	89,991	100%	**6,134**

In this department the Program has projected to expand farming land in 4,282 ha and to improve irrigation in 1,852 ha totaling 6,134 ha. According to agriculture production indicated above, the program for cultivation area was conducted with the following distribution: amillaceous maize 1,433 ha, potato 1,109 ha, barley in grain 1,098 ha, wheat 823 ha, alfalfa 710 ha, dry brad bean 411 ha and dry pea in grain 269 ha, olluco in 181 ha and hard yellow maize 101 ha. Chart in annex.

4) Expected productivity

In the following chart the expected productivity for the years of cultivation are shown; according to the general criteria of the development plan formulation, they will gradually increase as consequence of the technological transfer. It is considered that the first year of operation, traditional products in dry land will go on, and they will have a slight increase in productivity due to the launching of the project.

Values assigned for the stabilization year are those expected with the application of a medium technology.

Table 3.4-15 Productivity Estimation (kg/ha)

Product	Level	DEPARTMENT								
		AMA	CAJ	PIU	LIB	ANC	HUANU	JUN	HUANCA	AYA
Alfalfa	1	0	34,280	9,610	38,640	21,520	20,800	28,190	28,050	27,850
	2	0	48,965	13,723	55,197	30,749	29,709	40,266	40,067	39,791
	3	0	73,450	20,580	82,800	46,120	44,560	60,400	60,100	59,690
Potato	1	10,830	9,330	10,020	12,620	8,080	13,000	13,460	7,730	13,010
	2	15,466	13,323	14,310	18,031	11,545	18,571	19,223	11,040	18,588
	3	23,200	19,980	21,470	27,050	17,320	27,860	28,830	16,560	27,880
Barley Grain	1	780	670	610	1,170	710	1,060	1,380	1,130	1,050
	2	1,110	959	872	1,678	1,010	1,509	1,967	1,611	1,500
	3	1,670	1,440	1,310	2,520	1,520	2,260	2,950	2,420	2,250
Amillaceous Maize	1	650	1,050	700	1,550	990	1,070	1,350	1,180	880
	2	927	1,500	1,000	2,211	1,407	1,533	1,930	1,682	1,250
	3	1,390	2,250	1,500	3,320	2,110	2,300	2,900	2,520	1,880
Fresh Pea Grain	1	2,160	1,720	550	3,060	2,570	4,220	4,900	2,770	2,870
	2	3,089	2,454	786	4,370	3,667	6,029	7,004	3,953	4,100
	3	4,630	3,680	1,180	6,560	5,500	9,040	10,510	5,930	6,150
Wheat	1	750	860	780	1,370	720	980	1,480	1,050	1,010
	2	1,068	1,231	1,111	1,962	1,030	1,396	2,114	1,502	1,436
	3	1,600	1,850	1,670	2,940	1,550	2,090	3,170	2,250	2,150
Fresh Broad Bean	1	2,450	2,290	570	4,020	2,610	5,830	4,790	3,070	2,010
	2	3,500	3,269	810	5,742	3,733	8,333	6,847	4,392	2,875
	3	5,250	4,900	1,220	8,610	5,600	12,500	10,270	6,590	4,310
Dry Pea Grain	1	630	1,070	1,130	990	880	1,260	1,220	1,000	860
	2	900	1,528	1,611	1,413	1,250	1,800	1,738	1,434	1,222
	3	1,350	2,290	2,420	2,120	1,880	2,700	2,610	2,150	1,830
Choclo maize	1	5,690	6,510	5,040	7,130	7,390	6,040	8,660	9,100	5,440
	2	8,124	9,294	7,200	10,188	10,555	8,636	12,369	13,000	7,765
	3	12,190	13,940	10,800	15,280	15,830	12,950	18,550	19,500	11,650
Rice	1	5,120	5,580	6,970	7,330	5,530	4,370	4,320	0	1,460
	2	7,318	7,965	9,960	10,475	7,895	6,249	6,171	0	2,088
	3	10,980	11,950	14,940	15,710	11,840	9,370	9,260	0	3,130
Hard Yellow Maize	1	1,600	4,840	3,490	6,010	3,630	3,840	2,370	1,650	2,100
	2	2,292	6,912	4,982	8,583	5,192	5,482	3,390	2,354	3,000
	3	3,440	10,370	7,470	12,870	7,790	8,220	5,090	3,530	4,500
Manioc	1	10,770	5,960	7,450	10,690	15,050	7,920	8,260	0	7,390
	2	15,050	8,512	10,636	15,267	21,500	11,313	11,803	0	10,556
	3	22,580	12,770	15,950	22,900	32,250	16,970	17,700	0	15,830
Dry Broad Bean	1	1,050	1,000	700	1,020	850	1,080	1,350	1,150	840
	2	1,500	1,428	1,000	1,459	1,213	1,540	1,927	1,636	1,200
	3	2,250	2,140	1,500	2,190	1,820	2,310	2,890	2,450	1,800
Olluco	1	5,440	4,060	2,750	6,050	3,690	12,440	4,520	3,960	3,760
	2	7,767	5,801	3,925	8,643	5,273	17,771	6,456	5,656	5,375
	3	11,650	8,700	5,890	12,960	7,910	26,660	9,680	8,480	8,060
Sweet potato	1	9,100	5,880	17,620	10,110	12,760	9,740	0	0	8,520
	2	13,000	8,400	25,169	14,442	18,222	13,917	0	0	12,167
	3	19,500	12,600	37,750	21,660	27,330	20,880	0	0	18,250
Dry Bean	1	840	960	700	1,130	1,050	1,290	1,060	1,050	1,460
	2	1,207	1,374	1,000	1,615	1,500	1,848	1,508	1,500	2,083
	3	1,810	2,060	1,500	2,420	2,250	2,770	2,260	2,250	3,120
Coffee	1	590	760	340	700	0	430	800	400	570
	2	837	1,088	488	1,000	0	612	1,139	570	817
	3	1,260	1,630	730	1,500	0	920	1,710	860	1,230

Source; Data from MINAG (1995 to 2007)

Productivity with project are compatible with the information of productivity in the surrounding zones with similar characteristics that are irrigated. This information is responsibility of the agrarian agency of the Ministry of Agriculture in the zone. (Documents in annex).

5) Unit cost of production and product price in farm

With the purpose to know the technical and economic possibilities of the different products,

production unit costs updated to April 2009 are elaborated, to be complemented with the other necessary indicators, such as expected income from the productivity calculated with the technology used in the Project development, as well as data referred to daily payment, use of animal cultivator and input, costs that are shown in the following chart.

Table 3.4-16 Cost of Production (S/./kg)

Product	Level	DEPARTMENT								
		AMA	CAJ	PIU	LIB	ANC	HUANU	JUN	HUANCA	AYA
Alfalfa	1	2,616	2,616	1,083	2,616	2,425	2,344	2,616	2,616	2,616
	2	3,105	3,105	1,285	3,105	2,879	2,782	3,105	3,105	3,105
	3	3,105	3,105	1,285	3,105	2,879	2,782	3,105	3,105	3,105
Potato	1	4,220	3,635	3,904	4,246	3,148	4,246	4,246	3,012	4,246
	2	6,267	5,399	5,799	6,308	4,678	6,308	6,308	4,474	6,308
	3	6,267	5,399	5,799	6,308	4,678	6,308	6,308	4,474	6,308
Barley Grain	1	983	845	769	1,199	895	1,199	1,199	1,199	1,199
	2	1,295	1,119	1,018	1,584	1,179	1,584	1,584	1,584	1,584
	3	1,295	1,119	1,018	1,584	1,179	1,584	1,584	1,584	1,584
Amillaceous maize	1	951	1,532	1,025	1,532	1,449	1,532	1,532	1,532	1,288
	2	1,088	1,752	1,173	1,752	1,651	1,752	1,752	1,752	1,467
	3	1,088	1,752	1,173	1,752	1,651	1,752	1,752	1,752	1,467
Fresh Pea	1	1,745	1,390	444	2,228	2,076	2,228	2,228	2,228	2,228
	2	2,425	1,927	617	3,093	2,879	3,093	3,093	3,093	3,093
	3	2,425	1,927	617	3,093	2,879	3,093	3,093	3,093	3,093
Wheat	1	899	1,031	935	1,199	863	1,175	1,199	1,199	1,199
	2	1,144	1,318	1,190	1,529	1,103	1,495	1,529	1,529	1,529
	3	1,144	1,318	1,190	1,529	1,103	1,495	1,529	1,529	1,529
Fresh Broad bean	1	1,777	1,661	414	2,228	1,893	2,228	2,228	2,227	1,458
	2	2,497	2,332	578	3,131	2,663	3,131	3,131	3,131	2,051
	3	2,497	2,332	578	3,131	2,663	3,131	3,131	3,131	2,051
Dry Pea	1	751	1,197	1,197	1,180	1,049	1,197	1,197	1,192	1,025
	2	1,029	1,639	1,639	1,616	1,430	1,639	1,639	1,639	1,398
	3	1,029	1,639	1,639	1,616	1,430	1,639	1,639	1,639	1,398
Choclo maize	1	1,636	1,872	1,449	1,949	1,949	1,737	1,949	1,949	1,564
	2	2,097	2,399	1,859	2,499	2,499	2,229	2,499	2,499	2,004
	3	2,097	2,399	1,859	2,499	2,499	2,229	2,499	2,499	2,004
Rice	1	3,821	3,821	3,821	3,821	3,821	3,694	3,652	3,821	1,234
	2	4,168	4,168	4,168	4,168	4,168	4,033	3,983	4,168	1,348
	3	4,168	4,168	4,168	4,168	4,168	4,033	3,983	4,168	1,348
Yellow hard maize	1	879	1,802	1,802	1,802	1,802	1,802	1,302	906	1,153
	2	1,042	2,132	2,132	2,132	2,132	2,132	1,542	1,071	1,364
	3	1,042	2,132	2,132	2,132	2,132	2,132	1,542	1,071	1,364
Manioc	1	2,880	2,102	2,628	2,880	2,880	2,793	2,880	2,880	2,606
	2	3,699	2,708	3,384	3,699	3,699	3,599	3,699	3,699	3,358
	3	3,699	2,708	3,384	3,699	3,699	3,599	3,699	3,699	3,358
Dry Broad bean	1	1,197	1,192	834	1,197	1,013	1,197	1,197	1,197	1,001
	2	1,606	1,600	1,120	1,606	1,359	1,606	1,606	1,606	1,344
	3	1,606	1,600	1,120	1,606	1,359	1,606	1,606	1,606	1,344
Olluco	1	3,321	2,600	1,761	3,321	2,363	3,321	2,895	2,536	2,408
	2	4,520	3,540	2,395	4,520	3,218	4,520	3,939	3,451	3,280
	3	4,520	3,540	2,395	4,520	3,218	4,520	3,939	3,451	3,280
Sweet potato	1	3,390	2,433	3,390	3,390	3,390	3,390	3,390	3,390	3,390
	2	4,122	2,959	4,122	4,122	4,122	4,122	4,122	4,122	4,122
	3	4,122	2,959	4,122	4,122	4,122	4,122	4,122	4,122	4,122
Dry bean	1	1,646	1,881	1,372	2,077	2,057	2,077	2,077	2,057	2,077
	2	1,956	2,227	1,620	2,455	2,431	2,455	2,444	2,431	2,455
	3	1,956	2,227	1,620	2,455	2,431	2,455	2,444	2,431	2,455
Coffee	1	3,009	3,009	2,006	3,009	3,009	2,537	3,009	2,360	3,009
	2	3,229	3,229	2,165	3,229	3,229	2,715	2,616	2,616	3,229
	3	3,229	3,229	2,165	3,229	3,229	2,715	3,105	3,105	3,229

Source; Extracted from MINAG data (1995 to 2007)

Prices in farm are the following;

Table 3.4-17 Price in farm (S/./kg)

Product	DEPARTMENT								
	AMA	CAJ	PIU	LIB	ANC	HUANU	JUN	HUANCA	AYA
Alfalfa	0.29	0.06	0.24	0.27	0.31	0.18	0.14	0.19	0.28
Potato	0.55	0.56	0.68	0.67	0.77	0.65	0.52	0.62	0.59
Barley Grain	1.36	0.80	0.89	1.14	1.07	0.83	0.95	1.02	0.72
Amillaceous maize	0.98	1.36	0.80	1.42	1.65	1.21	1.57	1.91	1.25
Fresh pea	1.13	1.06	2.00	1.29	1.18	0.98	1.17	1.09	0.91
Wheat	1.40	1.07	1.27	1.33	1.47	1.19	1.24	1.40	1.02
Fresh Broad bean	0.70	0.95	0.00	0.94	0.68	0.61	0.59	0.75	0.76
Dry pea	2.02	2.13	1.66	1.80	1.90	1.67	1.60	1.44	1.25
Choclo maize	0.68	1.03	0.82	0.74	0.71	0.63	0.70	1.09	0.87
Rice	1.05	1.13	1.14	1.29	1.30	0.97	1.10	0.00	1.43
Yellow hard maize	0.76	0.69	0.78	0.80	0.82	0.80	0.79	1.21	0.78
Manioc	0.48	0.58	0.74	0.83	0.94	0.44	0.79	0.00	0.41
Dry Broad	1.73	1.50	1.62	1.47	1.84	1.23	1.24	1.35	1.20
Olluco	0.65	0.51	0.61	0.77	1.17	0.99	0.98	1.06	0.65
Sweet potato	0.44	0.49	0.43	0.63	0.72	0.48	0.00	0.00	0.52
Dry Bean	1.97	2.12	1.94	2.33	3.06	3.01	2.19	2.59	2.02
Coffee	5.31	5.32	4.61	3.66	0.00	5.06	5.18	1.97	5.00

6) Technical Assistance

The present section focus on the need to implement the following Programs to support production:

Beneficiaries of the project should be convinced and show their acceptance to the technological change in their production. This can be verified through the surveys conducted.

The development plan should foresee the installation of an agriculture extension service, in order to use to the top the hectares considered with rotation crops that will be achieved through the technological transfer to rural families, allowing the improvement of their level of life.

The "Agriculture Extension Service" proposed should provide to the farmer knowledge on new techniques together with practical demonstrations, also it should provide supervision and advisement to works of land habilitation to be executed by the beneficiaries in their lots. The service of agriculture extension will have the following characteristics:

- Full participation of the rural population.
- Extensive range without distinction of sex or religious belief.
- Use of educational and didactic methods.
- Attend the whole family.
- Work closely with other supporting entities of rural development and broadly with rural socio economic development. In this sense, it requires the integration of rural credit to the proposed development plan.

7) Training

The Extension service will be provided not only for farmers but also to rural women. For that, the work team should count on with experts in Agronomics, Rural sociology and agricultural economy, to develop the following activities:

- Training farmers in cultural practices and production management, promoting organization in association units and/or service.
- Training in irrigation techniques, fertigation and practices of soil conservation.

- Organization of farmers to administer, operate and maintain the irrigation system.
- Dissemination of procedures to obtain credits from the "Banco Agrario" (Agrarian Bank) and training for the proper use of the same.
- Demonstration of agronomic practices of irrigation and fertigation in the demonstration lots under production.
- Dissemination of techniques to improve and balance the family alimentary portions.

(4) Water demand

Water demand has been estimated as follows;

a. Definition of Cultivation Products

b. Definition of the Crop Schedule

c. Definition of Water Demand

1) Department of Amazonas

(a) Definition of the Cultivation Products

The cultivation products proposed for the Department of Amazonas is the following;

Table 3.4-18 Cultivation Products Proposed for the Department of Amazonas

BASIC PRODUCT	AREA (Has)	ROTATION PRODUCT	AREA (Has)
COFFEE	3,135	YELLOW HARD MAIZE	1,337
RICE	2,674	POTATO	369
MANIOC	830	AMILLACEOUS MAIZE	323
YELLOW HARD MAIZE	738	FRESH PEA	277
DRY BEAN	645	FRESH	184
AMILLACEOUS MAIZE	553	POTATO	46
POTATO	369	FRESH BROAD BEAN	46
CHOCLO MAIZE	92	CHOCLO MAIZE	46
WHEAT	92		
FRESH PEA	92		
TOTAL	**9,221**		**2,628**

For the first campaign the following products have been selected: rice in 2,674 ha, manioc in 830 ha, Yellow hard maize in 738 ha, dry bean in 645 ha, amillaceous maize in 553 ha, potato in 369 ha, choclo maize in 92 ha, wheat in 92 ha and fresh pea in 92 ha, totaling 9,221 ha.(coffee is permanent crop).

(b) Definition of Crop Schedule

The cultivation schedule for the Department of Amazonas is the following;

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO ROTACIÓN
CAFÉ	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	
ARROZ CASCARA	2,674	2,674	2,674	2,674	1,337	1,337	1,337	1,337	1,337	1,337		2,674	2,674	MAÍZ AMARILLO DURO
YUCA	830	830				830	830	830	830	830	830	830	830	
MAIZ AMARILLO DURO	738	738	738	738	369	369	369	369	369	369	738	738	738	PAPA
FRIJOL GRANO SECO	645	645	645	645	645	645	323	323	323	323	645	645	645	MAÍZ AMILÁCEO
MAIZ AMILACEO	553	553	553	553	553	553	277	277	277	277	553	553	553	ARVEJA G.V.
PAPA	369	369	369	369			184	184	184	184	369	369	369	ARVEJA G.V.
MAIZ CHOCLO	92	92	92	92	46	46	46	46	46	46	92	92	92	PAPA
TRIGO	92	92	92	92	92	92			46	46	46	46	92	HABA G.V.
ARVERJA GRANO VERDE	92	92	92	92	92				46	46	46	46	46	MAÍZ CHOCLO
Total	**9,221**	9,221	8,391	8,391	6,270	7,008	6,501	6,501	6,593	6,593	6,455	9,129	9,175	

Among permanent crops there is coffee with 3,135 ha. In the second crop, rotation is 1,337 ha of rice with Yellow hard maize, 369 ha of Yellow hard maize with potato, 369 ha of amillaceous maize with potetos, 323 ha of amillaceus maiz with fresh pea, 184 ha of potetos with fresh pea choclo maize with potato and 46 ha of fresh pea with choclo maize, and 46ha of fresh broad bean totaling 2,628 ha in the second crop.

Proposed cultivation schedule with project, department of Amazonas

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña	Area (Has)
CAFÉ	3135														
ARROZ CASCARA	2674													MAÍZ AMARILLO DURO	1,337
YUCA	830														
MAIZ AMARILLO DURO	738													PAPA	369
FRIJOL GRANO SECO	645													MAÍZ AMILÁCEO	323
MAIZ AMILACEO	553													ARVEJA G.V.	277
PAPA	369													ARVEJA G.V.	184
MAIZ CHOCLO	92													PAPA	46
TRIGO	92													HABA G.V.	46
ARVERJA GRANO VERDE	92													MAÍZ CHOCLO	46
TOTAL	**9221**													TOTAL	**2,628**

For the project water demand calculation, the efficiency of irrigation is the same used by the projects executed by the National Authority of Water (Ex Intendancy of Water Resources). In the case of new canals, efficiency of conduction equal to 95 %, efficiency of distribution equal to 75 % and efficiency of application of 56 %, it results in an irrigation efficiency of 40%, as shown in the chart in annex. A first peak of flow requirement for the products can be noticed between September to March with a maximum in November, 11.10 m3/s.

(c) Definition of Water Demand

Water Demand for the Department of Amazonas is the following;

Table 3.4-19 Water demand of products with Project, department of Amazonas.

Cultivo	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
Area (Has)	9,221	8,391	8,391	6,270	7,008	6,501	6,501	6,593	6,593	6,455	9,129	9,175
Eto (mm/month)	146.37	115.73	130.81	119.67	128.87	113.28	131.25	135.13	151.08	146.33	155.95	156.47
Weighted Kc	0.79	0.81	0.70	0.65	0.60	0.72	0.89	0.91	0.77	0.62	0.68	0.76
Etc (mm/month)	115.25	93.79	92.17	77.35	77.43	81.66	116.41	122.98	116.90	90.75	106.63	119.37
Pe (mm/month)	43.40	51.20	79.80	68.10	61.70	51.30	26.70	26.30	37.00	64.70	51.00	45.10
Humidity Deficit (mm/mth)	71.85	42.59	12.37	9.25	15.73	30.36	89.71	96.68	79.90	26.05	55.63	74.27
Bet Req. (m3/ha/month)	718.52	425.92	123.71	92.46	157.32	303.58	897.12	966.78	799.02	260.46	556.29	742.73
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	1,790.56	1,061.41	308.28	230.40	392.05	756.53	2,235.65	2,409.23	1,991.18	649.06	1,386.28	1,850.91
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00
Gross Req. (m3/ha/day)	57.76	37.91	9.94	7.68	12.65	25.22	72.12	77.72	66.37	20.94	46.21	59.71
Time (hs)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Mr (l/s/ha)	0.67	0.44	0.12	0.09	0.15	0.29	0.83	0.90	0.77	0.24	0.53	0.69
Required Q (l/s)	6,164	3,682	966	557	1,026	1,897	5,426	5,930	5,065	1,564	4,882	6,340
Required Q (m3/s)	6.16	3.68	0.97	0.56	1.03	1.90	5.43	5.93	5.06	1.56	4.88	6.34
Vol. (M3/month)	16.51	8.91	2.59	1.44	2.75	4.92	14.53	15.88	13.13	4.19	12.66	16.98
Vol. Project (M3)	114.49											

(*) Para él cálculo de la demanda de agua de un proyecto se debe tener en cuenta todas las pérdidas resultantes de la conducción, sistema de distribución y de la eficiencia de aplicación del agua al cultivo. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

2) Department of Cajamarca

(a) Definition of the Cultivation Products

Cultivation Products proposed for the Department of Cajamarca is the following;

Table 3.4-20 Cultivation products proposed for the Department of Cajamarca

BASIC CROP	AREA (Has)	ROTATION CROP	AREA (Has)
AMILLACEOUS MAIZE	887	G.V. PEA	443
WHEAT	674	BROAD BEAN G.V.	337
POTATO	579	PEA G.V.	290
YELLOW HARD MAIZE	441	POTATO	221
DRY PEA	330	BROAD BEANS G.V.	165
DRY BEAN	329	AMILLACEOUS MAIZE	165
BARLEY GRAIN	303	YELLOW HARD MAIZE	151
FRESH PEA	205	CHOCLO MAIZE	103
MANIOC	189		
TOTAL	**3,938**		**1,874**

These selected products are in accordance to the agronomic requirements such as soil, water, climate,

predominant slopes, marketing studies and profitability. For the first crop, the following products with short vegetative period were selected: amillaceous maize in 887 ha, wheat in 674 ha, potato in 579 ha, Yellow hard maize in 441 ha, dry pea in 330 ha, dry bean in 329 ha, barley in grain 303 ha, fresh pea 205 ha, manioc 189 ha, totaling 3,938 ha.

(b) Definition of the Cultivation Schedule

The cultivation schedule for the Department of Cajamarca is the following;

Proposed cultivation products with project, department of Cajamarca

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO ROTACIÓN
MAÍZ AMILACEO	887	887	887	887	887	887	443	443	443	443			887	ARVEJA G.V.
TRIGO	674	674	674	674	674	674			337	337	337	337	674	HABA G.V.
PAPA	579	579	579	579			290	290	290	290	579	579	579	ARVEJA G.V.
MAÍZ AMARILLO DURO	441	441	441	441	221	221	221	221	221	221	441	441	441	PAPA
ARVEJA GRANO SECO	330	330	330	330	330	330	165	165	165	165		330	330	HABAS G.V.
FRIJOL GRANO SECO	329	329	329	329	329	329	165	165	165	165	165	165	329	MAÍZ AMILÁCEO
CEBADA GRANO	303	303	303	303	303	303	151	151	151	151	151	151	303	MAÍZ AMARILLO DURO
ARVEJA GRANO VERDE	205	205	205	205	205				103	103	103	103	103	MAÍZ CHOCLO
YUCA	189	189				189	189	189	189	189	189	189	189	
TOTAL	**3938**	**3938**	**3749**	**3749**	**2949**	**2933**	**1624**	**1624**	**2064**	**2064**	**1966**	**2296**	**3835**	

For the second crop there is rotation of 443 ha of amillaceous maize with fresh pea, 337 ha of wheat with fresh broad bean, 290 ha of potato with fresh pea, 221 ha of Yellow hard maize with potato, 165 ha of dry pea with fresh broad bean, 165 ha de of dry bean with amillaceous maize, 151 ha of barley with Yellow hard maize, 103 ha of fresh pea with choclo maize.

Proposed cultivation schedule with project, department of Cajamarca

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña	Area (Has)
MAÍZ AMILACEO	**887**													ARVEJA G.V.	443
TRIGO	**674**													HABA G.V.	337
PAPA	**579**													ARVEJA G.V.	290
MAÍZ AMARILLO DURO	**441**													PAPA	221
ARVEJA GRANO SECO	**330**													HABAS G.V.	165
FRIJOL GRANO SECO	**329**													MAÍZ AMILÁCEO	165
CEBADA GRANO	**303**													MAÍZ AMARILLO DURO	151
ARVEJA GRANO VERDE	**205**													MAÍZ CHOCLO	103
YUCA	**189**														
Total	**3,938**													**TOTAL**	**1,874**

(c) Definition of Water Demand

Water Demand for the Department of Cajamarca is the following;

Table 3.4-21 Water Demand of Products with Project, department Cajamarca

Cultivo	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
Area (Has)	3938	3749	3749	2949	2933	1624	1624	2064	2064	1966	2296	3835
Eto (mm/month)	146.13	129.05	130.28	118.08	120.93	109.22	119.32	131.43	140.61	153.67	152.68	157.21
Weighted Kc	0.77	0.98	0.98	0.85	0.43	0.52	0.74	0.88	0.84	0.64	0.57	0.60
Etc (mm/month)	112.75	126.34	127.60	100.62	51.91	56.38	88.77	115.72	117.55	98.79	86.34	93.69
Pe (mm/month)	68.2	79.2	93	72.5	3.5	7.8	4.1	6.1	24.3	61.6	51	59.2
Humidity Deficit (mm/mth)	44.55	47.14	34.60	28.12	48.41	48.58	84.67	109.62	93.25	37.19	35.34	34.49
Bet Req. (m3/ha/month)	445.48	471.45	345.98	281.22	484.10	485.78	846.65	1096.19	932.46	371.91	353.37	344.87
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	1113.70	1178.62	864.95	703.05	1210.25	1214.46	2116.63	2740.47	2331.15	929.78	883.42	862.18
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31
Gross Req. (m3/ha/day)	35.93	42.09	27.90	23.43	39.04	40.48	68.28	88.40	77.70	29.99	29.45	27.81
Time (hs)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Mr (l/s/ha)	0.416	0.487	0.323	0.271	0.452	0.469	0.790	1.023	0.899	0.347	0.341	0.322
Required Q (l/s)	1637.45	1826.32	1210.58	799.78	1325.28	760.99	1283.51	2111.50	1855.99	682.32	782.52	1234.65
Required Q (m3/s)	1.64	1.83	1.21	0.80	1.33	0.76	1.28	2.11	1.86	0.68	0.78	1.23
Vol. (M3/month)	4.39	4.42	3.24	2.07	3.55	1.97	3.44	5.66	4.81	1.83	2.03	3.31
Vol. Project (M3)	40.71											

(*) Para él cálculo de la demanda de agua de un proyecto se debe tener en cuenta todas las pérdidas resultantes de la conducción, sistema de distribución y de la eficiencia de aplicación del agua al cultivo. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

3) Department of Piura

(a) Definition of the Cultivation Products

Cultivation products proposed for the Department of Piura is the following;

Table 3.4-22 Cultivation products proposed for the Department of Piura

BASIC CROP	AREA (Has)	ROTATION CROP	AREA (Has)
YELLOW HARD MAIZE	798	POTATO	399
AMILLACEOUS MAIZE	732	PEA G.V.	366
WHEAT	409	BROAD BEAN G.V.	204
COFFEE	332	BROAD BEANS G.V.	172
DRY PEA	172	AMILLACEOUS MAIZE	131
DRY BEAN	131	PEA G.V.	26
POTATO	52	YELLOW HARD MAIZE	20
MANIOC	50	YELLOW HARD MAIZE	28
SWEET POTATO	41		
BARLEY GRAIN	28		
TOTAL	2,745		1,347

For the first crop the following products of short vegetative period have been selected: Yellow hard maize in 798 ha, amillaceous maize in 732 ha, wheat in 409 ha, coffee in 332 ha, dry pea in 172 ha, dry bean in 131 ha, potato in 52 ha, manioc in 50 ha, sweet potato in 41 ha, barley grain in 28 ha.

(b) Definition of cultivation schedule

The cultivation schedule for the Department of Piura is the following;

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO DE ROTACIÓN
MAIZ AMARILLO DURO	798	798	798	798	399	399	399	399	399	399	798	798	798	PAPA
MAÍZ AMILACEO	732	732	732	732	732	732	366	366	366	366			732	ARVEJA G.V.
TRIGO	409	409	409	409	409	409			204	204	204	204	409	HABA G.V.
CAFÉ	332	332	332	332	332	332	332	332	332	332	332	332	332	
ARVEJA GRANO SECO	172	172	172	172	172	172	172	172	172	172		172	172	HABAS G.V.
FRIJOL GRANO SECO	131	131	131	131	131	131	131	131	131	131	131	131	131	MAÍZ AMILÁCEO
PAPA	52	52	52	52	26	26	26	26	26	26	52	52	52	ARVEJA G.V.
YUCA	50	50				50	50	50	50	50	50	50	50	
CAMOTE	41	41	41	41	20	20	20	20	20	20	41	41	41	MAÍZ AMARILLO DURO
CEBADA GRANO	28	28	28	28	28	28	28	28	28	28	28	28	28	MAÍZ AMARILLO DURO
TOTAL	2745	2745	2695	2695	2249	2300	1525	1525	1729	1729	1636	1808	2745	

For products with long vegetative period, 332 ha of coffee. Second crop rotation is 399 ha of Yellow hard maize with potato, 987 ha of amillaceous maize with fresh pea, 366 ha of wheat with fresh broad bean, 204 ha of dry pea with fresh broad bean, 172 ha of dry bean with amillaceous maize, 26 ha of potato with fresh pea, 20 ha of sweet potato with Yellow hard maize and 28 ha of barley grain with Yellow hard maize. In total, 1,347ha.

Proposed cultivation schedule with project, department of Piura

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
MAIZ AMARILLO DURO	798												
MAÍZ AMILACEO	732												
TRIGO	409												
CAFÉ	332												
ARVEJA GRANO SECO	172												
FRIJOL GRANO SECO	131												
PAPA	52												
YUCA	50												
CAMOTE	41												
CEBADA GRANO	28												
TOTAL	2717												

Segunda Campaña	Area (Has)
PAPA	399
ARVEJA G.V.	366
HABA G.V.	204
HABAS G.V.	172
MAÍZ AMILÁCEO	131
ARVEJA G.V.	26
MAÍZ AMARILLO DURO	20
MAÍZ AMARILLO DURO	28
TOTAL	1,347

(c) Definition of Water Demand

Water demand for the Department of Piura is the following;

Table 3.4-23 Water Demand of Products with Project, department of Piura

Cultivo	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
Area (Has)	2745	2695	2695	2249	2300	1525	1525	1729	1729	1636	1808	2745
Eto (mm/month)	164.0	145.2	153.5	138.8	137.3	125.1	134.0	145.6	154.4	162.3	164.6	168.3
Weighted Kc	0.78	0.93	0.82	0.80	0.49	0.65	0.87	0.93	0.85	0.60	0.58	0.63
Etc (mm/month)	128.62	135.02	125.09	110.41	67.07	81.03	116.38	134.70	130.70	97.14	95.51	106.42
Pe (mm/month)	47.5	63.4	80.6	61.6	32.4	21.8	12.3	21.6	18.1	38.4	43.4	40.0
Humidity Deficit (mm/mth)	81.12	71.62	44.49	48.81	34.67	59.23	104.08	113.10	112.60	58.74	52.11	66.42
Bet Req. (m3/ha/month)	811.24	716.22	444.90	488.10	346.66	592.30	1040.78	1131.01	1125.99	587.44	521.15	664.16
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	2028.10	1790.55	1112.25	1220.24	866.64	1480.75	2601.96	2827.53	2814.98	1468.61	1302.87	1660.41
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31
Gross Req. (m3/ha/day)	65.42	63.95	35.88	40.67	27.96	49.36	83.93	91.21	93.83	47.37	43.43	53.56

Time (hs)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Mr (l/s/ha)	0.757	0.740	0.415	0.471	0.324	0.571	0.971	1.056	1.086	0.548	0.503	0.620
Required Q (l/s)	2078.53	1994.60	1119.10	1058.98	744.06	871.02	1481.18	1825.31	1877.78	897.27	908.93	1701.70
Required Q (m3/s)	2.08	1.99	1.12	1.06	0.74	0.87	1.48	1.83	1.88	0.90	0.91	1.70
Vol. (M3/month)	5.57	4.83	3.00	2.74	1.99	2.26	3.97	4.89	4.87	2.40	2.36	4.56
Vol. Project (M3)	43.43											

(*) Para él cálculo de la demanda de agua de un proyecto se debe tener en cuenta todas las pérdidas resultantes de la conducción, sistema de distribución y de la eficiencia de aplicación del agua al cultivo. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

4) Department of La Libertad

(a) Definition of the Cultivation Products

Cultivation products proposed for the Department of La Libertad is the following;

Table 3.4-24 Cultivation products proposed for the Department of La Libertad

BASIC CROP	AREA (Has)	ROTATION CROP	AREA (Has)
WHEAT	429	BROAD BEAN G.V.	215
BARLEY GRAIN	405	YELLOW HARD MAIZE	202
YELLOW HARD MAIZE	400	POTATO	200
POTATO	337	PEA G.V.	168
AMILLACEOUS MAIZE	230	PEA G.V.	115
DRY PEA	106	BROAD BEANS G.V.	53
ALFALFA	69	AMILLACEOUS MAIZE	30
DRY BEAN	60	CHOCLO MAIZE	29
DRY BROAD BEAN	58	BROAD BEAN G.V.	18
OLLUCO	36		
TOTAL	**2129**		**1,030**

For the first crop the following products with short vegetative period have been selected: wheat in 429 ha, barley grain in 405 ha, Yellow hard maize in 400 ha, potato in 337 ha, amillaceous maize in 230 ha, dry pea in 106 ha, alfalfa in 69 ha, dry bean in 60 ha, dry broad bean in 58 ha and olluco in 36 ha, totaling 2,129 ha.

(b) Definition of the cultivation schedule

The cultivation schedule for the Department of La Libertad is the following;

Proposed cultivation products with project, department La Libertad

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO ROTACIÓN
TRIGO	429	429	429	429	429	429			215	215	215	215	429	HABA G.V.
CEBADA GRANO	405	405	405	405	405	405	202	202	202	202	202	202	405	MAÍZ AMARILLO DURO
MAÍZ AMARILLO DURO	400	400	400	400	200	200	200	200	200	200	400	400	400	PAPA
PAPA	337	337	337	337			168	168	168	168	337	337	337	ARVEJA G.V.
MAÍZ AMILÁCEO	230	230	230	230	230	230	115	115	115	115			230	ARVEJA G.V.
ARVERJA GRANO SECO	106	106	106	106	53	53	53	53	53	53		106	106	HABAS G.V.
ALFALFA	69	69	69	69	69	69	69	69	69	69	69	69	69	
FRIJOL GRANO SECO	60	60	60	60	60	60	30	30	30	30	30	30	60	MAÍZ AMILÁCEO
HABA GRANO SECO	58	58	58	58	58	58	29	29	29	29	29	58	58	MAÍZ CHOCLO
OLLUCO	36	36	36	36	36	36		18	18	18	18	36	36	HABA G.V.
TOTAL	**2129**	**2129**	**2129**	**2129**	**1539**	**1539**	**866**	**884**	**1099**	**1099**	**1299**	**1453**	**2129**	

For products with long or semi-permanent vegetative periods alfalfa in 69 ha was selected. In the second crop rotation is 215 ha of wheat with amillaceous maize, 20p2ha of barley grain with Yellow hard maize, 200 of Yellow hard maize with potato, 168 ha of potato with fresh pea, 115 ha of amillaceous maize with fresh pea, 53 ha of dry pea with fresh broad beans, 30 ha of dry bean with amillaceous maize, 18 ha of olluco with fresh broad bean, totaling 1,030 ha of rotation crops.

Proposed cultivation schedule with project, department La Libertad

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña	Area (Has)
TRIGO	429													HABA G.V.	215
CEBADA GRANO	405													MAÍZ AMARILLO DURO	202
MAÍZ AMARILLO DURO	400													PAPA	200
PAPA	337													ARVEJA G.V.	168
MAÍZ AMILÁCEO	230													ARVEJA G.V.	115
ARVERJA GRANO SECO	106													HABAS G.V.	53
ALFALFA	69														
FRIJOL GRANO SECO	60													MAÍZ AMILÁCEO	30
HABA GRANO SECO	58													MAÍZ CHOCLO	29
OLLUCO	36													HABA G.V.	18
Total	**2129**													**TOTAL**	**1030**

For the project water demand calculation, the efficiency of irrigation is the same used by the projects

executed by the National Authority of Water (Ex Intendancy of Water Resources). In the case of new canals, efficiency of conduction equal to 95 %, efficiency of distribution equal to 75 % and efficiency of application of 56 %, it results in an irrigation efficiency of 40%, as shown in the chart in annex. A first peak of flow requirement for the products can be noticed between the months of June to October with a maximum in August equal to 1.98 m3/s.

(c) Definition of the Water Demand

Water demand for the Department of La Libertad is the following;

Table 3.4-25 Water Demand of Products with Project, department La Libertad

Cultivo	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
Area (Has)	2129.00	2129.00	2129.00	1539.37	1539.37	866.45	884.32	1098.98	1098.98	1299.29	1452.55	2129.00
Eto (mm/month)	126.48	105.42	106.37	96.54	100.32	98.76	107.85	121.96	130.21	129.12	135.61	132.40
Weighted Kc	0.80	0.96	0.93	0.82	0.47	0.60	0.80	0.91	0.92	0.64	0.55	0.63
Etc (mm/month)	101.74	101.39	98.79	79.34	47.33	58.88	86.05	111.54	119.78	82.93	74.77	83.05
Pe (mm/month)	126.3	134.4	155.3	136.3	68.6	28.8	11.2	14	43.2	93.9	84.1	90.6
Humidity Deficit (mm/mth)	0.00	0.00	0.00	0.00	0.00	30.08	74.85	97.54	76.58	0.00	0.00	0.00
Bet Req. (m3/ha/month)	0.00	0.00	0.00	0.00	0.00	300.83	748.54	975.41	765.78	0.00	0.00	0.00
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	0.00	0.00	0.00	0.00	0.00	749.68	1865.38	2430.74	1908.35	0.00	0.00	0.00
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31
Gross Req. (m3/ha/day)	0.00	0.00	0.00	0.00	0.00	24.99	60.17	78.41	63.61	0.00	0.00	0.00
Time (hs)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Mr (l/s/ha)	0.000	0.000	0.000	0.000	0.000	0.289	0.696	0.908	0.736	0.000	0.000	0.000
Required Q (l/s)	0.00	0.00	0.00	0.00	0.00	250.60	615.88	997.36	809.12	0.00	0.00	0.00
Required Q (m3/s)	0.00	0.00	0.00	0.00	0.00	0.25	0.62	1.00	0.81	0.00	0.00	0.00
Vol. (M3/month)	0.00	0.00	0.00	0.00	0.00	0.65	1.65	2.67	2.10	0.00	0.00	0.00
Vol. Project (M3)	7.07											

(*) Para él cálculo de la demanda de agua de un proyecto se debe tener en cuenta todas las pérdidas resultantes de la conducción, sistema de distribución y de la eficiencia de aplicación del agua al cultivo. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

5) Department of Ancash

(a) Definition of the Cultivation Products

Cultivation products proposed for the Department of Ancash is the following;

Table 3.4-26 Cultivation products proposed for the Department of Ancash

BASIC CROP	AREA (Has)	ROTATION CROP	AREA (Has)
YELLOW HARD MAIZE	1,744	POTATO	872
WHEAT	1,607	BROAD BEAN G.V.	803
BARLEY GRAIN	1,260	YELLOW HARD MAIZE	630
POTATO	1,086	YELLOW HARD MAIZE	543
AMILLACEOUS MAIZE	971	PEA G.V.	486
CHOCLO MAIZE	633	POTATO	316
ALFALFA	608	BROAD BEAN G.V.	82
OLLUCO	163	CHOCLO MAIZE	71
DRY BROAD BEAN	143	AMILLACEOUS MAIZE	67
DRY BEAN	134		
TOTAL	**8,349**		**3,870**

For the first crop (Table 14) the following products of short vegetative period are selected: Yellow hard maize in 1,744 ha, wheat in 1,607 ha, barley grain 1,086 ha, potato in 1,545 ha, amillaceous maize 971 ha, choclo maize in 633 ha, alfalfa in 608 ha, olluco 163 ha, dry broad bean in 143 ha, dry bean in 134 ha.

(b) Definition of the cultivation schedule

The cultivation schedule proposed for the Department of Ancash is the following;

Proposed cultivation products with project, department of Ancash

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO ROTACIÓN
MAÍZ AMARILLO DURO	1,744	1,744	1,744	1,744	872	872	872	872	872	872	1,744	1,744	1,744	PAPA
TRIGO	1,607	1,607	1,607	1,607	1,607	1,607			803	803	803	803	1,607	HABA G.V.
CEBADA GRANO	1,260	1,260	1,260	1,260	1,260	1,260	630	630	630	630	630	630	1,260	MAÍZ AMARILLO DURO
PAPA	1,086	1,086	1,086	1,086	543	543	543	543	543	543	1,086	1,086	1,086	MAÍZ AMARILLO DURO
MAÍZ AMILÁCEO	971	971	971	971	971	971	486	486	486	486			971	ARVEJA G.V.
MAÍZ CHOCLO	633	633	633	633	316	316	316	316	316	316	633	633	633	PAPA
ALFALFA	608	608	608	608	608	608	608	608	608	608	608	608	608	
OLLUCO	163	163	163	163	163	163		82	82	82	82	163	163	HABA G.V.
HABA GRANO SECO	143	143	143	143	143	143	71	71	71	71	71	143	143	MAÍZ CHOCLO
FRIJOL GRANO SECO	134	134	134	134	134	134	67	67	67	67	67	67	134	MAÍZ AMILÁCEO
Total	**8,349**	**8,349**	**8,349**	**8,349**	**6,618**	**6,618**	**3,594**	**3,675**	**4,479**	**4,479**	**5,724**	**5,877**	**8,349**	

For products with large or semi-permanent vegetative period alfalfa in 865 ha was selected. Second crop rotation is 630 ha of Yellow hard maize with potato, 543ha of wheat with fresh broad bean, 486 ha of barley with Yellow hard maize, 316 ha of potato with Yellow hard maize, 82 ha of olluco with fresh broad bean, 71ha of dry broad bean with choclo maize and 67 ha of dry bean with amillaceous maize.

Products and cultivation schedule proposed with project, department of Ancash

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña	Área (Has)
MAÍZ AMARILLO DURO	1,744													PAPA	872
TRIGO	1,607													HABA G.V.	803
CEBADA GRANO	1,260													MAÍZ AMARILLO DURO	630
PAPA	1,086													MAÍZ AMARILLO DURO	543
MAÍZ AMILÁCEO	971													ARVEJA G.V.	486
MAÍZ CHOCLO	633													PAPA	316
ALFALFA	608														
OLLUCO	163													HABA G.V.	82
HABA GRANO SECO	143													MAÍZ CHOCLO	71
FRIJOL GRANO SECO	134													MAÍZ AMILÁCEO	67
TOTAL	**8,349**														**3,870**

(c) Definition of water demand

Water demand for the Department of Ancash is the following;

Table 3.4-27 Water Demand of Products with Project, department Ancash.

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dic
Area (Has)	8,349	8,349	8,349	6,618	6,618	3,594	3,675	4,479	4,479	5,724	5,877	8,349
Eto (mm/month)	139.02	116.67	117.14	103.51	104.58	101.89	108.64	122.85	120.38	133.59	139.78	147.24
Weighted Kc	0.83	0.96	0.86	0.77	0.53	0.79	0.92	0.92	0.89	0.62	0.60	0.68
Etc (mm/month)	115.83	112.52	101.20	79.50	55.54	80.50	100.32	112.96	107.55	83.38	84.25	99.60
Pe (mm/month)	71.33	69.52	75.4	32.14	0	0	0	0	0.04	10.39	12.69	41.51
Humidity Deficit (mm/mth)	44.50	43.00	25.80	47.36	55.54	80.50	100.32	112.96	107.51	72.99	71.56	58.09
Bet Req. (m3/ha/month)	445.00	429.99	258.00	473.64	555.42	804.97	1003.22	1129.60	1075.12	729.87	715.62	580.86
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	1112.49	1074.99	645.00	1184.10	1388.54	2012.42	2508.06	2824.01	2687.79	1824.68	1789.05	1452.16
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31
Gross Req. (m3/ha/day)	35.89	38.39	20.81	39.47	44.79	67.08	80.91	91.10	89.59	58.86	59.64	46.84
Time (hs)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Mr (l/s/ha)	0.415	0.444	0.241	0.457	0.518	0.776	0.936	1.054	1.037	0.681	0.690	0.542
Required Q (l/s)	3467.81	3709.93	2010.57	3023.11	3430.73	2789.99	3441.32	4722.00	4644.04	3899.63	4056.46	4526.62
Required Q (m3/s)	3.47	3.71	2.01	3.02	3.43	2.79	3.44	4.72	4.64	3.90	4.06	4.53
Vol. (M3/month)	9.29	8.98	5.39	7.84	9.19	7.23	9.22	12.65	12.04	10.44	10.51	12.12
Vol. Project (M3)	112.89											

(*) For calculation of water demand for a project, all loss resulting from the conduction, distribution system and the efficieny of application have to be taken into account. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

6) Department of Huánuco

(a) Definition of Cultivation Products

Cultivation products proposed for the Department of Huánuco is the following;

Table 3.4-28 Cultivation products proposed for the Department of Huánuco

BASIC CROP	AREA (Has)	ROTATION CROP	AREA (Has)
POTATO	249	YELLOW HARD MAIZE	125
AMILLACEOUS MAIZE	104	PEA G.V.	52
YELLOW HARD MAIZE	73	POTATO	37
WHEAT	68	BROAD BEAN G.V.	34
BARLEY GRAIN	56	YELLOW HARD MAIZE	28
DRY BEAN	32	AMILLACEOUS MAIZE	16
MANIOC	29	CHOCLO MAIZE	24
DRY BROAD BEAN	24	BROAD BEAN G.V.	14
OLLUCO	14		
TOTAL	**649**		**329**

These selected products are in accordance to the agronomic requirements of soil, water, climate, predominant slopes, marketing studies and profitability. For the first crop the following products with short vegetative period are selected: potato in 249 ha, amillaceous maize in 104ha, Yellow hard maize in 73 ha, wheat in 68ha, barley grain in 56 ha, dry bean in 32 ha, manioc in 29 ha, dry broad bean in 24 ha, and olluco in 14 ha.

(b) Definition of the cultivation schedule

Cultivation schedule for the Department of Huanuco is the following;

Cultivo	Area (Has	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO DE ROTACIÓN
PAPA	249	249	249	249	125	125	125	125	125	125	249	249	249	MAÍZ AMARILLO DURO
MAÍZ AMILÁCEO	104	104	104	104	104	104	52	52	52	52			104	ARVEJA G.V.
MAÍZ AMARILLO DURO	73	73	73	73	37	37	37	37	37	37	73	73	73	PAPA
TRIGO	68	68	68	68	68	68			34	34	34	34	68	HABA G.V.
CEBADA GRANO	56	56	56	56	56	56	28	28	28	28	28	28	56	MAÍZ AMARILLO DURO
FRIJOL GRANO SECO	32	32	32	32	32	32	16	16	16	16	16	16	32	MAÍZ AMILÁCEO
YUCA	29	29				29	29	29	29	29	29	29	29	
HABA GRANO SECO	24	24	24	24	24	24	24	24	24	24	24	24	24	MAÍZ CHOCLO
OLLUCO	14	14	14	14	14	14		14	14	14	14	14	14	HABA G.V.
Total	**649**	**649**	**620**	**620**	**459**	**488**	**310**	**324**	**358**	**358**	**467**	**467**	**649**	

Second crop rotation is 125ha of potato with Yellow hard maize, 52ha of amillaceous maize with fresh pea, 37 ha of Yellow hard maize with potato, 34 ha of wheat with fresh broad bean, 28 ha of barley with Yellow hard maize, 16 ha of dry bean with amillaceous maize, 24 ha of dry broad bean with choclo maize and 14 ha of olluco with fresh broad bean.

-Proposed cultivation schedule with project, department Huanuco

Cultivo	Area (Has	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña	Area (Has)
PAPA	249													MAÍZ AMARILLO DURO	125
MAÍZ AMILÁCEO	104													ARVEJA G.V.	52
MAÍZ AMARILLO DURO	73													PAPA	37
TRIGO	68													HABA G.V.	34
CEBADA GRANO	56													MAÍZ AMARILLO DURO	28
FRIJOL GRANO SECO	32													MAÍZ AMILÁCEO	16
YUCA	29														
HABA GRANO SECO	24													MAÍZ CHOCLO	24
OLLUCO	14													HABA G.V.	14
TOTAL	**649**														**329**

(c) Definition of Water Demand

Water demand for the Department of Huanuco is the following;

Table 3.4-29 Water demand of products with Project, department Huánuco.

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Area (Has)	649	620	620	459	488	310	324	358	358	467	467	649
Eto (mm/month)	115.72	100.98	99.28	90.02	86.56	79.63	86.56	103.05	109.55	125.01	120.59	122.03
Weighted Kc	0.87	0.97	0.91	0.71	0.49	0.71	0.86	0.93	0.74	0.53	0.57	0.70
Etc (mm/month)	100.84	97.94	90.82	63.90	42.03	56.31	74.11	96.24	80.91	66.43	69.25	85.71
Pe (mm/month)	44.9	71.8	89.6	29.3	11.1	1.7	3.1	5.4	22.9	33.8	60.3	50.9
Humidity Deficit (mm/mth)	55.94	26.14	1.22	34.60	30.93	54.61	71.01	90.84	58.01	32.63	8.95	34.81
Bet Req. (m3/ha/month)	559.37	261.37	12.17	346.01	309.31	546.15	710.07	908.40	580.09	326.28	89.53	348.11
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	1398.43	653.42	30.43	865.02	773.26	1365.36	1775.17	2271.00	1450.23	815.70	223.84	870.29
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31

Gross Req. (m3/ha/day)	45.11	23.34	0.98	28.83	24.94	45.51	57.26	73.26	48.34	26.31	7.46	28.07
Time (hs)	24.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Mr (l/s/ha)	0.522	0.360	0.015	0.445	0.385	0.702	0.884	1.131	0.746	0.406	0.115	0.433
Required Q (l/s)	338.85	223.28	9.39	204.24	187.85	217.73	286.32	404.73	267.07	189.63	53.77	281.17
Required Q (m3/s)	0.34	0.22	0.01	0.20	0.19	0.22	0.29	0.40	0.27	0.19	0.05	0.28
Vol. (M3/month)	0.91	0.41	0.02	0.40	0.38	0.42	0.58	0.81	0.52	0.38	0.10	0.56
Vol. Project (M3)	5.49											

(*) For calculation of water demand for a project, all loss resulting from the conduction, distribution system and the efficieny of application have to be taken into account. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

7) Department of Junín

(a) Definition of Cultivation Products

Cultivation products proposed for the Department of Junin is the following;

Table 3.4-30 Cultivation products proposed for the Department of Junin

BASIC CROP	AREA (Has)	ROTATION CROP	AREA (Has)
COFFEE	2,776	YELLOW HARD MAIZE	373
POTATO	747	YELLOW HARD MAIZE	210
BARLEY GRAIN	420	PEAG.V.	156
AMILLACEOUS MAIZE	311	POTATO	135
CHOCLO MAIZE	270	BROAD BEAN G.V.	122
WHEAT	244	POTATO	68
MANIOC	167	CHOCLO MAIZE	68
YELLOW HARD MAIZE	137	AMILLACEOUS MAIZE	60
FRESH PEA	136		
FRESH BROAD BEAN	120		
TOTAL	**5,327**		**1,192**

These selected products are in accordance to the agronomic requirements of soil, water, climate, predominant slopes, marketing studies and profitability. For the first crop the following products with short vegetative period are selected: potato in 747 ha, barley grain 420 ha, amillaceous maize in 311 ha, choclo maize in 270 ha, wheat in 244 ha, manioc in 167 ha, Yellow hard maize in 137 ha, fresh pea in 136 ha and fresh broad in 120 ha.

(b) Definition of the cultivation schedule

The cultivation schedule for the Department of Junin is the following;

Proposed cultivation products with project, department Junín

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO DE ROTACIÓ
CAFÉ	2776	2776	2776	2776	2776	2776	2776	2776	2776	2776	2776	2776	2776	
PAPA	747	747	747	747	373	373	373	373	373	373	747	747	747	MAÍZ AMARILLO DURO
CEBADA GRANO	420	420	420	420	420	420	210	210	210	210	210	210	420	MAÍZ AMARILLO DURO
MAÍZ AMILÁCEO	311	311	311	311	311	311	156	156	156	156			311	ARVEJA G.V.
MAÍZ CHOCLO	270	270	270	270	135	135	135	135	135	135	270	270	270	PAPA
TRIGO	244	244	244	244	244	244			122	122	122	122	244	HABA G.V.
YUCA	167	167				167	167	167	167	167	167	167	167	
MAÍZ AMARILLO DURO	137	137	137	137	68	68	68	68	68	68	137	137	137	PAPA
ARVERJA GRANO VERDE	136	136	136	136	136	136			68	68	68	68	68	MAÍZ CHOCLO
HABA GRANO VERDE	120	120	120	60	60	60	60	60	60			120	120	MAÍZ AMILÁCEO
Total	**5327**	**5327**	**5160**	**5100**	**4524**	**4690**	**3945**	**3945**	**4135**	**4075**	**4496**	**4616**	**5259**	

For products with long or permanent vegetative period coffee is selected with 3,131ha. Second crop rotation is 373ha of potato with Yellow hard maize, 210 ha of barley grain with Yellow hard maize, 176 ha of amillaceous maize with fresh pea, 156 ha of choclo maize with potato, 122 ha of wheat with fresh broad bean, 68 ha of Yellow hard maize with potato, 68 ha of fresh pea with choclo maize, 68 ha of fresh broad bean with amillaceous maize.

Proposed cultivation schedule with project, department Junín

Cultivo	rea (Ha	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña	Area (Has)
PAPA	249													MAÍZ AMARILLO DURO	125
MAÍZ AMILÁCEO	104													ARVEJA G.V.	52
MAÍZ AMARILLO DURO	73													PAPA	37
TRIGO	68													HABA G.V.	34
CEBADA GRANO	56													MAÍZ AMARILLO DURO	28
FRIJOL GRANO SECO	32													MAÍZ AMILACEO	16
YUCA	29														
HABA GRANO SECO	24													MAÍZ CHOCLO	24
OLLUCO	14													HABA G.V.	14
TOTAL	**649**														**329**

(c) Definition of water demand

Water demand for the Department of Junín is the following;

Table 3.4-31 Water Demand of the Products with Project, department of Junín

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Area (Has)	649	620	620	459	488	310	324	358	358	467	467	649
Eto (mm/month)	115.72	100.98	99.28	90.02	86.56	79.63	86.56	103.05	109.55	125.01	120.59	122.03
Weighted Kc	0.87	0.97	0.91	0.71	0.49	0.71	0.86	0.93	0.74	0.53	0.57	0.70
Etc (mm/month)	100.84	97.94	90.82	63.90	42.03	56.31	74.11	96.24	80.91	66.43	69.25	85.71
Pe (mm/month)	44.9	71.8	89.6	29.3	11.1	1.7	3.1	5.4	22.9	33.8	60.3	50.9
Humidity Deficit (mm/mth)	55.94	26.14	1.22	34.60	30.93	54.61	71.01	90.84	58.01	32.63	8.95	34.81
Bet Req. (m3/ha/month)	559.37	261.37	12.17	346.01	309.31	546.15	710.07	908.40	580.09	326.28	89.53	348.11
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	1398.43	653.42	30.43	865.02	773.26	1365.36	1775.17	2271.00	1450.23	815.70	223.84	870.29
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31
Gross Req. (m3/ha/day)	45.11	23.34	0.98	28.83	24.94	45.51	57.26	73.26	48.34	26.31	7.46	28.07
Time (hs)	24.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Mr (l/s/ha)	0.522	0.360	0.015	0.445	0.385	0.702	0.884	1.131	0.746	0.406	0.115	0.433
Required Q (l/s)	338.85	223.28	9.39	204.24	187.85	217.73	286.32	404.73	267.07	189.63	53.77	281.17
Required Q (m3/s)	0.34	0.22	0.01	0.20	0.19	0.22	0.29	0.40	0.27	0.19	0.05	0.28
Vol. (M3/month)	0.91	0.41	0.02	0.40	0.38	0.42	0.58	0.81	0.52	0.38	0.10	0.56
Vol. Project (M3)	49.11											

(*) For calculation of water demand for a project, all loss resulting from the conduction, distribution system and the efficieny of application have to be taken into account. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

8) Department of Huancavelica

(a) Definition of Cultivation Products

Cultivation products proposed for the Department of Huancavelica is the following;

Table 3.4-32 Cultivation products proposed for the Department Huancavelica

BASIC CROP	AREA (ha)	ROTATION CROP	AREA (ha)
BARLEY GRAIN	52	YELLOW HARD MAIZE	52
POTATO	44	YELLOW HARD MAIZE	22
AMILLACEOUS MAIZE	40	PEA G.V.	20
ALFALFA	34	BROAD BEAN G.V.	19
WHEAT	19	CHOCLO MAIZE	15
DRY BROAD BEAN	15	CHOCLO MAIZE	12
FRESH PEA	12	BROAD BEAN G.V.	12
DRY PEA	12	AMILLACEOUS MAIZE	6
DRY BEAN	6	AMILLACEOUS MAIZE	6
FRESH BROAD BEAN	6		
TOTAL	**240**		**164**

These selected products are in accordance to the agronomic requirements of soil, water, climate, predominant slopes, marketing studies and profitability. For the first crop the following products with short vegetative period are selected: barley grain in 52 ha, potato in 44 ha, amillaceous maize in 40 ha, wheat in 19 ha, dry broad bean in 15 ha, fresh pea in 12 ha, dry pea in 6 ha and fresh broad bean in 6 ha.

(b) Definition of cultivation schedule

Cultivation schedule proposed for the department of Huancavelica is the following;

Proposed cultivation products with project, department of Huancavelica

Cultivo	Área (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO ROTACIÓN
CEBADA GRANO	52	52	52	52	52	52	52	52	52	52	52	52	52	MAÍZ AMARILLO DURO
PAPA	44	44	44	44	22	22	22	22	22	22	44	44	44	MAÍZ AMARILLO DURO
MAÍZ AMILÁCEO	40	40	40	40	40	40	20	20	20	20			40	ARVEJA G.V.
ALFALFA	34	34	34	34	34	34	34	34	34	34	34	34	34	
TRIGO	19	19	19	19	19	19			19	19	19	19	19	HABA G.V.
HABA GRANO SECO	15	15	15	15	15	15	15	15	15	15	15	15	15	MAÍZ CHOCLO
ARVERJA GRANO VERDE	12	12	12	12	12				12	12	12	12	12	MAÍZ CHOCLO
ARVERJA GRANO SECO	12	12	12	12	12	12	12	12	12	12		12	12	HABAS G.V.
FRIJOL GRANO SECO	6	6	6	6	6	6	6	6	6	6	6	6	6	MAÍZ AMILÁCEO
HABA GRANO VERDE	6	6	6	6	6	6	6	6	6			6	6	MAÍZ AMILÁCEO
TOTAL	**240**	**240**	**240**	**240**	**218**	**206**	**166**	**166**	**198**	**192**	**183**	**200**	**240**	

For products with long or permanent vegetative period alfalfa in 34 ha is selected. Second crop rotation is 52 ha of barley grain with Yellow hard maize, 22 ha of potato with Yellow hard maize, 31ha of amillaceous maize with fresh pea, 20 ha of wheat with fresh broad bean, 19 ha of dry broad bean with choclo maize, 15 ha of fresh pea with choclo maize, 12 ha of fry pea with fresh broad beans, 12 ha of dry bean with amillaceous maize and 6 ha of fresh broad bean with amillaceous maize.

Proposed cultivation schedule with project, department Huancavelica

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña
CEBADA GRANO	51.891892													MAÍZ AMARILLO DURO
PAPA	44.108108													MAÍZ AMARILLO DURO
MAÍZ AMILÁCEO	39.567568													ARVEJA G.V.
ALFALFA	33.72973													
TRIGO	19.459459													HABA G.V.
HABA GRANO SECO	14.918919													MAÍZ CHOCLO
ARVERJA GRANO VERDE	12.324324													MAÍZ CHOCLO
ARVERJA GRANO SECO	11.675676													HABAS G.V.
FRIJOL GRANO SECO	6.4864865													MAÍZ AMILÁCEO
HABA GRANO VERDE	5.8378378													MAÍZ AMILÁCEO
TOTAL	**240**													**TOTAL**

(c) Definition of water demand

Water demand for the Department of Junín is the following:

Table 3.4-33 Water demand of products with Project, department of Huancavelica

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Area (Has)	240	240	240	218	206	166	166	198	192	183	200	240
Eto (mm/month)	116.89	95.71	83.43	89.15	88.85	79.88	82.13	98.81	113.18	131.86	134.21	142.64
Weighted Kc	0.78	0.94	1.01	0.83	0.55	0.63	0.81	0.89	0.89	0.85	0.61	0.66
Etc (mm/month)	91.70	90.42	84.46	74.25	48.96	50.66	66.65	88.14	100.70	112.69	82.10	93.91
Pe (mm/month)	123.5	105.8	113.8	24.7	5.6	0.5	0.2	0.9	7.2	4.9	21.1	54.3
Humidity Deficit (mm/mth)	0.00	0.00	0.00	49.55	43.36	50.16	66.45	87.24	93.50	107.79	61.00	39.61
Bet Req. (m3/ha/month)	0.00	0.00	0.00	495.49	433.64	501.64	664.52	872.45	934.99	1077.88	609.96	396.10
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Gross Req. (m3/ha/month)	0.00	0.00	0.00	1234.77	1080.65	1250.11	1656.00	2174.17	2330.02	2686.09	1520.03	987.09
Days in the month	31	28	31	30	31	30	31	31	30	31	30	31
Gross Req. (m3/ha/day)	0.00	0.00	0.00	41.16	34.86	41.67	53.42	70.13	77.67	86.65	50.67	31.84
Time (hs)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Mr (l/s/ha)	0.000	0.000	0.000	0.476	0.403	0.482	0.618	0.812	0.899	1.003	0.586	0.369
Required Q (l/s)	0.00	0.00	0.00	103.82	82.96	80.24	102.87	160.86	172.89	183.44	117.54	88.45
Required Q (m3/s)	0.00	0.00	0.00	0.10	0.08	0.08	0.10	0.16	0.17	0.18	0.12	0.09
Vol. (M3/month)	0.00	0.00	0.00	0.27	0.22	0.21	0.28	0.43	0.45	0.49	0.30	0.24
Vol. Project (M3)	2.89											

(*) For calculation of water demand for a project, all loss resulting from the conduction, distribution system and the efficieny of application have to be taken into account. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

9) Department of Ayacucho

(a) Definition of the cultivation products

Cultivation products proposed for the Department of Ayacucho is the following:

Table 3.4-34 Cultivation products proposed for the Department of Ayacucho

BASIC CROP	AREA (Has)	ROTATION CROP	AREA (Has)
AMILLACEOUS MAIZE	1,433	PEA G.V.	717
POTATO	1,109	YELLOW HARD MAIZE	554
BARLEY GRAIN	1,098	YELLOW HARD MAIZE	549
WHEAT	823	BROAD BEAN G.V.	411
ALFALFA	710	CHOCLO MAIZE	205
DRY BROAD BEAN	411	BROAD BEANS G.V.	135
DRY PEA	269	BROAD BEAN G.V.	91
OLLUCO	181	POTATO	50
YELLOW HARD MAIZE	101		
TOTAL	**6,134**		**2,712**

These selected products are in accordance to the agronomic requirements of soil, water, climate, predominant slopes, marketing studies and profitability. For the first crop the following products with short vegetative period are selected: amillaceous maize in 1,433 ha, potato in 1,109 ha, barley grain in 1,098 ha, wheat in 823 ha, dry broad bean in 411 ha, dry pea in 269 ha, olluco in 181 ha, and Yellow hard maize in 101 ha.

(b) Definition of the cultivation schedule

The cultivation schedule for the department of Ayacucho is the following;

Proposed cultivation products with project, department of Ayacucho

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	CULTIVO ROTACIÓN
MAÍZ AMILÁCEO	1433	1433	1433	1433	1433	1433	717	717	717	717			1433	ARVEJA G.V.
PAPA	1109	1109	1109	1109	554	554	554	554	554	554	1109	1109	1109	MAÍZ AMARILLO DURO
CEBADA GRANO	1098	1098	1098	1098	1098	1098	549	549	549	549	549	549	1098	MAÍZ AMARILLO DURO
TRIGO	823	823	823	823	823	823			411	411	411	411	823	HABA G.V.
ALFALFA	710	710	710	710	710	710	710	710	710	710	710	710	710	
HABA GRANO SECO	411	411	411	411	411	411	205	205	205	205	205	411	411	MAÍZ CHOCLO
ARVERJA GRANO SECO	269	269	269	269	269	269	135	135	135	135		269	269	HABAS G.V.
OLLUCO	181	181	181	181	181	181		91	91	91	91	181	181	HABA G.V.
MAÍZ AMARILLO DURO	101	101	101	101	50	50	50	50	50	50		101	101	PAPA
Total	**6134**	**6134**	**6134**	**6134**	**5529**	**5529**	**2920**	**3011**	**3422**	**3422**	**3075**	**3741**	**6134**	

For products with long or permanent vegetative period alfalfa 768 ha is selected. Second crop rotation is 710 ha of amillaceous maize with fresh pea,554 ha of potato with Yellow hard maize, 411 ha of barley grain with Yellow hard maize, 205 ha of wheat with fresh broad bean, 135 ha of dry broad bean with choclo maize, 91 ha of dry pea with fresh broad bean, 98 ha of olluco with fresh broad bean, 55 ha of Yellow hard maize with potato.

Proposed cultivation schedule with project, department of Ayacucho

Cultivo	Area (Has)	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Segunda Campaña
MAÍZ AMILÁCEO	1,433													ARVEJA G.V.
PAPA	1,109													MAÍZ AMARILLO DURO
CEBADA GRANO	1,098													MAÍZ AMARILLO DURO
TRIGO	823													HABA G.V.
ALFALFA	710													
HABA GRANO SECO	411													MAÍZ CHOCLO
ARVERJA GRANO SECO	269													HABAS G.V.
OLLUCO	181													HABA G.V.
MAÍZ AMARILLO DURO	101													PAPA
TOTAL	**6,134**													**TOTAL**

(c) Definition of water demand

Water demand for the Department of Ayacucho is the following:

Table 3.4-35 Water Demand of products with Project, department Ayacucho

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Area (Has)	6134	6134	6134	5529	5529	2920	3011	3422	3422	3075	3741	6134
Eto (mm/month)	170.58	148.09	143.43	127.21	110.57	93.79	100.51	118.57	138.25	163.31	171.33	175.70
Weighted Kc	0.78	0.96	1.02	0.86	0.52	0.68	0.84	0.96	0.86	0.76	0.60	0.61
Etc (mm/month)	133.35	142.00	146.86	109.51	57.35	63.36	84.03	113.69	119.11	124.84	102.50	107.24
Pe (mm/month)	85.4	84.9	79.5	24.7	8.5	4.2	4.6	8.8	19	30.9	31.3	61.2
Humidity Deficit (mm/mth)	47.95	57.10	67.36	84.81	48.85	59.16	79.43	104.89	100.11	93.94	71.20	46.04
Bet Req. (m3/ha/month)	479.47	570.98	673.56	848.14	488.45	591.61	794.28	1048.88	1001.11	939.40	712.03	460.42
Efficiency of Conduction	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Efficiency of Distribution	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Efficiency of Application	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Efficiency of irrigation (%) *	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40

Gross Req. (m3/ha/month)	1198.68	1427.45	1683.90	2120.35	1221.13	1479.03	1985.71	2622.21	2502.79	2348.49	1780.07	1151.04
Days in the month	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31
Gross Req. (m3/ha/day)	38.67	50.98	54.32	70.68	39.39	49.30	64.06	84.59	83.43	75.76	59.34	37.13
Time (hs)	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Mr (l/s/ha)	0.448	0.590	0.629	0.818	0.456	0.571	0.741	0.979	0.966	0.877	0.687	0.430
Required Q (l/s)	2745.19	3619.38	3856.42	4523.17	2520.91	1666.18	2232.00	3350.26	3304.27	2696.12	2568.87	2636.08
Required Q (m3/s)	2.75	3.62	3.86	4.52	2.52	1.67	2.23	3.35	3.30	2.70	2.57	2.64
Vol. (M3/month)	7.35	8.76	10.33	11.72	6.75	4.32	5.98	8.97	8.56	7.22	6.66	7.06
Vol. Project (M3)	93.69											

(*) For calculation of water demand for a project, all loss resulting from the conduction, distribution system and the efficieny of application have to be taken into account. ("El Riego - Principios Básico". Vásquez, A; Chang, L. 1992)

10) Summary of Water Demand

The water demand for Program Area of each Department is as follows;

Departament	Demand at Present Situation		Demand at Improved Condition		Wxisting Water Resources
	Area (has)	m3/seg	Area (has)	m3/seg	m3/seg
Amazonas	7,659	5.27	9,221	6.34	16.57
Cajamarca	535	0.29	3,938	2.11	4.05
Piura	1,207	0.91	2,745	2.08	4.92
La Libertad	1,300	0.61	2,129	1.00	4.51
Ancash	1,795	1.02	8,349	4.72	10.44
Huánuco	21	0.01	649	0.40	0.44
Junín	3,734	2.27	5,327	3.24	3.59
Huancavelica	20	0.02	240	0.18	2.80
Ayacucho	1,852	1.37	6,134	4.52	4.66
TOTAL	**18,123**	**11.76**	**38,732**	**24.60**	

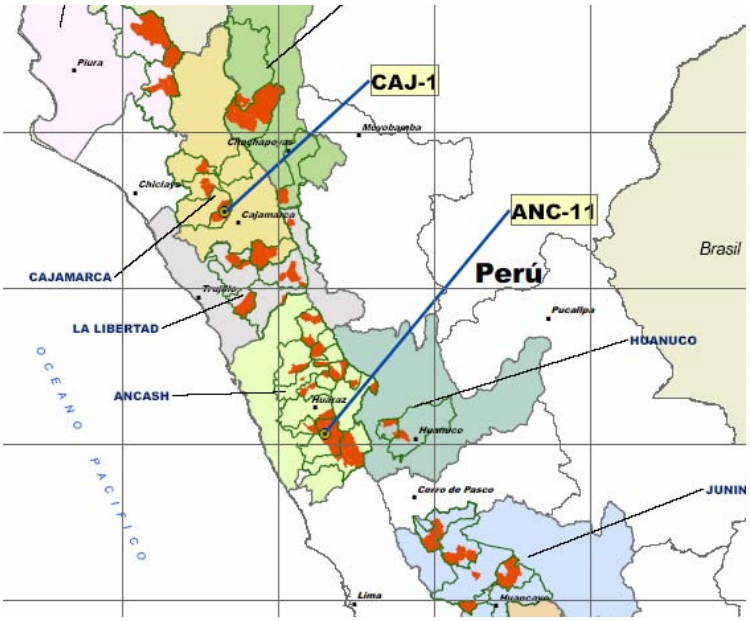
Fuente: Procesado por Equipo del Estudio JICA

(5) Type 1 Group; Irrigation infrastructure (Investment higher than S./ 10 million)

Subprojects whose amount is over S/.10 million belong to this group that consists in two subprojects of irrigation infrastructure, detailed below;

Table 3.4-36 Type 1 Group; Irrigation infrastructure (investment higher than S./10 million)

No	Name of the Project	Location			Area (ha)			Benefit	Budget	Refe,
		Depart.	Prov.	District	Mejor.	Incorp.	Total	Families	(thousand S/.)	
1	Construction Canal of Irrigation El Rejo	Cajamarca	San Pablo	Tumbaden and others		1,510	1,510	560	12,056	Tipico
2	Construction Canal Cordillera Negra	Ancash	Huaráz	Huaráz		1,300	1,300	2,117	11,399	
	TOTAL	2	2	2	0	2,810	2,810	2,677	23,455	



Irrigation infrastructure projects of this Group are located in the departments of Cajamarca and Ancash.

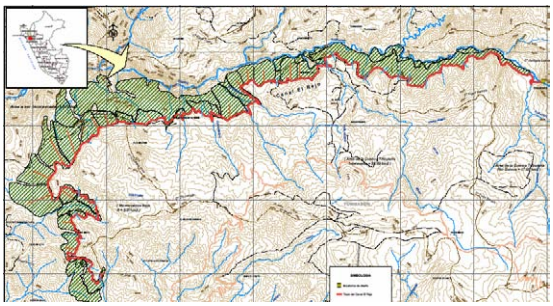
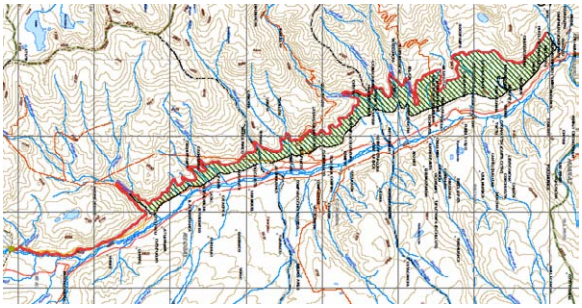
Both Projects are to construct intake works in the river and conduction canal.

According to SNIP regulations, for this group of Subprojects, Pre-Feasibility and Feasibility Studies are required to select the best alternative for investment.

1) Selection of Typical Subprojects

The characteristics are the

following:

Construction Canal of Irrigation El Rejo	Construction Canal Cordillera Negra
	
Main Irrigation Infrastructure 1. Intake 2. 30 km of Canal 3. Culverts 4. Benefited Area; 1,510 has	Main Irrigation Infrastructure 1. Intake 2. 22 km of Canal 3. Culverts 4. Benefited Area; 1,300 has

The two Subprojects show the same characteristics, both concerning systems as well as topography. They consider the Main Canal and irrigate the parts of the low watershed. There is a difference in the number of beneficiaries. Project El Rejo has less beneficiaries than Cordillera Negra. For the present Study, the Subproject Construction of Irrigation Canal El Rejo was selected to study the technical and economic feasibility.

2) Typical Study for the Construction of Irrigation Canal El Rejo

(a) Description of the Subproject in the Proposed Alternative "Construction Canal of Irrigation El Rejo"

The results of the exam of this Subproject are shown as follows:

A. Name of the Public Investment Project (PIP)

Construction Canal of Irrigation El Rejo

B. Objective of the project

As the objective of the Project is to increase agriculture production, its objective coincides with the Program Objective. The average income per capita in the Project area is S. / 143/month and annual production of food is 820 kg/year per family. It is estimated that producers are in conditions of extreme poverty, for they are not producing enough food necessary for their consumption.

C. Balance demand and offer of goods or services of the PIP

The interest in irrigation system is high. In this Subproject, great efforts were made to obtain water formerly, through the construction of platforms for canal construction. The results of the social survey show that 95% of the farmers want the implementation of the work. Concerning water resources availability, they have the certificate that water availability is 1.5 m3/s.

D. Technical Description of the PIP

Main Works are the following;

Benefited Area；1,510 has
Number of Beneficiaries；560 families
Intake works；1 unit
Main Canal；30.4km（Flow of Design；1.5m^3/s, S=1/1000）
Works of Culverts；Works of Intake, etc.

The sizing of the intake is based on the maximum flow of Rejo river derivable and authorized by the ATDRJ, the geological characteristics where it crosses and the results obtained from the agrological study.

E. Costs of the PIP

Intake:	S/. 832,000
Main Canal:	S/. 6,876,000
Culverts:	S/. 1,102,000
Others:	S/. 3,245,000
Total:	S/. 12,055,000

F. Benefits of the PIP

The Benefit of the Project is the increase of Production by the Incorporation of new irrigation areas. The irrigation area will increase from 380 ha to 2,231 ha. Crops to be introduced are: Potato, Barley, Wheat and Maize.

G. Results of the social evaluation

IRR in private prices (8.1%), IRR in social prices（11.5%）

Although the IRR of this Subproject is relatively low, it has a positive intangible social impact, causing the increase of agriculture production and mitigating poverty in its geographic area.

H. Sustainability of the PIP

This Subproject, has been expected for long by the Community, it has been promoted by the province and district mayors, besides it counts on with the participation of the communities in the construction of platforms for the Main Canal. According to results of the survey conducted, communities show a high interest to participate in the Maintenance of the Canal and to pay for the water tariff. Considering this aspect, it is estimated that the PIP is sustainable.

I. Environmental Impact

In this Project, it is proposed to build the Main Canal in the slope with risk of erosion. It is necessary to take the necessary proper measures to prevent this erosion. There is an Environmental Impact Assessment with a plan of environmental management and a Plan of environmental monitoring.

J. Organization and Management

Social agents connected to the Project are the Irrigation water users' organizations, beneficiaries and the El Rejo Management Committee, headed by the Provincial Mayor, who will conduct the tasks for the project development. There are the following entities:

- Organization of the Irrigators Committees
- Management Committee

K. Plan of Implementation

(In the specific study)

L. Conclusions and Recommendations

(In the specific study)

a) Subproject Area

The access to San Pablo, capital of the Province , is by paved road from Cajamarca to Chilete (93 km.) and by compacted road from Chilete to San Pablo (25 km.). Population of the Province is 23,114 inhabitants (1.7 % of the Department), and 84% at the rural area and 16% in the urban area.

The 67 % of the occupied PEA carry out agricultural activities; 5.7 % of the same works in activities of transformation (dairy, liquor elaboration, honey, brown sugarloaf, handicraft, etc.), and 27.6% is in the service sector (trade, transportation, tourism, office workers of the public and private sector).

Predominant products are pea, Yellow hard maize, wheat, amillaceous maize, beans, pepper, potato, barley and cultivate pasture. A great part of the food production is for self-consumption, such as the case in Tumbadén. There is an important activity of cattle breeding for dairy and also sheepherding both in Tumbadén and in San Pablo. Also, silviculture activity for domestic use is carried out.

The main crop is between the months of October to January, months of greater production are: May-June for fresh pea; July-September for lentil, Yellow hard maize, wheat, barley and rice respectively.

b) Results of the Survey about the Subproject

The results of the survey conducted by the study at the project are the following;

- The 94.8 % of producers are willing to participate in the Construction of the irrigation canal "El Rejo".
- The 88.5 % of producers would participate with their labor force.
- The 91.1 % of producers are willing to pay for the operation and maintenance of the irrigation infrastructure.
- The 75.5 % is willing to participate in the system of water fee collection.
- The 92.2 % declared that their water sources need conservation and improvement.
- The 46.9 % declared that by building dams the water source can be better kept and improved, the 29.2 % by reforestation, 5.7 % by improving the irrigation infrastructure and 5.7 % with technical irrigation.
- The 72.4 % of interviewed producers declared that reforestation can conserve the water source and 5.7 % by making filtration ditches.
- The 78.6 % declared to know about the irrigation system by aspersion.
- The 89.6 % declared that the use of irrigation by aspersion would increase production and would improve their income.
- The 92.7 % declared that would be disposed to change from traditional irrigation practices to irrigation by aspersion.
- The 71.9 % of the interviewed declared that could request for investment credit to improve irrigation in their lots.
- The 82.3 % of the producers declared they did not know about the competitive grants.
- The 90.1 % declared that if the government contributes with 80 % they would contribute with the remaining 20 % to improve the system of technical irrigation.
- The 92.7 % declared that would be willing to pay for the contribution with labor.
- The most important products in the zone are Yellow hard maize, amillaceous maize, wheat, pea, beans, potato and barley.
- In the zone of Tumbaden the micro-climate allows pasture during practically the whole year, the same that serves as forage for the dairy cattle that is becoming a major product in importance since Nestlé and Gloria buy the product direct from the agriculture units.
- The execution of this project is very important for the local population that is in conditions of extreme poverty.

c) Results of the Selection for the Proposed Alternatives of the Subproject

In this Subproject, two alternatives are proposed;

Alternative 1; Construct only the part of land incorporation (1,510 ha)

Alternative 2; Include the rehabilitation part (1,510 ha + 1,100 ha)

The characteristics of each alternative are;

Alternative 1	Exploit only the high part, using the flow of design at the intake Peña Blanca (1.5 m3/s). Irrigation area; Incorporation of 1,510 ha Cultivated Areas of Irrigation ; 2,230 ha Number of Beneficiaries; 560 families Proposed works are composed by; 1. Construction of Main Canal (30.4 km length) 2. 1 Headwork 3. 1 Aqueduct 4. 2 Vehicular Canal Transversal works 5. 32 pedestrian overpass works 6. 5 Overshoot 7. 17 lateral intake works 8. 34 Box culvert

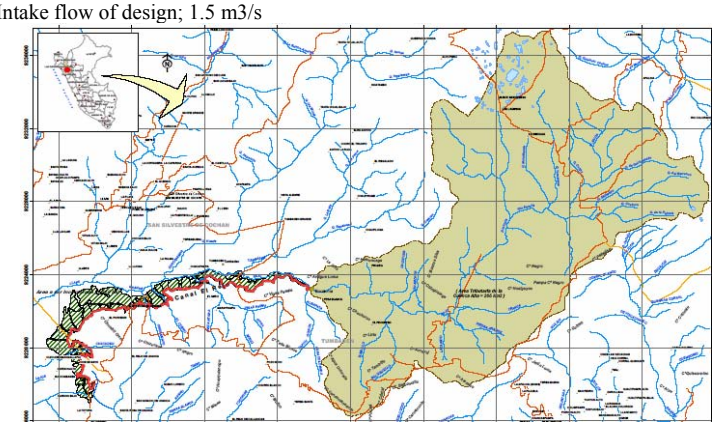
Alternative 2	This alternative composed by the construction of open canal with 28.7 km and 4 unit of siphon with 1.5 m3/s discharge. Main works proposed in this alternative are; 1. Trapezoidal Open canal (28.5 km) 2. 4 unit of siphons (L=160m) 3. 1 Headwork 4. 1 Aqueduct 5. 2 vehicular transversal work 6. 32 pedestrian overpass work 7. 4 Overshoot 8. 17 Lateral intake work 9. 32 Box Culvert

In Alternative 2, the 4 existing irrigation systems will be improved (1,100 has), through the use of water sources around the 6 microwatersheds (74.4 km2).

The Plan of Agriculture Production of each alternative is shown in the following chart:

	Alternative 1 and 2			
	Area (ha)		Production (t)	
	Without	With	Without	With
Potato	55.5	400.0	517.8	5,329.2
Barley Grain	29.0	209.0	19.4	200.4
Amillaceous maize	85.0	612.0	89.3	918.0
Fresh Pea	19.8	142.0	34.0	348.5
Wheat	64.5	464.0	55.5	571.2
Dry Pea	31.8	229.0	34.0	349.9
Yellow hard maize	42.3	304.0	204.5	2,101.2
Manioc	18.3	73.0	108.8	621.4
Dry Beans	31.5	227.0	30.2	311.9
	377.5	2,660.0	1,093.4	10,751.7

The Plan of water caption of each Alternative is the following;

Alternative 1	High Watershed (205.5 km2); Dry season flow=2.0 m^3/s Intake flow of design; 1.5 m3/s 

The water demand calculation is the following:

(Alternative 1 & 2; First crop 1,510 ha, Second crop; 1,150 ha)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q available (m3/s)*	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Q required (m3/s)	0.02	0.09	0.10	0.07	0.07	0.51	0.87	1.31	0.82	0.03	0.00	0.00
Water Balance (m3/s)	1.48	1.41	1.40	1.43	1.43	0.99	0.63	0.19	0.68	1.47	1.50	1.50

Costs are the following;

Item	Alternative 1	Alternative 2
Intake works	S/. 990,000	S/. 990,000
Main Canal	S/. 8,182,000	S/. 7,773,000
Ancillary works	S/. 1,311,000	S/. 1,300,000
Siphones		S/. 900,000
Others	S/. 1,572,000	S/. 1,572,000
Total	S/. 12,055,000	S/.12,535,000

Benefits generated by each alternative are;

Net benefit generated by each Alternative (S/. thousand)

	Alternative 1	
	Without	With
Potato	129	964
Barley Grain	57	1,170
Amillaceous maize	37	621
Fresh Pea	79	192
Wheat	60	552
Dry Pea	83	3,567
Yellow hard maize	197	1,110
Manioc	642	8,176
Dry Beans	129	964
	57	1,170

The net benefit generated by alternative is S/. 8 million of soles and Alternative 2 is S/. 4.9 million. Estimated IRR for each alternative are:

Item	Alternative 1	Alternative 2
At Private Prices	11.8	11.0
At Social Prices	16.8	15.8

This result shows that economic profitability of Alternative 1 is better. This Study will consider Alternative 1 as the Proposed Alternative. The Feasibility Study will be conducted based in Alternative 1.

3) Works to be constructed for each Subproject

Considering that the subprojects in this Group have similar characteristics, both in cost and in beneficiary area, it is estimated that both are economic and technically feasible. Works to be conducted are the following:

Table 3.4-37 Major Irrigation Infrastructure Works

No		1	2	Total
Symbol		CAJ-1	ANC-11	
NAME OF THE PROJECT		Construction Canal de Irrigation El Rejo	Construction Canal Cordillera Negra	
TYPE OF PROJECT		Solo Canal	Solo Canal	
TYPE OF WORK		Construction.	Construction.	
CANAL	CONCRETE (km)	30.36	43.00	63.31
OBRAS (Nos.)	INTAKE	1	1	2
	GRIT REMOVER		1	1
	DISTRIBUTOR		10	10
	SIPHON		3	3
	AQUEDUCT	1	8	9
	BRIDGE (VEHICLE)	2	7	9
	BRIDGE (PEDESTRIAN)	32	21	53
	CANOE	5	37	42
	DRAIN	34	2	36
	LATERAL INTAKE	18	96	114

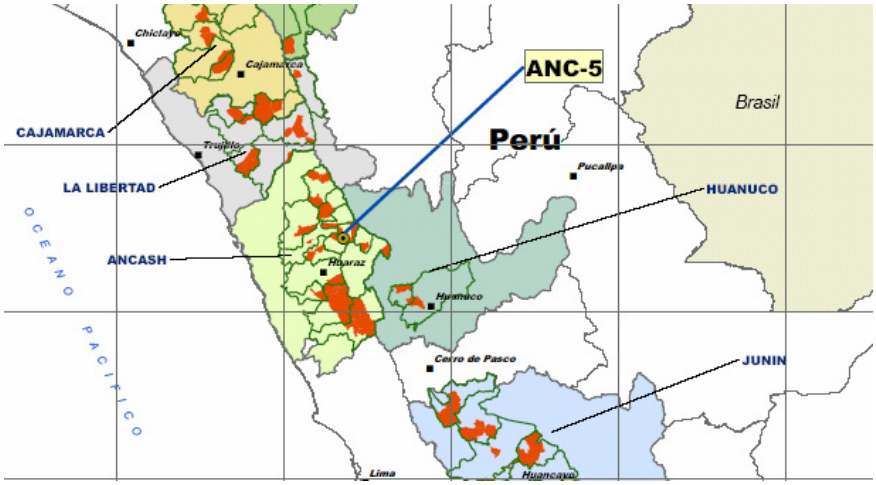
(6) Type 2-A Group Irrigation infrastructure (Only Canal and Investment between S/. 6 to 10 million)

This Group has two subprojects with investment amounts between S/.6 million and S/.10 million. It consists in only one subproject of irrigation infrastructure.

Table 3.4-38 Group Type 2-A Irrigation infrastructure (Only Canal and Investment between S/. 6 to 10

million)

No	Name of the Project	Location			Area(ha)			Benefit Families	Budget (thousand S/.)	Refe,
		Depart.	Province	District	Impr.	Incorp.	Total			
1	Construction Canal of Irrigation Sol Naciente de San Luis	Ancash	C. F. Fitzcarrald	San Luis		1,066	1,066	719	6,600	
	TOTAL	1	1	1		1,066	1,066	719	6,600	



According to the SNIP, this group of Sub projects requires a Pre-feasibility Study, in order to select the best investment alternative.

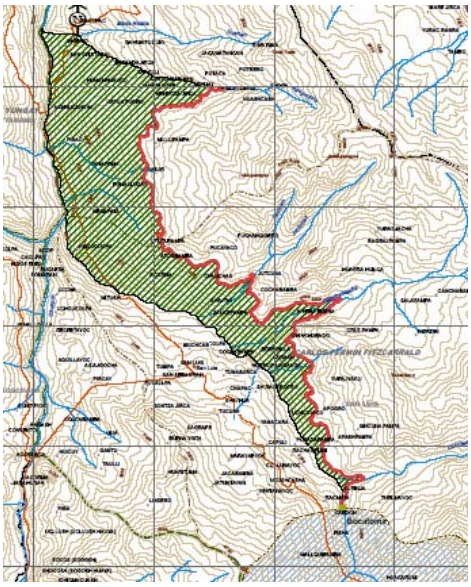
1) Results of the Pre-feasibility Study (Construction Canal of Irrigation Sol Naciente de San Luis)

2) Description of the Subproject in the Proposed Alternative (Construction Canal of Irrigation Sol Naciente de San Luis)

A.	**Name of the Public Investment Project (PIP)**
	Construction Canal of Irrigation Sol Naciente de San Luis
B.	**Objective of the project**
	It aims to achieve an increase of production and productivity locally, causing the improvement of rural families income, job opportunities, better distribution of wealth and consequently, a better level of life for the farmer. Regionally, it will provide a higher self esteem in the rural families, increasing trade among the different producing centers in the region. The objective of this Subproject coincides with the Program Objective. Farmers at the Program area, due to the lack of job opportunities, migrate during the dry season looking for temporary jobs. It is expected to avoid this situation with the introduction of irrigation infrastructure, making farming possible during the dry season.
C.	**Balance offer and demand of goods or services of the PIP**
	The wish to increase irrigation area is high. According to results of the survey conducted by this Study, the lack of irrigation infrastructure is identified as the main problem of the region (77%). Besides, it shows that 100% is willing to participate in communal works and to pay the water tariff. Concerning water resources, intake works at Rio Tambillo are planned. However, in the high watershed of the intake works, there are some lakes distributed in several places. In the Study the flow at the dry season is estimated in 1.1 m3/s, higher than the flow designed for the intake.
D.	**Technical Description of the Public Investment Project**
	Contents of the Subproject : Areas of Benefit: 1,066 ha Number of Beneficiaries ; 719 families Intake works: 2 Units Main Canal ; 19km (Flow of Design: 0.8m^3/s) Culverts: Siphons, Derivation works, drainage, etc.
E.	**Costs of the PIP**
	Works of intake ; 241,000 Main Canal ; 3,743,000 Siphon ; 798,000 Culverts ; 278,000 Others ; 1,541,000 Total ; 6,601,000
F.	**Benefits of the PIP**
	The benefit will be generated by the 1,565ha of incorporated area; products: alfalfa, potato, barley and wheat.

G. Results of the social evaluation	
	IRR at private prices (23.6%), IRR at social prices（28.3%）
H. Sustainability of the PIP	
	In this Subproject, the system of water fee collection has been established already, besides there is a Committee of Users. Producers are willing to work in communal works. Considering these factors, it is considered that there is sustainability for this project. According to results of the social survey, producers show a high coincidence about their participation in the water fee collection system, the maintenance of the system and the watershed conservation.
I. Environmental Impact	
	The project is located between 2,490 to 3,275 a.m.s.l.. It considers the construction of an intake and a canal of 20 km of longitude. The location of the Project does not intercept any Natural protected area and the environment problems that could occur would be the pronounced talus in the first kilometers of the canal.
J. Organization and Management	
	The Commission of Users at the District of San Luis will be responsible for the construction of the lateral canals and to participate in the execution of the Project, collect the water fee, and assume the costs and execution of the operation and maintenance activities.

(a) Subproject Area



San Luís district is a zone under extreme poverty, with a low level of life. The insufficient availability of water resources for irrigation purposes reduces the possibilities of the population to increase production in agriculture and livestock activities, depending mainly in the rainfall conditions. The 79% of the population is constituted basically by farmers and the remaining 21 % is occupied in other activities. Rural population carries out communal agricultural activities, mostly for self-consumption. The surplus of agricultural production to be commercialized is minimal, so they have to complement their economies with other tasks.

In the localities of the zone of influence, farmers have only one crop during the year, exclusively during the rain season, in the months from October to March; and are unoccupied during April to September, so the population temporarily goes to the Costa and Selva, looking for temporary jobs. Agriculture productivity is very low, due to lack of water and there is much non cultivated land.

(b) Results of the Survey Conducted

Results of the Survey are the following;

- The 100 % of producers are willing to participate in the "Construction of Canal Sol Naciente de San Luis" District of San Luís, Province of Carlos Fermín Fitzcarrald, Region Ancash.
- The 81.3 % answered that "yes" they would participate with labor force and the 18.8 % with communal work
- The 95 % is willing to pay the tariff for the operation and maintenance of the irrigation infrastructure.
- Of the farmers who answered "no", the 100 % said that they would do it through communal work.
- The 96.3 % of interviewed producers are willing to participate in the water fee collection system.
- The 96.3 % needs to conserve and improve the water source.
- The 98.8 % declared interest in reforestation to conserve the water source.
- The 77.5 % of interviewed producers declared that they know what irrigation by aspersion is.
- The 88.8 % of producers that the use of irrigation by aspersion saves water, increase production and allows higher income.
- The 100 % of producers are willing to change from the traditional irrigation system to the irrigation by aspersion.
- To the question it they could get investment credit to improve irrigation of theirs properties, 55 % said yes.
- The 81.3 % does not know about the competitive grants.
- If the government contributes with 80 %, interviewed producers said that they agree to pay for the remaining 20 % in order to improve the existing irrigation system by technical irrigation.
- If the answer is "yes" the 100 % is willing to pay with work.
- This work would be 28.8 % through communal work and 71.3 % with labor force.

(c) Results of the Selection of Alternatives

In this Subproject, due to the steep topography, two alternatives are considered;

Alternative 1; Construction of Concrete Canal (20 km)

Alternative 2; Construction of the Conveyance Canal with PVC S-25 pipe

The characteristics of each alternative are;

Alternative 1	▪ Use the Circular Pipe Canal only in one necessary part (9.2 km) ▪ There are many ways of construction
Alternative 2	▪ Convey all parts through the Circular Pipe Canal (20 km)

The difference between theses alternatives are only the cost and the maintenance system.

The Plan of Agriculture Production of each alternative is the following:

	Alternative 1 and 2			
	Area (ha)		Production (t)	
	Without	With	Without	With
Alfalfa	39.0	78.0	839.3	2,398.4
Potato	69.5	209.0	561.6	2,412.9
Barley Grain	80.5	242.0	57.2	244.4
Amillaceous maize	62.0	186.0	61.4	261.7
Wheat	102.5	308.0	73.8	317.2
Choclo maize	40.5	122.0	299.3	1,287.7
Yellow hard maize	111.5	335.0	404.7	1,739.3
Dry Broad bean	9.0	27.0	7.7	32.8
Olluco	10.5	32.0	38.7	168.7
Dry Beans	8.5	26.0	8.9	39.0
Total	533.5	1,565.0	2,352.5	8,902.2

The Plan of canal conveyance is the following:

Alternative 1	Benefited Area ; 1,066 ha Number of Beneficiaries ; 719 families Trapezoidal Concrete Canal; 6.5 km Circular Pipe Canal; 9.2 km Canal with Geotextile; 3.5 km Intake; 2 Units Inverted Siphon; 870 m Culverts; 1 Unit
Alternative 2	Benefited Area ; 1,066 ha Number of Beneficiaries ; 719families Circular Pipe Canal 20 km Intake 2 Units Culverts 1 Unit

The calculation of water demand is the following:

(Alternative 1; First crop 1,510 ha, Second crop ; 1,150 ha)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q available (m3/s)*	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Q required (m3/s)	0.02	0.07	0.00	0.08	0.32	0.51	0.65	0.86	0.84	0.29	0.21	0.20
Water Balance (m3/s)	0.88	0.83	0.90	0.82	0.58	0.39	0.25	0.04	0.06	0.61	0.69	0.70

In the case of Alternative 1, with the existing water flow availability certificate (1.5 m3/s) it is possible to irrigate the 80% (1,150 ha) during the dry season. In the case of Alternative 2, with the water availability of 2.0 m3/s, only 70% can be attended (1,741 ha).

Costs are the following;

Item	Alternative 1	Alternative 2
Intake works	S/. 241,000	S/. 241,000
Main Canal	S/.3,743,000	9,664,000
Siphon	S/.798,000	-
Culverts	S/. 278,000	S/. 278,000
Others	S/. 1,541,000	S/. 1,541,000
Total	S/. 6,600,000	S/.11,724,000

Benefits generated by each alternative are;

Net benefit to be generated by each Alternative (S/. thousand)

PRODUCTS	Alternative 1 and 2	
	Without	With
Alfalfa	165.6	518.9
Potato	213.6	880.1
Barley Grain	(10.9)	(23.7)
Amillaceous maize	11.4	124.8
Wheat	20.0	126.6
Choclo maize	133.6	609.4
Yellow hard maize	131.0	712.0
Dry Broad bean	5.0	23.6
Olluco	20.5	94.5
Dry Beans	9.8	56.1
Total	699.6	3,122.4

The net benefit generated by the alternative 1 is 699 thousand soles and the alternative 2 is 3.1 million soles. IRR estimated for each alternative are;

Item	Alternative 1	Alternative 2
At private prices	32.6 %	17.4 %
At social prices	38.2 %	21.5 %

This results show that both Alternatives have a high IRR. However, Alternative 1 has better economic profitability. This Study will consider Alternative 1 as the Proposed alternative.

3) Works to be constructed in each Subproject

Works to be constructed are the following;

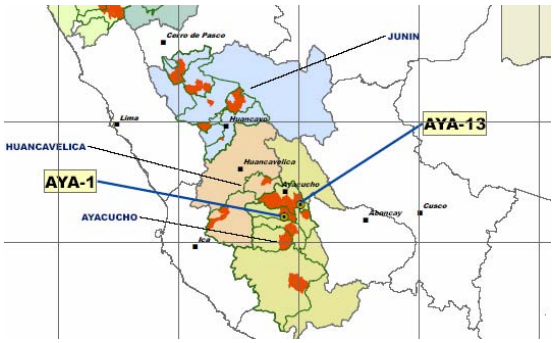
		ANC-5
		Construction Canal of Irrigation Sol Naciente de San Luis
CANAL (km)	CONCRETE.	6.45 Km
	PIPING	9.20 Km
	GEOTEXTILE	3.48 Km
CULVERTS (Nos.)	INTAKE	2 Units
	GRIT REMOVER	1 Units
	SIPHON	2 Units
	BRIDGE (PEDESTRIAN)	14 Units
	CANOE	8 Units
	CHECK BOX	38 Units
	LATERAL INTAKE	24 Units

(7) Type 2-B Group: Irrigation infrastructure (Investment between S/. 6 to 10 million, Canal with Dam)

This Group is comprised by subprojects with investment amounts between S/.6 million and S/.10 million with Construction of dam. It consists in two irrigation infrastructure subprojects.

Table 3.4-39 Type 2-B Group: Irrigation infrastructure (Investment between S/. 6 to 10 million, Canal with dam)

No	Name of the Project	Location			Area (ha)			Benefic	Budget	Refe,
		Depart.	Prov.	District	Mejor.	Incorp.	Total	Families	(thousand S/.)	
1	Construction and Improvement of irrigation system Cangallo	Ayacucho	Cangallo	Cangallo	555	105	660	532	7,238	
2	Const. Canal and Dam Tintayccocha-Acocro	Ayacucho	Huamanga	Acocro	100	500	600	1,000	8,796	Tipico (TypeB)
	GRAND TOTAL	1	2	2	655	605	1,260	1,532	16,034	



Investment amounts of these 2 Subprojects are between S/.6 to S/. 10 million and include construction of canal and dams.

Both projects in this Type 2-B Group are located in the Department of Ayacucho. The typical characteristic of this group is to store rain water to use it during the dry season.

It is a way to maximize water resources through the construction of dams.

1) Selection of the Typical Subprojects

In this Group, as it considers projects with dam, the efficiency of the same has to be studied. In order to conduct this Study, the Subproject for Construction of Canal and Dam Tintayccocha-Acocro (Ayacucho) was selected.

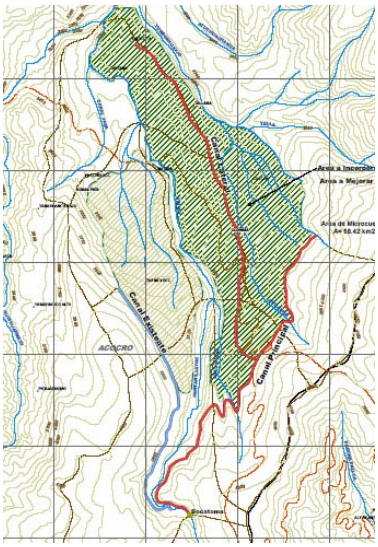
Construction Canal and Dam Tintayccocha-Acocro (Ayacucho)

2) Results of the Typical Pre-feasibility Study (Construction Canal and Dam Tintayccocha-Acocro)

Proposed Alternative

A.	**Name of the Public Investment Project (PIP)**
	Construction of Canal and Dam Tintayccocha-Acocro
B.	**Objective of the project**
	The Objective established in this Subproject is; Reduce the poverty level of the population in the communities of Tarhuiyocc, Ccoisa, Matará, Ccenhuapampa and Soytocco at the District of Acocro – Huamanga – Ayacucho through the increase of production in the crops of the communities of Tarhuiyocc, Ccoisa, Matará, Ccenhuapampa and Soytocco del District de Acocro – Huamanga – Ayacucho
C.	**Balance offer and demand of goods or services of the PIP**
	This Subproject is located in the major potato producer zone in the Department of Ayacucho. Presently in this zone, potato is produced in dry land. However, due to the instability of the climate, frequently they are exposed to the climate damage. In some circumstances, there is no rain for a long time and they loose their crops. They are very vulnerable to the natural conditions, for this reason, they stay in a situation of poverty. Said problems can be solved by introducing irrigation.
D.	**Technical Description of the PIP**
	The contents of the Subproject is ; Benefited Area: 1,100 has Number of Beneficiaries ; 1,000 families ▪ Dam 1, V=0.40 m3 ▪ Dam 2, V=0.20 m3 ▪ Dam 3, V=0.20 m3 ▪ Dam 4; V=2.80 m3 ▪ Intake (02 UNITS)

	▪ Canal of Concrete Q=300 L/S (18.00 KM) ▪ Canal of Concrete (7.00 KM) ▪ Load chamber (02 UNITS)
E.	**Costs of the PIP**
	Dam 1 S/. 1,000,000 Dam 2 S/. 500,000 Dam 3 S/. 500,000 Dam 4 S/. 2,600,000 Intake works S/. 10,000 Main Canal S/. 2,180,000 Culverts S/. 2,200,000 Total S/. 8,990,000
F.	**Benefits of the PIP**
	Increase agriculture area to produce quinua, potato, green peas and prepared potato and to introduce double crop.
G.	**Results of the social evaluation**
	IRR at private prices: 13.9%, and at social prices: 17.8%.
H.	**Sustainability of PIP**
	Producers acknowledge the importance of the project, participate in the management in common agreement with the Mayor of Acocro; they have an agreement to pay for the water tariff and to participate in communal works. Producers have insertion in the wholesale market at Lima. The Subproject has economic and social sustainability.
I.	**Environmental Impact**
	The project consists in three dams to allow water offer for two crops a year. Besides, it consists in two irrigation canals to irrigate downstream zones. Environmental aspects are referred to the presence of birds in the zone of the dam and the variation of flow that will show at the ravine. Also, in the high parts there are over-pasture and erosion. It does not intersect with any natural protected areas.
J.	**Conclusions and Recommendations**
	Considering that the existing system of water resources caption at the Perfil is not enough to offer the benefited area, it is recommended to study another alternative.



(a) Area of the Subproject

This irrigation subproject is located in the district of Acocro (3,246 amsl of altitude in the urban village), Province of Huamanga, in the department of Ayacucho and is part of the Mantaro watershed, microwatershed of Manioces river.

Annual rainfall is approximately 590mm and the project area is located mainly in the intermediate zone of Acocro, in the quechua (2900-3500 amsl.) proper for agricultural activities and suni regions(3,500 – 4000 amsl), proper for sheepherding and fish farming.

Economic activity is mainly agriculture, there is some animal husbandry activity, silviculture, agroindustry and handicraft activities, as well as services items (trade, transportation, tourism, etc.). Main crop occurs during October and November.

Main products are potato, followed by wheat, barley, broad bean, pea, quinua, amillaceous maize, and others such as olluco, oca, mashua, etc., and are located at the medium zone. Great part of the production of potato, wheat, barley, broad bean and pea, when the volumes are important, are sent to the regional and national markets, commercialized many times with transportation of the same farmers. Small volumes are marketed in the farmland and the local market at weekly fairs in different communities of the districts.

(b) Results of the Survey

Results of the Survey are the following:

- The 98.5 % of producers are willing to participate in the construction of the canal and dam Tintaycoccha – Acocro – Ayacucho, providing labor force (95.5%)
- The 59.1 % of producers are disposed to pay a tariff for the operation and maintenance of the irrigation infrastructure.
- Those not willing to pay for would do it providing labor force (59.3%) and communal work (14.8%).
- The 59.1 % is available to participate in the system of water fee collection.
- The 90.9 % declared that it is necessary to conserve and improve the water sources.
- The 86.4 % have no knowledge about the actions necessary to conserve and improve the water sources.
- The 9 producers who declared that have any idea, said that it could be made through enclosure of pasture, reforestation and filtration ditches.
- The 68.2 % declared that they know the irrigation system by aspersion.
- The 97 % declared that would change from the traditional irrigation system to the irrigation by aspersion.
- The 66.7 % of the interviewed declared that they could request an investment credit to improve the irrigation in their lots.
- The 97 % does not know about the competitive grants.
- The 97 % declared that if the government contributes with 80 %, interviewed producers said that they agree to pay for the remaining 20 % in order to improve the existing irrigation system by technical irrigation..
- El 82 % declared that would pay for this contribution with work.
- It is necessary to update the hydrological information of the caption flow, dam of Tintayccocha lake, to determine precisely the area and families to be benefited, in the alternative selected.
- Most important crops are: potato, wheat, quinua and barley. Potato is the most important crop, attaining good yield when agronomic managements is appropriate and there is no problems with water.
- In general production is low, as well as productivity per ha.
- Province is considered as one with extreme poverty, according to the official entities of the government, so the economic and social impact with the execution of this project should be taken into account.

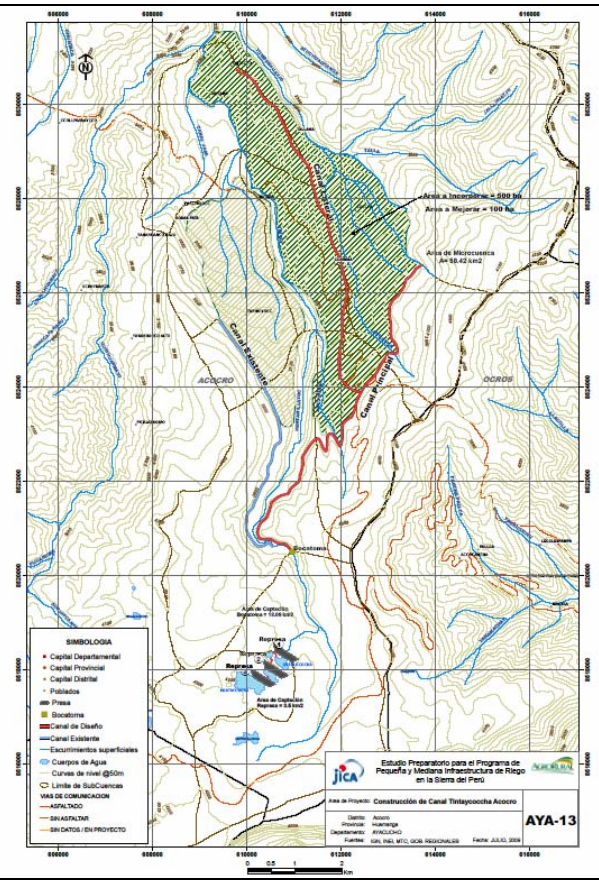
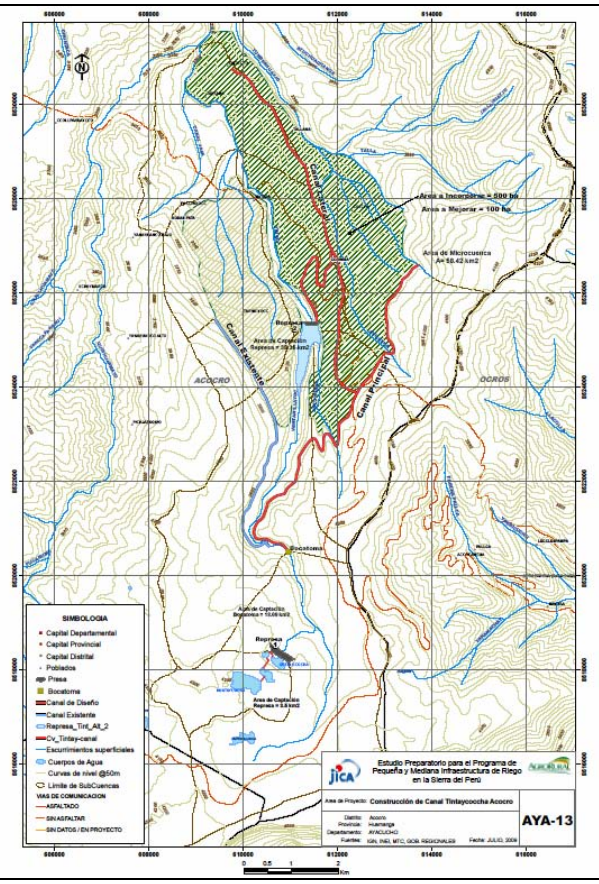
(c) Results of the Selection of Alternatives

Due to the shortage of water resources, in this Subproject two alternatives are proposed;

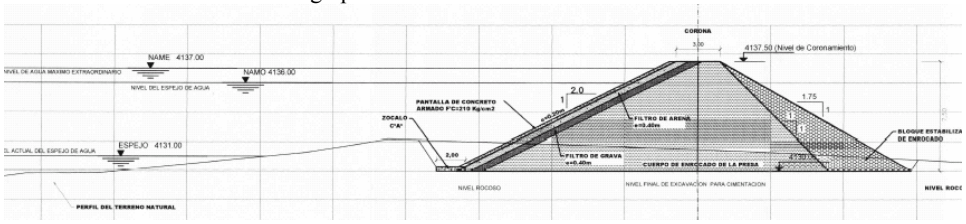
Alternative 1; Construction of three dams to irrigate 600 ha.

Alternative 2; Construct a dam, using the waters of Tintacocha lake and other in the low Watershed to irrigate 600 ha.

The characteristics of each alternative are;

	
Alternative 1 Use the 4 existing lakes to store rainwater and use them for irrigation. Stored volumes would be; ▪ Tintaycocha Dam (1); 1.2 M3 ▪ Tintaycocha Dam, (2); 0.4 M3 ▪ Tintaycocha Dam (3); 0.4 M3	Alternative 2 Use a existing lake in the high Watershed with the construction of a dam and to build another dam in the Subproject area. Volumes to be stored would be: ▪ Tintaycocha Dam (1), (2) y (3); 0.8 M3 ▪ Dam (4); 2.8 MM3

Characteristics of each alternative:

Alternative 1	▪ Use water resources only at the high Watersheds, storing the existing lakes of Tintaycocha and take flow of Ventanillayoc river, constructing the intake work (Watershed 18.0 km2). ▪ Construct 3 dams in the high parts where there are lakes to store 2.0 M3.  ▪ The storage capacity in the existing lakes are limited, with a maximum of 2.0 M3, that could attend only 20% of the area,
Alternative 2	▪ Use water resources at the high and medium parts through the construction of small dams in the high part and one large in the medium part to offer the irrigation area with less altitude. ▪ The construction of two intakes and one dam in the medium zone maximize water resources. ▪ By maximizing the use of water resources in several sources approximately 70% of the beneficiary area can be attended. ▪ Stored water resources would be used only at the critical season.

Water demand calculation is the following:

Alternative 1; First crop 1,100 ha, Second crop; 195 ha (20%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q available (m3/s)*	1.02	0.97	0.98	0.30	0.13	0.05	0.10	0.13	0.14	0.30	0.30	1.02
Q required (m3/s)	0.00	0.02	0.06	0.53	0.31	0.18	0.20	0.29	0.30	0.24	0.30	0.00
Water Balance (m3/s)	1.02	0.95	0.91	-0.23	-0.17	-0.13	-0.10	-0.16	-0.16	0.06	0.00	1.02

Water Balance (M3/month)	2.74	2.29	2.44	-0.60	-0.46	-0.33	-0.28	-0.43	-0.41	0.15	0.00	2.74
Accumulated Requirement (M3)				(0.60)	(1.06)	(1.40)	(1.67)	(2.11)	(2.52)			

The alternative 1 allows the cultivation of only 20% in the dry season, because the collecting watershed is 18 km2. This Alternative requires a storage volume of 2.52 M3.

Alternative 2; First crop 1,100 ha, Second crop722 ha(70%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q available (m3/s)*	2.16	2.05	2.06	0.63	0.28	0.11	0.21	0.28	0.31	0.63	0.64	1.24
Q required (m3/s)	0.00	0.02	0.06	0.53	0.35	0.36	0.44	0.71	0.71	0.45	0.34	0.14
Water Balance (m3/s)	2.16	2.02	2.00	0.09	-0.07	-0.24	-0.23	-0.43	-0.40	0.18	0.30	1.10
Water Balance (M3/month)	5.79	4.90	5.35	0.25	-0.20	-0.63	-0.62	-1.16	-1.04	0.47	0.77	2.94
Accumulated Requirement (M3)					(0.20)	(0.82)	(1.44)	(2.61)	(3.65)			

Alternative 2 allows the cultivation of approximately 70% in the dry season. This Alternative requires a stored volume of 3.65 M3.

The Plans of Agriculture Production for each alternative are the following:

	Alternative 1				Alternative 2			
	Area (ha)		Production (t)		Area (ha)		Production (t)	
	Without	With	Without	With	Without	With	Without	With
Alfalfa	64	127	3,141	5,053	64	127	3,141	5,053
Potato	99	239	2,292	4,443	99	378	2,292	7,026
Quinua	98	236	141	271	98	335	141	385
Amillaceous maize	129	308	201	385	129	437	201	546
Wheat	74	178	133	256	74	252	133	362
Dry pea	24	58	37	71	24	82	37	100
Yellow hard maize	9	22	34	66	9	31	34	93
Dry Broad bean	37	89	55	107	37	126	55	151
Olluco	17	38	110	204	17	54	110	290
Total	549	1,295	6,143	10,856	549	1,822	6,143	14,008

In the case of Alternative 1, with water resources stored in the high watershed, 20% (1295 ha) can be irrigated during the dry season. In the case of Alternative 2, with the available water to be exploited, up to 70% could be attended.

The costs are the following;

Item	Alternative 1	Alternative 2
Dam 1	S/. 2,518,000	S/. 1,000,000
Dam 2	S/. 1,160,000	S/. 500.000
Dam 3	S/. 1,024,000	S/. 500,000
Dam 4		S/. 2,600,000
Main Canal	S/. 1,980,000	S/. 1,980,000
Intake Works	S/. 8,000	S/. 10,000
Main Canal 2		S/. 200,000
Culverts	S/. 2,107,000	S/. 2,200,000
Total	S/. 8,796,000	S/. 8,990,000

Benefits generated by each alternative are:

Benefits generated by each Alternative (S/. thousand)

	Alternative 1		Alternative 2	
	Without	With	Without	With
Alfalfa	324	566	324	566
Potato	660	1,247	660	1,972
Quinua	46	104	46	147
Amillaceous maize	115	284	115	402

Wheat	35	86	35	121
Dry Pea	10	21	10	30
Yellow hard maize	24	50	24	70
Dry Broad bean	10	25	10	35
Olluco	48	92	48	131
Total	1,271	2,473	1,271	3,474

The net benefit generated by alternative 1 is S/. 2.47 million and Alternative 2 is 3.47 million. Estimated IRR for each alternative are;

Item	Alternative 1	Alternative 2
Private prices	3.4 %	13.9 %
Social prices	4.8 %	17.8 %

This result shows that alternative 2 has the best economic result.

3) Works to be constructed in each Subproject

In this Group, the projects have similar characteristics (Storage of water resources to use them in the dry season). Works to be constructed are;

No		1	2	Total
SYMBOL		AYA-1	AYA-13	
NAME OF THE PROJECT		Construction and Improvement irrigation system Cangallo	Construction Canal and Dam Tintayccocha-Acocro	
TYPE OF PROJECT		B	B	
TYPE OF WORK		Construction/Improvement.	Construction/Improvement.	
CANAL (km)	CONCRETE	36.42 Km	35.00 Km	71.42 Km
CULVERTS (Nos.)	INTAKE	1 Unit	2 Unit	3 Unit
	GRIT REMOVER	1 Unit		1 Unit
	AQUEDUCT	19 Unit		19 Unit
	RAPIDS	1 Unit		1 Unit
	BRIDGE (VEHICLE)	1 Unit		1 Unit
	BRIDGE (PEDESTRIAN)	15 Unit		15 Unit
	CANOE	22 Unit		22 Unit
	LATERAL INTAKE	20 Unit		20 Unit
DAM	Nos.	1 Unit	4 Unit	5 Unit
	M3	1.64 M3	3.6 M3	5.24 M3

(8) Type 3-A Group: Irrigation infrastructure (Investment between S/. 3 to 6 Million, Only Canal)

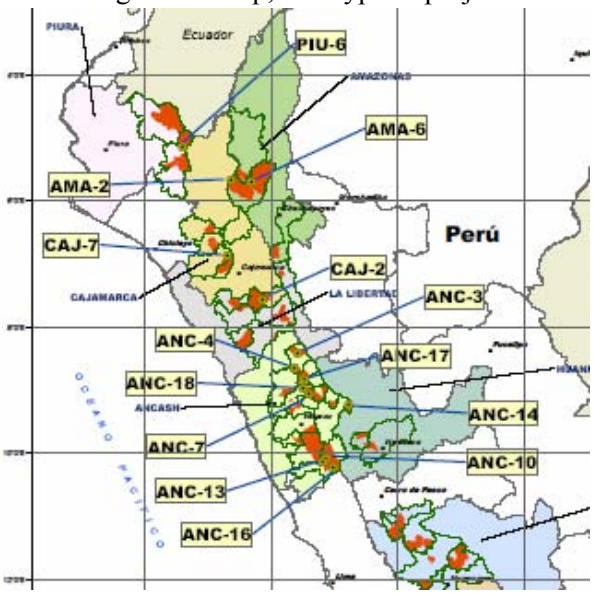
Subprojects with investment amount between S/.3 and S/.6 million consist in 14 subprojects of irrigation infrastructure including only irrigation infrastructure of canals

Table 3.4-40 Type 3-A Group: Irrigation infrastructure (Investment between S/. 3 to 6 Million, Only Canal)

No	Name of Projects	Location			Area(ha)			Families	Budget	Refe,
		Depart.	Prov.	Distrito	Mejor.	Incorp.	Total	Benef.	(mil S/.)	
1	Mejor. del Sist. Riego San Juan Marañón-La Papaya	Amazonas	Utcubamba	El Milagro	1,322	155	1,477	224		1
2	Rehabilitación Canal El Huayo	Cajamarca	Cajabamba	Condebamba	535	893	1,428	321	Tipico (TipoA)	2
3	Construcción Canal de Irrigación Casablanca- Jocosbamba – Quiches (Joquillo)	Ancash	Sihuas	Quiches	100	463	563	660		3
4	Construcción Canal Rupawasi - Rosamonte	Ancash	Sihuas	San Juan		550	550	2,050		4
5	Const. Canal de Riego Aynin-Huasta	Ancash	Bolognesi	Huasta	25	500	525	320		5
6	Const. Sistema de riego Jatun Parco	Ancash	Bolognesi	Pacllòn	40	585	625	280		6
7	Mejoramiento Canal Chuayas-Huaycho	Ancash	Pomabamba	Huayllan	240	410	650	600		7
8	Mejoramiento Chinguil - Cruzpampa	Ancash	Mariscal Luzuriaga	Llumpa	120	480	600	820		8
					2,382	4,036	6,418	5,275	2,382	

In the following figure the Location distribution of this Group is shown:

Among this Group, one typical project is selected and the perfil of the concerned subprojects will be revised. The following variables are considered for the selection:



- Subproject irrigation area (maximum 11 points)
- Number of beneficiary families (maximum 11 points)
- Budget (maximum 11 points)
- Investment amount per hectare (maximum 11 points)
- Investment amount by beneficiary family (maximum 11 points)
- Existence of Perfil (maximum 11 points)

It should be noted that higher scores determine the project selection

1) Selection of Typical Subprojects

Considering the Subprojects that count on with a Study at Perfil level, a classification according to the variables indicated above was conducted, assigning a high score to the Subproject closest to the average. The subproject with highest score was selected as typical subproject.

Table 3.4-41 Selection of Typical Subproject; Type 3-A (Investment between S/. 3 to 6 Million, Only Canal)

No	Symbol	Name of the Subprojects	Area (ha)	Beneficiaries	Budget (S/.)	Amount per ha.(S/. /ha)	Amount by beneficiary (S/./Bene)	Total Score	Order
1	AMA-2	Mejor. del Sist. Riego San Juan Marañón-La Papaya	1	2	6	1	4	**14**	
2	AMA-6	Mejoramiento del Sistema de Riego Naranjos - Canal El Tigre	2	3	3	2	6	**16**	
3	ANC-3	Construcción Canal de Irrigación Casablanca- Jocosbamba – Quiches (Joquillo)	5	9	10	3	5	**32**	
4	ANC-4	Construcción Canal Rupawasi - Rosamonte	4	1	4	10	2	**21**	
5	ANC-10	Const. Canal de Riego Aynin-Huasta	3	5	8	5	7	**28**	
6	ANC-16	Const. Sistema de riego Jatun Parco	8	4	1	4	1	**18**	
7	ANC-17	Mejoramiento Canal Chuayas-Huaycho	9	10	2	6	8	**35**	**3**
8	ANC-18	Mejoramiento Chinguil - Cruzpampa	7	7	5	9	3	**31**	
9	**CAJ-2**	**Rehabilitación Canal El Huayo**	**10**	**6**	**9**	**8**	**9**	**42**	**1**
10	CAJ-7	Irrigacion Cochán Alto	7	8	7	7	10	**39**	**2**

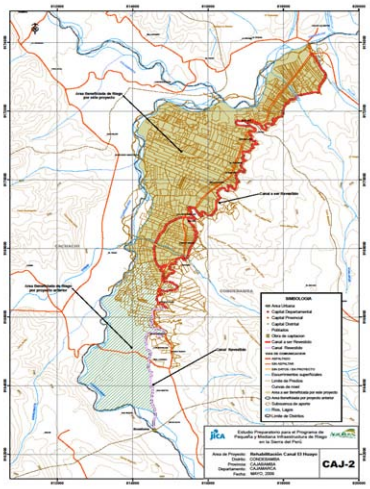
As shown in the classification chart, the Subproject Rehabilitation Canal El Huayo was selected as Typical Project of Minor Individual Irrigation infrastructure Type A.

2) Results of the Perfil Study (Rehabilitation Canal El Huayo)

(a) Proposed Alternative for the Subproject

A. Name of the Public Investment Project (PIP)	
	Rehabilitation Canal El Huayo
B. Objective of the project	
	The objective of the Subproject is to increase the socio-economic level and quality of life of the farmers at the district of Condebamba, improving agriculture production and productivity, through the good use, administration and maintenance of the irrigation system.
C. Balance offer and demand of the goods and services of the PIP	
	The Subproject faces a problem of sedimentation. In many opportunities the canal has been closed by sedimentation, causing a high cost in maintenance. For these reasons, producers are interested in the good functioning of the irrigation system and the watershed conservation. Water resources are sufficient to attend the beneficiary areas. Presently, they count on with a water use certificate of 1.8 m3/s for the Subproject.
D. Technical Description of the PIP	
	The contents of the Subproject are; Benefited Area：1,428 ha Number of de Families：560 families Intake works：Existent Main Canal：20.6 km（Concrete lining 5.1 km） Culverts：1 Unit
E. Cost of the PIP	
	Main Canal S/. 1,968,000 Rehabilitation of Intake works S/. 70,000 Culverts S/. 1,635,000 Total S/. 3,673,000
F. Benefits of the PIP	
	The execution of the present project will allow keeping under permanent irrigation total area of 1,480 ha, improving irrigation. The cultivation area will increase from 717 ha to 2,107 ha. Crops are: Potato, Barley, Wheat, Maize and Beans.
G. Results of the social evaluation	
	IRR at private prices: 26.1%, and at social prices: 31.0%. It is a project of high economic profitability.
H. Sustainability of the PIP	
	This Subproject counts on with a Committee of Irrigation Users that carry outs the maintenance of the irrigation system. The present project is sustainable because it has the commitment of the population that once the work is executed, they will assume the costs of operation and maintenance of the project to assure its sustainability. This agreement takes the form of an agreement statement signed by all beneficiaries and the committee of users; likewise, they have agreed to provide their homes to store the material and equipment during the execution of the works.
I. Environmental Impact	
	During the implementation of the improvement project, earth works that generate negative effects will not be conducted, on the contrary, with the lining and construction of the inspection side way, the zone will be properly conditioned for the correct use of the canal through lateral intakes. The project will avoid filtration that damages the surrounding farmlands, besides the construction of culverts will allow to channel the water and avoid erosion in these sections.

(b) Subproject Area



This Subproject is located in the Province of Cajabamba, in the district of Condebamba, department of Cajamarca, at 2000 amsl. It is part of the Crisnejas river watershed, micro watershed of Payac river and the subwatershed of river Seco, Cholocal. The access to Condebamba is through the paved road from Cajamarca to the Province of San Marcos (64km.) and by half paved toad from San Marcos to Cajabamba (60km).

The population of the district of Condebamba, according to the last Census of Population and Housing is 13,186 inhabitants (1.0 % of the Department), corresponding 95.2% to the rural population and 4.8% to the urban population.

The 71.2% of the occupied PEA is in the agriculture activity; 16.5% in the transformation activity (dairy, liqueur, honey, brown sugarloaf, handcraft, etc.) and 7.6% in services (trade, transportation, tourism, office workers of the public and private sector).

Main crops are, Yellow hard maize, alfalfa, potato, manioc and sweet potato, most part of the food production is for self-consumption, also, there is the forestry activity especially for domestic consumption.

Commercialization of products is mainly at local level and some products are sold in the farmland; also they trade with cattle, horse, goat, cuyes and poultry at the Saturday and Sunday fairs in the city of Cajabamba.

(c) Results of the Survey

The results of the social survey in the Subproject area are the following:

- The 100 % declared they would like to participate in the execution of the improvement of irrigation infrastructure.
- The 92.9 % declared that would participate with labor force, 1.4 % paying someone and 5.7 % did not declare.
- The 71.4 % declared that would pay the tariff for the operation and maintenance of the irrigation infrastructure.
- The farmers who answered “no” (20.0%) said that they would do it through labor force and 8.6 % by cleaning the canal.
- In the question Are you available to participate in the system of water tariff collection system? Approximately 36 % answered yes; the majority (64.3%) opposed.
- The 97.1 % expressed the need to conserve and improve the water source.
- At the question “Do you have any idea how to conserve and improve your water source? The 54.3 % declared by cleaning the canal, 10.0 % through a moderate irrigation, 4.3 % reforestation and the 31.4 % does not know.
- The 91.4 % of farmers do not know what to do to conserve their water sources.
- The 57.1 % interviewed producers declared that they know what irrigation by aspersion is.
- The 61.4 % declared that the use of irrigation by aspersion saves water, increase production and allows higher income.
- The 75.7 % producers are willing to change from the traditional irrigation system to the irrigation by aspersion
- The 42.9 % declared they could get investment credit to improve irrigation of their properties
- The 92.9 % does not know about the competitive grants.
- If the government contributes with 80 %, interviewed producers said that they agree to pay for the remaining 20 % in order to improve the existing irrigation system by technical irrigation.
- Producers who answered positively (88.6%) are willing to pay with labor.
- Most important crops are alfalfa, Yellow hard maize and potato.
- Like in El Rejo production and productivity are low because they do not use improved seeds and lack water.
- The Province is classified as in extreme poverty and it is important to support it with this project. For the population to have sufficient water to water their crops as well as to provide it to their herds is a vital demand.

The Study of the typical subproject in this group shows economic profitability and sustainability expressed in the interest and will of the beneficiaries.

(c) Works to be constructed in each Subproject

Works to be constructed are:

No	CODE	NAME OF THE PROJECT	CANAL (km)			
			CONCRETE.	CEMENT.	PIPE	TOTAL
1	AMA-2	Mejor. del Sist. Riego San Juan Marañón-La Papaya	6.00			6.00
2	CAJ-2	Rehabilitación Canal El Huayo	15.70			15.70
3	ANC-3	Construcción Canal de Irrigación Casablanca- Jocosbamba – Quiches (Joquillo)	19.20			19.20
4	ANC-4	Construcción Canal Rupawasi - Rosamonte	10.00			10.00
5	ANC-10	Const. Canal de Riego Aynin-Huasta			10.40	10.40
6	ANC-16	Const. Sistema de riego Jatun Parco	0.43		11.05	11.47
7	ANC-17	Mejoramiento Canal Chuayas-Huaycho	7.00			7.00
8	ANC-18	Mejoramiento Chinguil - Cruzpampa	14.89			14.89
		TOTAL	73.22	0.00	21.45	94.66

Source: Prepared by Study Team

(9) Type 3-B Group : Irrigation infrastructure (Investment between S. 3 to 6 Million, Canal with Dam)

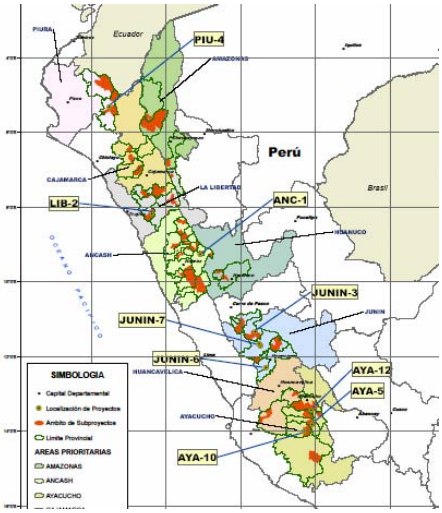
It consists in 8 subprojects of irrigation infrastructure.

Table 3.4-42 Type 3-B Group : Irrigation infrastructure (Investment between S. 3 to 6 Million, Canal with Dam)

No	Name of the Project	Location			Area(ha)			Benef	Budget	Refe,
		Depart.	Prov.	District	Impr.	Incorp.	Total	Families	(thousand S/.)	
1	Irrigación Cotosh II Etapa (Jun-3)	Junín	Tarma	Acobamba	500	601	1,101	1,081	3,812	
2	Construcción del Sistema de Riego Rupasha - Vista Alegre (Jun-6)	Junín	Huancayo	Chicche	899	382	1,281	202	3,212	Típico (TipoB)
3	Mejoramiento del Sistema de Riego de las Localidades de Yauli y Jajapaqui (Jun-7)	Junín	Jauja	Yauli	240	210	450	501	3,975	
4	Construcción de Presa y Sistema de Riego Chaqllani-Pucapampa (Aya-5)	Ayacucho	Fajardo	Huancapi-Huancaraylla	40	1,000	1,040	300	5,800	
5	Const. presa y sistema de riego Chito-Sachabamca y Quishuarcancha, Chiara (Aya-12)	Ayacucho	Huamanga	Chiara	500	1,500	2,000	2,000	5,760	
	Total	4	8	8	2,399	6,118	8,517	5,574	36,608	

Source: Prepared by Study Team

Considering the Subprojects of Type B that count on with a study at Perfil level, a classification was made according to the variables previously indicated, giving high scores for subprojects closest to the average.



1) Selection of Typical Subproject

The subproject with highest score was selected as the typical project. As result of the application of the method, the Subproject Construction of Irrigation System Huacatina (Lib-2)was selected as the Typical Project for the Type 3B Minor Individual Irrigation infrastructure Project

Table 3.4-43 Selection of Typical Subproject: Type 3-B (Investment between S/. 3 to 6 Million, Canal with dam)

No	Symbol	Name of Subprojects	Area (ha)	Beneficiaries	Amount (S/.)	Amount per ha.(S/. /ha)	Amount per beneficiary (S/./Bene)	Total Score	Order
1	AYA-12	Const. presa y sistema de riego Chito-Sachabamca y Quishuarcancha, Chiara	1	1	3	2	2	**9**	**5**
2	AYA-5	Construccion de Presa y Sistema de Riego Chaqllani-Pucapampa	3	3	1	5	1	**13**	**4**
3	JUNIN-3	Irrigación Cotosh II Etapa	5	2	4	4	3	**18**	**2**
4	**JUNIN-6**	**Construccion del Sistema de Riego Rupasha - Vista Alegre**	**4**	**5**	**3**	**3**	**4**	**19**	**1**
5	JUNIN-7	Mejoramiento del Sistema de Riego de las Localidades de Yauli y Jajapaqui	2	4	5	1	5	**17**	**3**

Fuente: Procesado por Equipo del Estudio JICA

In this set of Subprojects 3 are located in Junin, 3 in Ayacucho, 1 in Ancash and 1 in La Libertad, totaling 8 subprojects. This group has as characteristics to offer water during the dry season. The Subproject of Huancatina is examined as representative of the Group.

2) Results of the Perfil Study "Construction of irrigation system Rupasha-Vista Alegre" as Typical subproject

A. Name of the Public Investment Project (PIP)

CONSTRUCCIÓN DEL SISTEMA DE RIEGO RUPASHA - VISTA ALEGRE DISTRITO DE CHICCHE – HUANCAYO - JUNÍN".

B. Objective of the project

The Objective of the Subproject is to increase production, according to the Objective of the Program.

C. Balance offer and demand of the goods or services of the PIP

To carry out this balance,it has taken first into account the demand and monthly offer of the project, to evidence the months of more deficit. The demand of water maxim is of 330 lps. The water resources source which offer to satisfy the water demands of the project is in the Quebrada Sogoragra.

D. Technical Description of the PIP

Regukating Dam at Carcuna lake
Main channel with mixed simple concrete f'c = 175 kg/cm2 with 12.5 km of length.
Lateral Intake
Aqueduct, etc.

E. Costs of the PIP

Detailed Design	S/. 44,625
Infrastructure;	S/. 3,131,832
Equipments	S/. 20,552
Training	S/. 14,875
Total Cost	S/. 3,211,885

F. Benefits of the PIP

The benefit of this Subproject was estimated by following two manner;
Increase of Productin Net values
Water charge

G. Results of the social evaluation

VPN : 7,862,600
IRR : 69.24 %
B/C : 3.97

H. Sustainability of PIP

Viability Institucional.- The Unit of Formulator and Ejecution are the Municipality of Chicche District of Huancayo, which has the technical capacity, logistics and the experience that allow to execute suitable PIP without problems. The beneficiaries shows their interest to participate the prpject through the offer to contribute by the manpower not qualified in the excavation of the work in conducción canal site.
After the conclusion of the execution of PIP, the system will be relagate to the President of the Beneficiaries Committee, entity that take responsibility for the operation and maintenance.

I. Environmental Impact

	The possible alterations and environmental negative effects either in the floor, courses of water, flora, fauna and landscape, will be mitigated and controlled by means of the procedure of the environmental management contemplated in the project.

3) Works to be constructed in each Subproject

No	SYMBOL	NAME OF THE PROJECT	CANAL (km)				DAM	
			CONCRETE.	MASONRY.	PIPING	TOTAL	Nos.	Volume M3
1	JUNIN-3	Irrigación Cotosh II Etapa	7.00			7.00	1	2.49
2	JUNIN-6	Construcción del Sistema de Riego Rupasha - Vista Alegre	12.50			12.50	1	
3	JUNIN-7	Mejoramiento del Sistema de Riego de las Localidades de Yauli y Jajapaqui			18.00	18.00	2	0.25
4	AYA-5	Construcción de Presa y Sistema de Riego Chaqllani-Pucapampa	14.00			14.00	1	6.00
5	AYA-12	Const. presa y sistema de riego Chito-Sachabamba y Quishuarcancha, Chiara	10.00			10.00	1	3.50
		GRAN TOTAL	43.50	0.00	18.00	61.50	6.00	12.24

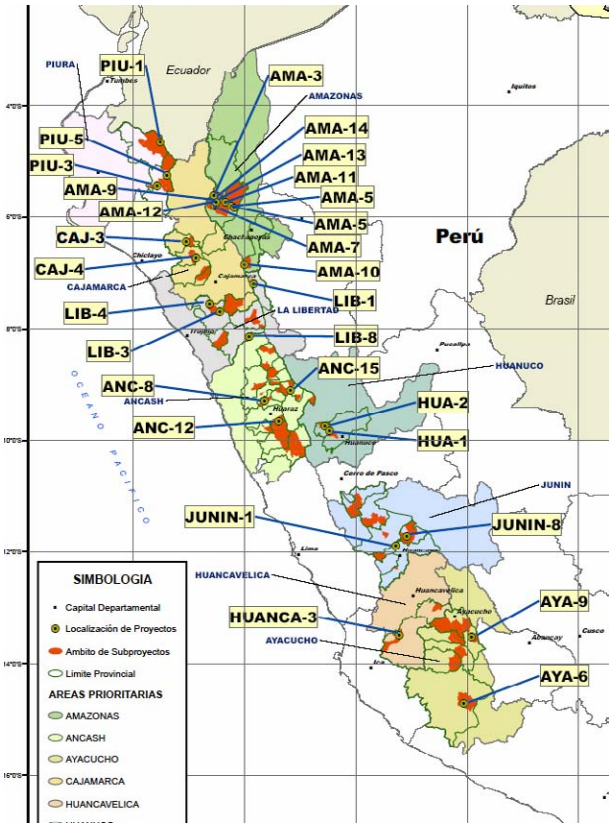
Source: Prepared by Study Team

(10) Type 4-A Group: Irrigation infrastructure (Investment between S/. 1.2 to 3 Million, Only Canal)

It consists in 30 subprojects of irrigation infrastructure.

Table 3.4-44 Type 4-A Group: Irrigation infrastructure (Investment between S/. 1.2 to 3 Million, Only Canal)

No	Name of the Project	Location			Area (ha)			Benef	Budget	Refe,
		Depart.	Province	District	Impr.	Incorp.	Total	Families.	(thousand S/.)	
1	Mejoramiento Canal San Roque Watson	Amazonas	Bagua	Bagua	681	190	871	306		1
2	Mejoramiento Canal Riego La Peca Baja - Canal Brujopata	Amazonas	Bagua	Bagua	269	71	340	100		2
3	Mejoramiento del Sistema de Riego Lumbay Balsas	Amazonas	Chachapoyas	Balsas	240	110	350	350		3
4	Mejoramiento del Sistema de Riego El Pintor - Canal Abad.	Amazonas	Utcubamba	Bagua Grande	503	74	577	113		4
5	Mejoramiento del Sistema de Riego Naranjitos - Canal Naranjtios Nº. 02	Amazonas	Utcubamba	Cajaruro	514	40	554	97		5
6	Mejoramiento del Sistema de Riego Utcuchillo - Canal Aventurero	Amazonas	Utcubamba	Cajaruro	401	173	574	101		6
7	Mejoramiento del Sistema de Riego Naranjos - Canal Naranjos	Amazonas	Utcubamba	Cajaruro	826	67	893	193		7
8	Mej.Boc.Rev.Tramo Canal Comunal Huarangopampa	Amazonas	Utcubamba	El Milagro	630	140	770	113		8
9	Mejoramiento del Sist. Riego Higuerones-San Pedro	Amazonas	Utcubamba	El Milagro	577	202	779	132		9
10	Mejoramiento Bocatoma y Canal Limonyacu Bajo	Amazonas	Utcubamba	La Peca	403	112	515	132		10
11	Mejoramiento Canal Rurec	Ancash	Recuay	Olleros	250	550	800	180		11
12	Irrigacion Papatapruna - Ccochalla	Ayacucho	Lucanas	Puquio	50	445	495	90		12
13	Mej y Const. Sistema Riego Putacca Ccatun Pampa	Ayacucho	Vilcashuaman	Concepción	107	293	400	168		13
14	Irrigación Cusicancha-Huayacundo-Arma-Huaytará.	Huancavelica	Huaytará	Cusicancha, Huaytara, etc		240	240	76		14
15	Construcción Canal de Riego Caracocha	Huánuco	Huánuco	Quisqui	8	241	249	120		15
16	Construcción Canal de Riego Sogoragra Rondobamba	Huánuco	Yarowilca	Aparico Pomares	13	387	400	157	Tipico (TipoA)	16
17	Mejoramiento Canal Achamayo	Junín	Concepcion	Sta Rosa de Ocopa	1,520		1,520	1,306		17
18	Mejoramiento del Canal Sute Pututе	La Libertad	Bolivar	Ucuncha		529	529	250		18
19	Mejor. Canal Riego Chuquillanqui-Shushipe	La Libertad	Gran Chimú	Lucma	1,000		1,000	250		19
20	Canal de Irrigación Espíndola	Piura	Ayabaca	Ayabaca		500	500	150		20
21	Mejoramiento Canal Chantaco Huaricanche	Piura	Huancabamba	Sondor	707	638	1,345	785		21
		9	20	25	8,699	5,002	13,701	5,169		



1) Selection of Typical Subprojects

A classification of the 25 Subprojects of Type A that count on with a study at Perfil level, with investment amount between S/.and y S/.2 million soles was made, according to the variables indicated above, giving high scores to subprojects close to the average. The subproject with the highest score was selected as typical project.

Selection of Typical Project ; Conglomerate Tipo 4A

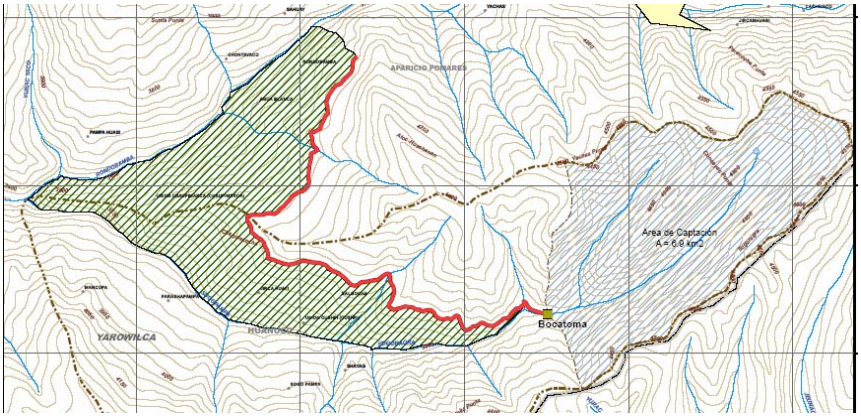
No.	Name of Subproject		Point						Rakning
			Area (ha)	Benefi. (familiy)	Cost (S./)	Cost. Unit. (US$/Ha.)	Cost. Unit. (US$/Ben.)	Total	
1	AMA-1	Mejoramiento del Sist. Riego Higuerones-San Pedro	16	12	3	17	7	**55**	
2	AMA-3	Mejoramiento Bocatoma y Canal Limonyacu Bajo	9	12	19	19	17	**76**	**2**
3	AMA-4	Mejoramiento del Sistema de Riego Utcuchillo - Canal Aventurero	20	7	21	13	8	**69**	
4	AMA-5	Mejoramiento del Sistema de Riego Naranjitos - Canal Naranjitos Nº. 02	19	4	4	7	20	**54**	
5	AMA-9	Mej.Boc.Rev.Tramo Canal Comunal Huarangopampa	18	9	20	9	12	**68**	
6	AMA-10	Mejoramiento del Sistema de Riego Lumbay Balsas	7	13	9	12	5	**46**	
7	AMA-11	Mejoramiento del Sistema de Riego Naranjos - Canal Naranjos	10	19	15	8	18	**70**	**3**
8	AMA-12	Mejoramiento del Sistema de Riego El Pintor - Canal Abad.	21	8	6	10	21	**66**	
9	AMA-13	Mejoramiento Canal San Roque Watson	11	18	7	5	6	**47**	
10	AMA-14	Mejoramiento Canal Riego La Peca Baja - Canal Brujopata	6	6	11	11	14	**48**	
11	ANC-12	Mejoramiento Canal Rurec	14	17	2	20	13	**66**	
12	AYA-6	Irrigacion Papatapruna - Ccochalla	12	5	5	6	1	**29**	
13	AYA-9	Mej y Const. Sistema Riego Putacca Ccatun Pampa	9	16	8	21	10	**64**	
14	HUA-1	Construcción Canal de Riego Caracocha	4	10	17	1	11	**43**	
15	**HUA-2**	**Construcción Canal de Riego Sogoragra Rondobamba**	**16**	**15**	**13**	**18**	**15**	**77**	**1**
16	HUANCA-3	Irrigación Cusicancha-Huayacundo-Arma-Huaytará.	3	3	18	2	3	**29**	
17	JUNIN-1	Mejoramiento Canal Achamayo	1	1	16	3	2	**23**	
18	LIB-1	Mejoramiento del Canal Sute Pututе	17	21	14	15	9	**76**	**2**
19	LIB-4	Mejor. Canal Riego Chuquillanqui-Shushipe	5	21	1	14	19	**60**	
20	PIU-1	Canal de Irrigación Espíndola	13	14	12	16	16	**71**	
21	PIU-5	Mejoramiento Canal Chantaco Huaricanche	2	2	10	4	4	**22**	

Source: Prepared by Study Team

2) Results of the Perfil Study (Construction canal of irrigation Huanuco Sogoragra - Rondobamba"district of Aparicio Pomares, Province of Yarowilca – Huánuco: Typical Project

(a) Results of the Perfil Study of Typical Project

A.	**Name of the Public Investment Project (PIP)**
	CONSTRUCTION CANAL OF IRRIGATION HUANUCO SOGORAGRA - RONDOBAMBA"DISTRICT OF APARICIO POMARES, PROVINCE OF YAROWILCA – HUÁNUCO
B.	**Objective of the project**
	The Objective of this Subproject is "The Socio-Economic Development in the microwatershed Tunahuayin", at the communities of Rondobamba, Agua Blanca, Unión Chaupimarca and Unión Cushpi.
C.	**Balance offer and demand of the goods and services of the PIP**
	Due to the lack of irrigation infrastructure at the Project area, agriculture practices are of subsistence, and it is not possible to cultivate during the dry season. Farmers have a high demand for irrigation infrastructure. Water resources of the Subproject count on with a dry season flow of 0.47 m3/s more than the flow required for the area of irrigation.
D.	**Technical Description of the PIP**
	Contents of the Subproject: Area of Benefit：400ha Number of Beneficiaries：157 families Main Canal：8.132km (Q=0.33m3/s) Culverts: Intake Works, Bridges, etc.
E.	**Costs of the PIP**
	Intake Works； S/. 26,000 Main Canal； S/. 661,000 Culverts； S/. 34,000 Others； S/. 803,000 Total； S/.1 ,524,000
F.	**Benefits of the PIP**
	The benefit of this Subproject is generated by the benefit area of 400 ha. The benefits derive from the increase in the production of Potato, Wheat, Barley, Broad bean, Maize and Forage cultivation.
G.	**Results of the social evaluation**
	IRR at private prices is 51.8% and at social prices is 59.4%. This Subproject shows high economic profitability.
H.	**Environmental Impact**
	The project consists in the construction of an intake and 8.13 km of canal to benefit 393 Ha. There is no intersection with Natural Protected Areas. The environmental aspects are the reforestation of the zone of cut and the stabilization of tauds. At the moment of the execution, waters have to be diverted to avoid contamination.



(11) Type 4-B Group: Irrigation infrastructure (Investment between S/. 1.2 to 3 Million, Canal with Dam)

It consists in 6 subprojects of irrigation infrastructure.

Table 3.4-45 Type 4-B Group: Irrigation infrastructure (Investment between S/. 1.2 to 3 Million, Canal with Dam)

No	Name of the Project	Location			Area (ha)			Benef	Budget	Refe,
		Depart.	Prov.	District	Impr.	Incorp.	Total	Families.	(thousand S/.)	
1	Irrigation System Mancan Aija	Ancash	Aija	Aija	0	540	540	418	2,500	
2	Construction Irrigation System Ccocha-Huayllay	Ayacucho	Huamanga	Vinchos		439	439	550	2,961	Typical (TypeB)
3	Dam Laguna Chochoguera	Cajamarca	Cajabamba	Cachachi	500	1000	1,500	1,000	2,620	
4	Irrigation Aywin	Junín	Conception	S.J. Quero		400	400	1,110	2,790	
5	Dam Laguna Negra-Const of irrigation Canal Chugay	La Libertad	Sanchez Carrión	Chugay	300	300	600	150	2,173	
6	Dam Laguna Collasgon-Const Canal Collasgon-Querobal	La Libertad	Sanchez Carrión	Curgos		236	236	366	2,582	
		5	5	6	800	2,915	3,715	3,594	15,626	

Source: Prepared by Study Team

1) Selection of Typical Subprojects

A classification according to the above indicated variables was made for the Subprojects of Type 4-B that have studies at Perfil level, giving high score to the Subproject closer to the average. The Subproject with the highest score was selected.

The Subproject Construction of irrigation system Ccocha-Huayllay was selected as Typical Project .

Table 3.4-46 Selection of Typical Subproject: Type 4-B (Investment between S/. 1.2 to 3 Million, Canal with Dam)

No.	Name of Subproject		Point						Rakning
			Area (ha)	Benefi. (familiy)	Cost (S./)	Cost. Unit. (US$/Ha.)	Cost. Unit. (US$/Ben.)	Total	
1	ANC-19	Sistema de Riego Mancan Aija	3	3	4	4	3	**17**	**2**
2	**AYA-2**	**Construcción Sistema de Riego Ccocha-Huayllay**	**4**	**4**	**3**	**3**	**4**	**18**	**1**
3	JUNIN-2	Irrigación Aywin	2	1	1	2	2	**8**	**3**
4	LIB-6	Represa Laguna Negra-Const Canal de Riego Chugay	1	2	2	1	1	**7**	**4**

Source: Prepared by Study Team

2) Results of the Typical Study of Feasibility (Construction irrigation System Ccocha-Huayllay)

(a) Perfil Executive Summary

PERFIL
A. Name of the Public Investment Project (PIP)
"CONSTRUCTION OF DAM AND EXPANSION THE IRRIGATION SYSTEM CANAL CCOCHA – HUAYLLAY, DISTRICT OF VINCHOS, PROVINCE OF HUAMANGA - AYACUCHO"
B. Objective of the project
Increase the profitability of agriculture production in the benefited communities (Ccoñani, Chucllahuaycco, Casacancha, Ccahuiñayocc, Accomarca, Chinquiray, Palmadera, Huayllay), district of Vinchos.
C. Balance offer and demand of goods or services of PIP
The water source that attends the demand of water for the projected products is the Paccha river. According to the hydrologic model, the average flow is lower to the projected demand during the dry seasons so it is necessary to regulate it through a mini dam in the natural vase named Ccocha, to cover the projected demand.
D. Technical Description of the PIP
The project consists in: 1. Construction of a dam 60 m of longitude with 7 m of height, to store 250,000 m3 of water and catch 300 l/s. 2. Concrete canal with existing rectangular section of 780 meters. 3. Construction of concrete canal of trapezoidal section trapezoidal 21 Km, to the community of Huayllay. 4. Construction of an inverted siphon, longitude 200 meters 5. Construction of culverts consisting in one canoe bridge L= 3m (15 units), aqueduct bridge 5 m (02 units), bridge (vehicular) (03 units), lateral intakes (50 units).
E. Costs of the PIP
S/. 2,712,185.38
F. Benefits of the PIP
Benefits are estimated based in: ▪ Count on with irrigation water in optimal quantity and opportunity ▪ Improvement of productivity thanks to the introduction of improved technology ▪ Crop schedule by the efficient use of soil, projecting two crops in order to obtain better benefits.

- Incorporation of new agricultural land increasing cultivation areas from 68 to 439 hectares, besides the possibility to use 231 ha in the second crop.

G. Results of the social evaluation

ALTERNATIVES	SOCIAL NPV	PRIVATE NPV	SOCIAL IRR	PRIVATE IRR
Alternative I	S/. 1,736,810	S/. 202,557	32%	13%
Alternative II	S/. 1,654,165	S/. 144,697	30%	12%

H. Sustainability of PIP

There is a commitment of the beneficiaries to assume the costs of operation and maintenance and to periodically conduct the works.
Operation and maintenance costs of the project amounts to S/. 9,632
Board of Users pay an average tariff of S/. 16.00 for each harvested hectare

I. Environmental Impact

The project includes the construction of an irrigation system conformed by one concrete dam of 60 m, with storage capacity of 250,000 m3, open canal of 21 Km to offer 439 hectares. A section corresponds to an inverted siphon in a longitude of 200 m. It does not intersect any Natural Protected Area. Before the start of the dam construction water is to be derived through provisional hydraulic structures to avoid turbidity that could avoid aquatic flora and fauna.

J. Organization and Management

Ejecution of the project: District Municipality of Vinchos through Direct Administration
For the operation stage of the PIP; Board of Users created in the consolidation stage.

K. Plan of Implementation

13 months (02 months for elaboration of detailed design and 1 months of execution of irrigation infrastructure works and training

L. Conclusions and Recommendations

According to the economic evaluation of sustainability, sensitivity and environment, the project "Construction of irrigation system Ccocha- Huayllay" is feasible and sustainable in time, so its approval is recommended to proceed to the elaboration of the detailed design and project execution.

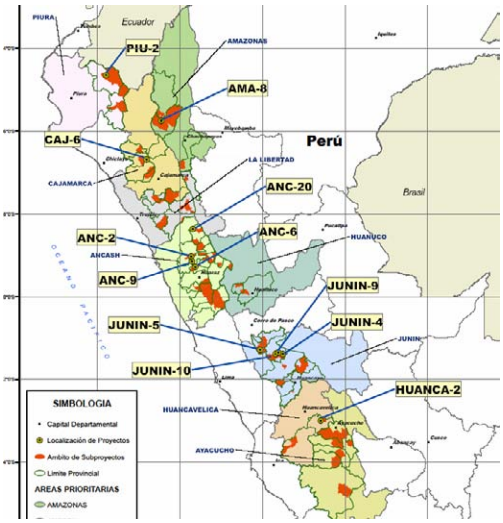
(12) Irrigation infrastructure - Type 5 (Investment less than S/. 1.2 million)

It consists in 12 subprojects of irrigation infrastructure.

Table 3.4-47 Type 5 Group : Irrigation infrastructure (Investment less than S/. 1.2 million, Only Canal)

No	Name of the Project	Location			Area (ha)			Benef	Budget	Refe,
		Depart.	Prov.	District	Impr.	Incorp.	Total	Families.	(thousand)	
1	Improvement of the irrigation system Goncha Morerilla - Canal Gonchillo Bajo	Amazonas	Utcubamba	Bagua Grande	241	43	284	77	737	
2	Improvement of the irrigation canal Paron II	Ancash	Huaylas	Caraz	400	110	510	350	1,059	
3	Improvement and Extension of Irrigation Canal Quishquipachan	Ancash	Huaylas	Caraz	250	0	250	160	997	
4	Canal of Irrigation Desembocadero – San Miguel	Ancash	Sihuas	Chingalpo	120		120	162	731	
5	Improvement of irrigation canal Quinta Toma	Ancash	Yungay	Ranrahirca	250	0	250	90	613	
6	Construccion Canal La Samana – Ushusqui	Cajamarca	Santa Cruz	Yauyucán		400	400	309	850	
7	Irrigation Chaynabamba	Huancavelica	Angaraes	Cangalla	20	110	130	576	900	
8	Improvement Canal Sector Atocsaico	Junín	Junin	Ondores	200		200	616	955	
9	Improvement Canal Mayuhuato – Huaracaya	Junín	Tarma	Acobamba	160		160	229	358	
10	Improvement canal Ranra Antabamba	Junín	Tarma	Palca o Acobamba	100		100	66	289	
11	Canal of irrigation Ninatambo	Junín	Tarma	Tarma	115		115	80	559	
12	Improvement Canal Sanguly	Piura	Ayabaca	Montero	500	400	900	350	808	
	Subtotal	5	9	11	2,356	1,063	3,419	3,065	8,856	

Source: Prepared by Study Team



Type 5 group is conformed by Subprojects under 1.2 million of soles. For the SNIP, this Group only requires a simplified Perfil and can include canal and dam.

3.4.3 Component B : Technical irrigation

In this Component, the installation of two modules of technical irrigation for each project of Component A is proposed, in order to introduce technical irrigation in the Sierra. The proposed site is a location with a group of producers interested in changing agricultural practices from the traditional way to a modern system. The technical irrigation system to be installed in the Project is technical irrigation by gravity without using pressurized system. The following figure indicates the model of technical irrigation.

(1) Program Design Matrix (PDM)

The PDM of the Component B is the following:

PDM of Component B; Technical irrigation

Summary of the project	Objectively verifiable indicators	Verification sources	External Conditions
Superior Objective Improve the availability and offer of water resources at irrigation area for families in the less developed areas.	Area of Technical irrigation	Record of cultivation area, statistic data	
Objective of the Program Save offer of water resources and improve irrigation water use and distribution at level of lots to improve production.	Economic use of water Incorporated system of technical irrigation	Monitoring report	
Results ・ Improve the better use of water resources, reducing water losses ・ Increase Agricultural Productivity ・ Efficient use of farming land ・ Proper practices of operation and maintenance through training activities	Monitoring of Implementation Works Situation of water control by farmers Changes in cultivation areas	Monitoring report	Producers introduce Technical irrigation with Government support
Activities ・ Competitive Grant ・ Conformation of technical irrigation beneficiary groups ・ Implementation of the technical irrigation system ・ Technical Assistance for the use of the System	Investment **1. Agro Rural** Pre investment Detailed Design Implementation of Works Input of the System **2. Local Governments** Technical Assistance	Farmers ・ Participation in the works ・ Contribution to the Competitive Grant ・ Operation and maintenance of the irrigation system ・ Administration of water	Previous Condition Capacity of the executing entity

(2) List of Subprojects

It consists in a preliminary list of 56 subprojects of irrigation infrastructure, each subproject conformed by one technical irrigation modules of 20 ha each. This component will cover an extension of 1,120 ha distributed in the 9 departments of the environment of the Program.

The selection criteria of the tecnical irrigation projects will be associated with the selection criteria of the Component A, completing certain requirements of the proposed site will be installed, the topographical condition of the objective area that allows the necessary water height for the operation of the splinkler, the organizational formation that guarantees the sustainable operation and maintenance. Basic design unit for the installation will be based on an area of 20 ha for effects of evaluation of costs and budget. Each subproject of technical irrigation catches water from a new canal or a canal improved with concrete. These canals are part of the irrigation infrastructure subprojects and are located in nine departments. The objective subprojects of this Component and the technical irrigation modules are the following;

Table 3.4-48 Number of Technical irrigation modules

Department	Number of Modules
Amazonas	13
Cajamarca	4
Piura	3
La Libertad	3
Ancash	14
Huánuco	2
Junin	9
Huancavelica	1
Ayacucho	7
Total	56

(3) Results of the typical study El Rejo

1) Plan of infrastructure

Sprinkler irrigation, more than a new irrigation system, is a new way to manage crops. Differ from the traditional irrigation systems by gravity, where wetting is produced by the displacement of water in the soil, causing inefficiency in water distribution at lot level, in the technical irrigation by sprinkler, the sprinkler propels water on the soil surface, falling in the way of controlled rain, wetting the soil in uniform depth, without producing runoffs or water displacement over the contact surface, limiting the water to the zone where active roots are concentrated, absorbing nutrients besides water. In this system of irrigation the right application of nutrients dissolved with irrigation water generates a multiplier effect in production. In the case of applying fertilizes in the soil separated from water, the benefits of irrigation are expressed in water saving or improvement of the efficiency and/or expansion of agriculture land. In zones with high slopes and silt loam soil the design requires a uniformity of minimal irrigation of 70%, as well as a precise rate of nutrients application and a high fractioning in application, that is, it requires uniformity especially at the moment of the fertigation application.

(a) Distribution Reservoir

The system of irrigation by sprinklers is conformed by ldistribution reservoir located at an intermediate in a El Rejo main canal, performing a double function of providing an average minimum and constant pressure of 18 mca and a flow between 0.5 and 0.6 m3/h in the sprinklers. The sprinkler irrigation module is designed to convey a flow 25.4 l/s during the season of maximum need of cultivation water, any imbalance that could occur between the fixed flow received by the system and the flow requested by the sprinklers is absorbed by the load chamber. The flow to be used in this system of pressurized irrigation requires a constant flow from the feeding canal, to make it possible for the load chamber structure to work as time regulator during irrigation.

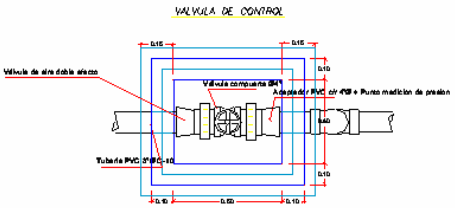
Water captured by the intake of El Rejo canal receives a first coarse filter in the main grit remover, a

second filter at the load chamber through a mesh of floating solids and a third filter through a coarse 30 mesh filter, located at the beginning of the conveyance pipe.

(b) System of conveyance and distribution

In this system, the main, secondary and tertiary pipe lines unite the load chamber to the lateral sprinkler stands. This system starts with a 4 inch pipe and during the trajectory it varies in 3, 2.5, 2 and 1 ½" inches. Its design conveys and distributes water to two independent sectors with 8 and 12 ha respectively. The delivery of water flow to the lateral sprinkler stands is through the tertiary pipe line. The connection between the tertiary pipe line and the lateral sprinkler stand is through hydrants.

(c) Check valve chamber



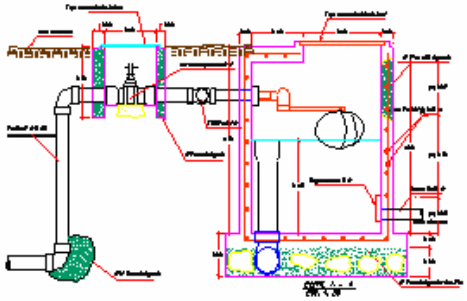
It consists in 14 plain concrete boxes of 0.50 m * 0.40 m and 0.35 m depth. Its function is to protect the double effect air valve, gate valve, ball valve, hydraulic valve and pressure meter valve against damage and robbery. The air valve absorbs the effects of the water hammering, allowing a larger useful life for the components of the system; the hydraulic, ball or gate valve allows the flow regulation and the pressure meter point is an indirect help to measure the flow. In order for these accessories to work well, they have to be correctly located, so the air valve has to be located centimeters upstream the check valve (hydraulic, gate or ball valve) and the pressure meter point should be centimeters downstream. To make operation easier, the structure is arch type so it is also known as irrigation arch chamber.

(d) Hydrant chamber.-

There are 21 units of hydrant protectors, basically plain concrete structures to protect one of the most vulnerable equipment of the irrigation by sprinkler. Its dimensions are 0.8 m * 0.7 m and 0.5 m depth, lid of 0.6 * 0.6 * ¾" and two lateral windows, to allow the exit of a 32 mm polyethylene hose known as the lateral irrigation sprinkler stand. This box protects the hydrant heads that consist in a galvanized iron elevator of 1" * 0.8 m of longitude and 60 cm of extension at each side.

At the two extensions of the "tee" two PVC ball valves, two pressure meter points and three connectors for fertigation are located.

(e) Pressure break chamber



Concrete structure located in the main pipeline, its function is to take pressure to zero at the end and beginning of the section with the purpose of keeping a proper pressure for the system requirements and to avoid class excess in the downstream pipe lines. The Project El Rejo has a pressure break chamber at the progressive height of 060 and altitude 2860 amsl, at the beginning of the pipe that conveys water to the sector 2 to control excess of pressure. It is conformed by a reinforced concrete structure with 3/8 @ 0.15 m, fe, dimensions of 1 m x 1 m and 1.30 m depth. It is implemented with a floating type valve, coating pipe, and cleaning and control valve.

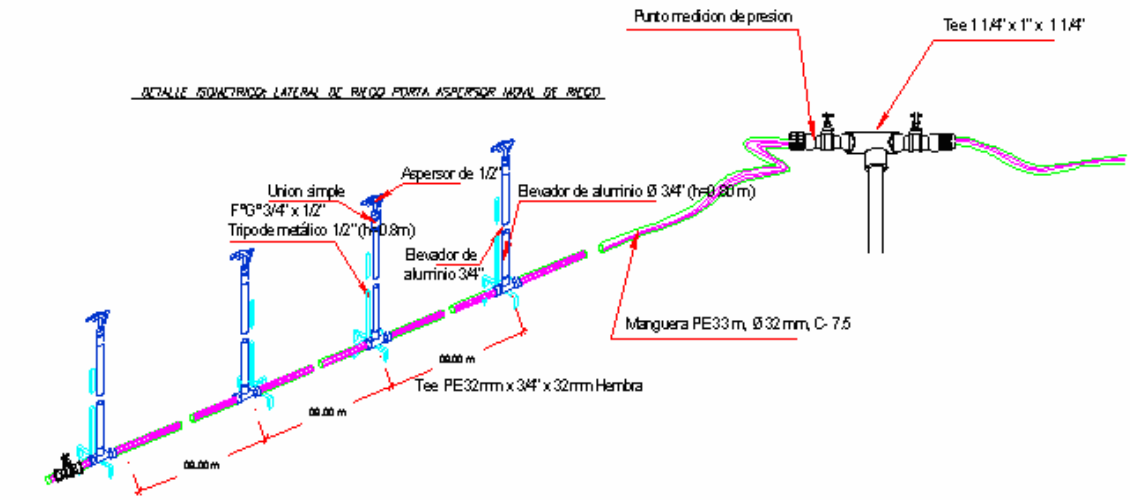
It is important to notice that the pressure reduction valve has similar functions but is not the same as the pressure break chamber, being the main difference that it does not reduces static pressure.

(f) Purge chamber

There are 12 units for purge valve protection; dimensions are 0.60 m x 0.60 m, 0.50 height and 4 mm thick in PE material. They are located at the ends of the secondary and tertiary pipelines; the purpose is to allow the evacuation of strange material and sand.

(g) Irrigation module

The system is conformed by 21 mobile lateral sprinkler stands. From each side of the hydrant head a polyethylene hose comes out, with 32 mm of diameters in one longitude of 50 m, 7.5 class. In the first 33 meters the hose is blind and the remaining are part of the lateral sprinkler stands, conformed by four elevators of aluminum stands of ¾" diameter, 0.8 m of altitude and connected to the sprinkler through a simple galvanized iron joint of ¾" to ½". The end of the lateral sprinkler stand has a screw top for cleaning and drainage.



The lateral irrigation stand is connected to the hydrant head through a polyethylene connector, the pressurized water comes in to the irrigation lateral through a gate type valve and the pressure control is made by a pressure point located some centimeters downstream the mentioned valve.

As the lateral irrigation stands are mobile, they do not occupy the entire area of the field and it is transported once the irrigation time is concluded, the same that will be in accordance to the climate and soil conditions, as well as the phenological conditions of the crop and/or presence of frost, in which case the main function is to absorb or dissipate low temperatures.

The selected sprinkler is the NAAN 5022 circular and sectored, high quality plastic, resistant to impact, ½" screw, 3.2 mm mouthpiece, drip and jet size control, precipitation is medium to low, pressure range between 10 and 40 meters and flow between 0.47 and 0.93 m3/h. Its saw characteristic is to apply a low blade to avoid erosion problems and wide range. Concerning wind, it is expected not to wet during high velocity hours, but to solve it, we proposed only one mouthpiece. With other mouthpieces the range is from 0.38 to 1.18 m3/h.

NAAN 5022

TABLA DE RENDIMIENTOS
ECUACION DE CAUDAL DESCARGA
Boquilla 3.2 mm, Circular, 1/2" Rosca macho
Q = 0.1498 H^0.4954

PRESION	CAUDAL	DIAMETRO
MCA	M3/H	M
12	0.51	22.50
14	0.55	22.80
16	0.59	23.10
18	0.62	23.30
20	0.66	23.50
30	0.81	24.50
40	0.93	25.00

TABLA DE RENDIMIENTOS
ECUACION DE CAUDAL DESCARGA
Boquilla 4.0 mm, Circular, 1/2" Rosca macho

PRESION	CAUDAL	DIAMETRO
MCA	M3/H	M
20	0.85	24.00
30	1.03	26.00
40	1.18	26.00

System of fertigation.

It has been considered 21 fertigation tanks with 50 liters of capacity and a connection kit to the hydrant head. The main cause to consider this system is that the multiplier element of the production is in the fertigation, which is the application of dissolved nutrients in the soil and crops. Connections are ½ inch and the right way of application resides in the position of the connectors. The produced load loss is small but it always slightly strangulates the pass of water.

2) Cost estimation

Cost estimation analysis was made assuming two scenarios; the first assuming the execution through direct administration of Agro Rural and the second assuming execution through a third part or contractor, considering profits.

(a) Costs of irrigation infrastructure.-

Costs corresponding to the load chamber, conveyance and distribution system, structures of check valve chambers, hydrant chambers, Pressure break chambers, purge chamber, irrigation module and system of fertigation.

For 1 Module（20ha）

Work	Cost(S/.)
1. Load Chamber	9,500
2. Conveyance and Distribution	55,100
3. Check valve chamber	5,800
4. Hydrant Chamber	5,700
5. Pressure Break Chamber	3,300
6. Purge Chamber	2,800
7. Module of irrigation	40,000
8. System of Fertigation	10,000
Total	**132,200**

(b) Costs of the Training Program

To achieve the project sustainability, two components based in permanent training to users are proposed, considering that constant training is a basic and necessary tool to disseminate and transfer technology to the rural area. A proper knowledge of technological innovation in issues of crop nutrition, organic matter and humic acids, allow farmers to know the importance and role of fertilizers in crops. The efficient use of certified seeds assures an optimum productivity and production of crops, also certifies the biophysical and biochemical characteristics of good quality. It is very important to train farmers in issues of irrigation, fertigation and irrigation infrastructure techniques, that is it is important to train them in the operation and maintenance of irrigation infrastructure with the purpose of obtaining an efficient management.

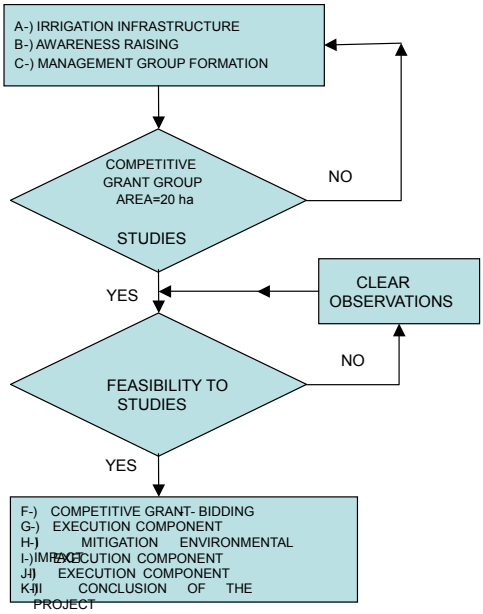
Cost of Assistance（for 1 Module）

	Training-Technical Assistance+Formation of Comitte		
9	Developments of Training Course	1 Unid	39,000
10	Technical Assistance and Agriculture Extension	1 Unid	30,695
11	Environmental Impact Mittigation	1 Unid	4,000
	SUBTOTAL		**73,695**
12	Formation of Tecnical Irrigation Comitte	1 Unid	1,000
	DIRECT COST FOR TRAINING AND FORMATION OF COMITTEE		**74,695**

(4) Summary of technical irrigation

1) General Plan

The start of the general plan of technical irrigation component, second component of the Program, is scheduled with the start of works of the first component "Irrigation infrastructure". In order to start works and installation of the technical irrigation system by sprinklers (item g), it would be better to have the canal physically constructed and the group of future beneficiaries registered and accepted the conditions of open competitive grants and count on with the financial resources. In this sense, a set of actions or tasks are proposed as components of the general plan.



(a) Irrigation Infrastructure

Beginning Stage of irrigation infrastructure.- At the beginning of the irrigation infrastructure construction stage, that is expected to take approximately 12 months, it is convenient also to start the process of awareness raising of the second component implementation "technical irrigation".

It should be remembered that while the irrigation canal is not concluded, the irrigation system by sprinklers cannot be put into operation because the water source to feed the system and the load chamber will be located in the canal.

(b) Awareness raising of technical irrigation.-

For this stage a minimum period of three months is estimated and the important tasks required are:

- Dissemination of the project, task to be performed to introduce the component B of the project to the target population, to the regional and local governments, important local companies and organizations, among others using the communication media.
- Technical irrigation workshops, dissemination and call the participation of the target population and the communities for the conduction and execution of workshops about the advantages of technical irrigation.
- Workshops about business plans and productive chains equally oriented mainly to the target population, showing the advantages.
- Data base of the groups of interest, in this stage it is essential to prepare the first data base of farmers interested in technical agriculture.

(c) Formation of management groups.-

Once the first stage is concluded it is convenient to go on with the previously formed groups and guide them toward a deeper knowledge of the project, being recommended:

- Seminars about competitive grants, to provide details about the objectives of said grants and their role in the project.
- Group workshops about the technical irrigation component, it is recommended to provide details about the components and modalities of operation of the equipment to be delivered to the beneficiaries of this component. At this stage, it is very important to make them notice that the main function is not only to save water but the multiplier effect of the production that can be obtained with the irrigation technological innovation and fertigation.
- Group workshops about the formation of technical irrigation committees, it is very important to stress that there must be an irrigation committee in charge of the operation and maintenance of the technical irrigation system, independent from the canal irrigation committee, the obligations and functions, organization, etc.
- Workshops about management of crops under technical irrigation, it is important to have in mind that the management of crops under technical irrigation is another way of managing crops, directed to increase production and productivity. To show the experience of other farmers is very important at this stage. It is better if the speaker has enough experience to provide explanations and examples based in real cases. At this stage, the farmer should have it clear that there are platforms of support such as AGRO RURAL, INIA, Regional office of MINAG, etc.
- Workshops about operation and maintenance of the irrigation system by sprinkler, preferably indicating the useful life of the system and the increase of productivity of crops is in function to the system maintenance and a correct operation related to irrigation and fertigation schedule.
- Conformation and register of farmers in management groups. It is normal that in the initial stage of awareness raising there is a list of assistants product of the project dissemination and presentation, but in this stage, due to absence of the interested people, lists are modified, and only farmers in doubt about the convenience of participating or not as beneficiaries of technical irrigation and those farmers convinced to be beneficiaries are maintained. This list is updated during this whole stage.

(d) Formation of groups for open competitive grants.-

This is a critical stage for the plan; consequently it is the generator of the previous stages and tasks, for the final objective of those stages is the awareness -raising of the benefits to be received and also the responsibilities to be assumed by the beneficiary farmers of component 2 “Technical irrigation”. If and only when the formation, constitution and submittal of all pertaining documents are materialized, the next stage materializes. That is, the elaboration of the studies required by the beneficiaries may continue.

The estimated time of this stage could be under an undetermined pessimist scenario; under an optimistic scenario we propose a period shorter than four months and under a moderate scenario we propose a period of four months. For the last two scenarios it would be recommendable if they were coincident with the finalization of the irrigation infrastructure works of component I. In this way, the group of beneficiaries of the modules of irrigation by sprinkler would be conformed at the opening of irrigation infrastructure works; the same group that would start the elaboration of their studies.

- Register of farmers to the open competitive grant. The list of registered farmers for the competitive grant should be prepared according to the previous management groups previously conformed.
- Site workshops. In this stage it is important to know the costs of equipment and the

factors that make said systems expensive. Experiences in the development of technical irrigation systems in Arequipa show that the spatial continuity of beneficiaries that conforms the irrigation modules makes them more expensive. Also, in case of technical irrigation by sprinkler, fine textures of soils reduce profitability of investment projects, because these types of soil demands low irrigation blades, increasing operation costs.

- Recompilation and updating of documents, this stage requires the guidance of Agro Rural to conform a personal file of each future beneficiary.
- Management of contributions; in this stage it is important to direct farmers to find the required contribution for the payment of the minimum fund agreed. Some suggestions are 10% with labor force contribution and 5% or 10% with the canon or royalties and possible agreements among local governments, PSI and Agro Rural. Other socio-economic considerations suggest justifying the non payment of 20% for those projects with farmers in extreme poverty living in zones above 3000 asml.
- Official conformation of members for the open competitive grants; for this task, legal advisement is suggested to avoid blanks referred to the commitments of contributions to the fund.

(e) Requirement of studies by the beneficiaries.-

In this stage, it is suggested that Agro Rural supports the beneficiary with the procedures in the local government to select the project designer who will prepare the Perfil studies. It is recommended that Agro Rural orients the farmer to get the payment of the studies from the local or regional government, or other entities, and in the last case, it would be in charge of the beneficiary. The preparation of the detailed design, as it corresponds to the investment stage, is considered in the project cost. The suggested tasks to be conducted are following:

- Elaboration and submittal of studies at perfil level
- Clear observations and feasibility
- Elaboration and submittal of detailed design
- Clear observations and approval
- Final Documents

In this task it is important the approval of the perfil study, feasibility and the detailed design. Otherwise, it is not recommended to go to the other action-task.

(f) Public competition: Installation and construction of the Technical irrigation system

The suggested period is one calendar month for the conduction of the following tasks:

- Publication SEACE
- Register of participants
- Formulation of consultation and observation. Absolution
- Integration of bidding conditions
- Presentation of proposals
- Evaluation of proposals
- Grant of Buena pro- Signature of contract

(g) Component I: Installation of the sprinkler irrigation system - It is suggested to conduct this task in a maximum period of 3.25 months

- Execution of works, suggested period of 3 months

- Work reception, suggested for two days, including verification of operation with irrigation and fertigation and measure the uniformity of the system of irrigation by sprinkler
- Transfer of works to the farmers, two days are suggested
- Transfer documents and opening of works, suggested for one day

(h) Mitigation of Environmental Impact.-

It is suggested to start this task of the plan together with the execution of module I, meaning the beginning of the irrigation system construction together with the start of the environmental impact mitigation. The scheduled tasks are:

- Wind breaker barriers
- Events of training in environmental management
- Installation of environmental posters
- Health risks

(i) Component II: Development of technical training events

It is recommended to conduct the events during twelve months as a platform of attention and support. The following tasks are suggested

- Training in maintenance, operation and management of technical irrigation
- Training in management and production of Andean products under fertigation
- Training in business plans and commercialization to irrigation users

(j) Component III: Technical assistance and extension in the management of irrigation, fertigation and crops. It is convenient to hire an expert during twelve months.

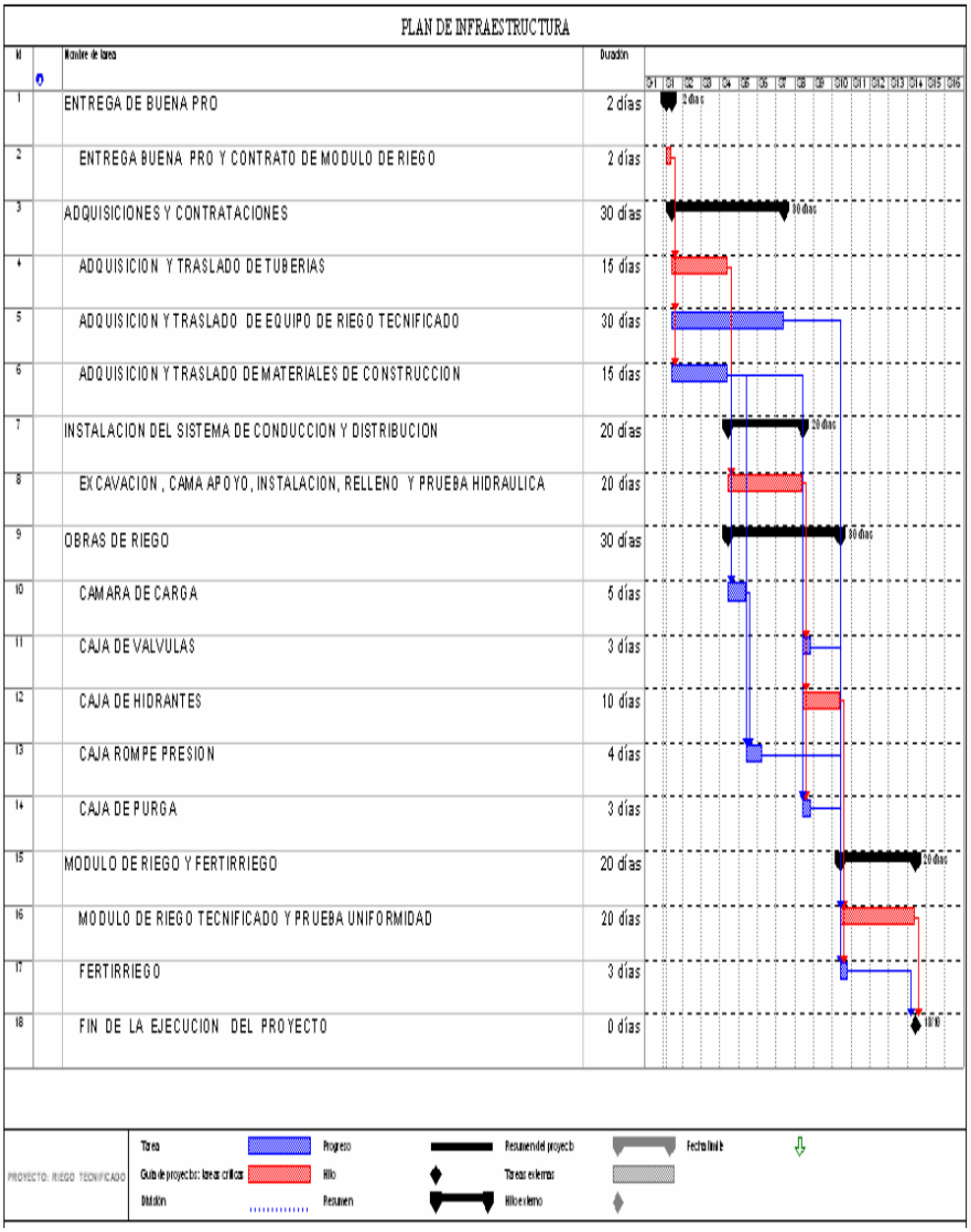
A follow-up of crops through field visits, technology transfer with demonstration of agronomic techniques and irrigation methods, technical seminars, agronomic tours, field days and demonstration of successful results are recommended.

- Field visits, recommendations and crop evaluation I
- Field visits, follow up and crop monitoring II
- Field visits, evaluation of crop harvest III

2) Plan of infrastructure

The start of the irrigation infrastructure plan of the technical irrigation component, second component of the Program, is scheduled from the day of the project Buena Pro award. The duration of the schedule is from three months to 65 working days. The critical route of the plan recommends special care in the fulfillment of the following tasks: Acquisition and conveyance of pipes to the work, installation of the conveyance and distribution system, construction of the hydrant chamber, module of technical irrigation and uniformity test.

DIAGRAMA DE GANTT



3) Cost of component B

The direct cost of the component B of the Program (technical irrigation) is the addition of costs of each subproject at the nine departments. In these departments, the incorporation of 1,120 ha of technical irrigation by sprinkler has been programmed, totaling 56 irrigation modules with a direct cost of 132,200 nuevos soles. Chart attached.

The total cost of component B includes direct cost of irrigation infrastructure with general expenses, supervision and profits, costs of studies (detailed design), training costs, technical assistance and agriculture extension costs and costs of environmental impact mitigation totaling 17.35 million of nuevos soles. Chart attached.

Cost for Component B

Description		Unit	Cost (S/.)
01	LOAD CHAMBER	1 Unit	9,500
02	CONVEYANCE AND DISTRIBUTION	1 Unit	55,100
03	CHECK VALVE CHAMBER (14 UNITS)	1 Unit	5,800
04	HYDRANT CHAMBER (21 HYDRANTS)	1 Unit	5,700
05	PRESSURE BREAK CHAMBER (1 CRP)	1 Unit	3,300
06	PURGE CHAMBER (12 UNITS)	1 Unit	2,800
07	IRRIGATION MODULE	1 Unit	40,000
08	SYSTEM OF FERTIGATION	1 Unit	10,000
	Direct Cost		**132,200**
	GENERAL EXPENDITURE (5 %)	5%	6,610
	PROFIT (5%)	5%	6,610
	SUBTOTAL		145,420
	SUPERVISION	6%	7,914
TOTAL			**153,334**
SUB TOTAL OF INSTALATION (56 MODULES)			**8,586,683**
	STUDY (Detailed Design and Environmental Study)	I unit	**13,543**
	TRAINING-TECHNICAL ASSISTANCE + COMITTE FORMATION		
09	Development of training events	I unit	39,000
10	Training in operation, maintenance and irrigation management	I unit	30,695
11	Mitigation of environmental impact		4,000
	SUBTOTAL		**73,695**
12	Formation of Technical Irrigation Comitte		1,000
	DIRECT COST OF TRAINING + TECHNICAL ASSISTANCE		74,695
	ADMINISTRATION EXPENSE		**18,821**
	TOTAL COST OF MOGULE		260,393
SUB TOTAL OF INSTALATION (56 MODULES)			**14,582,011**
IGV			**2,770,582**
TOTAL OF COMPOMENT B			**17,352,593**

3.4.4 Component C: Institutional Strengthening for Watershed Management

The institutional strenthening is developed under the focus of Management of water Resources in Micro Watershed, because the water is the primordial element inside this geographical space and it is indispensable to conserve it and to infiltrate it in the reception area for the sostenibilidad and bigger lifespan of the irrigation projects to be executed.

The selection criteria of Micro Watershed for the implementation of component C are the following ones: a) It will be in function of the selected environment of the Component A and B, b) interest demonstrated by the beneficiaries in participating in the conformation of the Committee of Management of Microcuencas (according to the surveys carried out for this study).

This component of the Program refers to the micro-watershed, once the projects conforming components A and B are located in the area of a micro-watershed and its scope is only about the capacity strengthening or development of organizations that play a major role in the micro-watersheds management and everything related to the improvement of water reload zones at the micro-watersheds heads (high parts or catchments area, where rain water infiltrates through a series of practices). It will not consider strengthening for management, conservation and administration of irrigation systems that have specific importance for components A and B.

(1) Formulation of the Institutional Strengthening Plan

1) Matrix of the Plan Design (MPD)

The objective proposed by AGRO RURAL is strengthening the management capacities of the

watershed actors to improve the microwatersheds water reload, where the irrigation projects are to be executed and strengthening the institutions for the management of said microwatersheds. It also considers the incorporation of conservation practices in the water reload zones to assure the quantity and quality of irrigation water.

The Matrix of the Plan Design for strengthening (MPD) is the following:

Summary of the project	Verifiable indicators	Verification sources	External conditions
Superior Objective: Improve the availability and offer of water resources at the irrigation area for families in the microwatersheds zones of the Program through strengthened organizations	Area with water sources at the wa reload zone. Total area conserved (with and witho practices).	Mid term and project ex-p evaluation report	Economic stability of t country. Continuity of soc development policies.
Objective of the Program Strengthen management capacities of the microwatershed actors (Farmers Communities, Committees of Irrigation and Committee of Microwatersheds Management), Local and Regional Government for an efficient management of microwatershed as well as to improve the water reload zones where the irrigation projects are to be executed, to achieve the institutional strengthening of watersheds management.	Number of Farmers Communit carrying out microwatershed manageme activities Number of Committees managi microwatershed	Monitoring and follow report	Social peace witho violence outbreaks.
Results : - Potential of the microwatershed territory is identified to build practices to improve water reload at the collecting watershed and the proper use in articulated and integral productive activities - Formation of organizations legalized and strengthened to conduct an efficient management of the microwatershed.	Studies for the identification of t potential area for practices to impro water load. Number of Microwatershed manageme committees conformed. Number of Microwatershed manageme committees legalized	Study for the physical, soc economic and environmen characterization of t microwatershed. Monitoring and follow report Monitoring and follow report	*Government support* *AGRO RURAL executing capacity together with the local and regional Governments*
Activities: - Elaboration of Studies for the collecting area management of the Microwatershed. - Territorial ordainment (OT) - Inventory and planning on water resources (IPRH) - Focused silvopastoral diagnosis (DES-P). - Organizational Strengthening of the farmers' communities and the Committees of irrigation and Microwatershed management. - Events of awareness raising and motivation to the farmers' communities. - Events of training on microwatershed management. - Technical assistance for organizational strengthening. - Legalization of irrigation committees - Formation of microwatersheds management committees. - Legalization of microwatershed management committees.	Number of studies of territor ordainment Number of IPRH's Number of DES-P. Number of events of awareness raisi and motivation. Number of radio spots Number of press releases Number of training events. Number of technical assistance events. Number of legalized irrigati committees Number of Microwatershed manageme committees conformed. Number of legalized committees	Study of ecologic a economic zoning Study of inventory and acti plan of water resources Study of diagnosis and acti plan Final Report Final Report Monitoring and follow report Final Report Document of the Users Boar Register of conformation a approval of the Statutes. Registration document at t Public Register Office	Financial availability for t execution of studies Farmers' communities agr to accept awareness raisi and motivation. Predisposition organizations to strengthened Financial support fr regional and lo Governments

Costs of pre-investment, detailed design, works implementation and expenses in input and material of studies and organizational strengthening are considered in the investment costs of the Program.

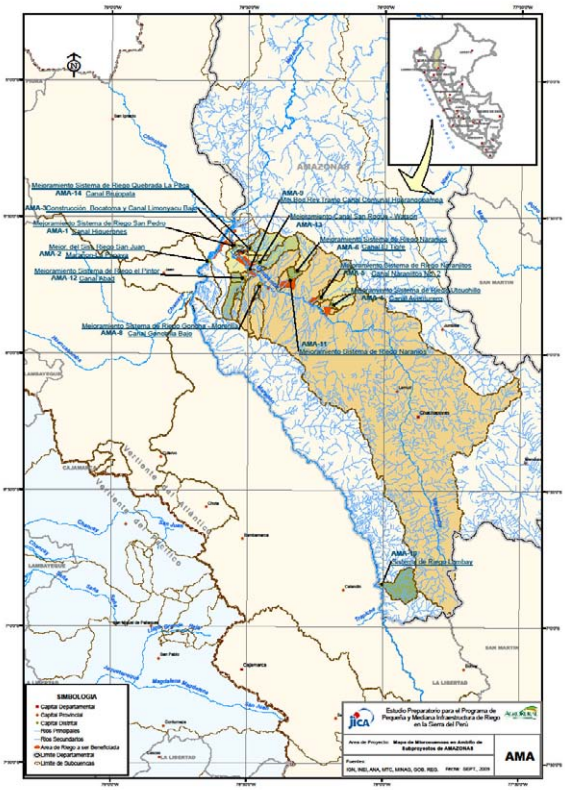
During the execution of Projects, it is assumed that local and regional Governments will financially support and also participate in the management, besides the Program of Rural Agricultural Development Program, AGRO RURAL.

In the case of the collecting watershed, it is an issue for another study with a specific objective, so it is not considered in the Program works budget.

2) Area of the Strengthening Plan

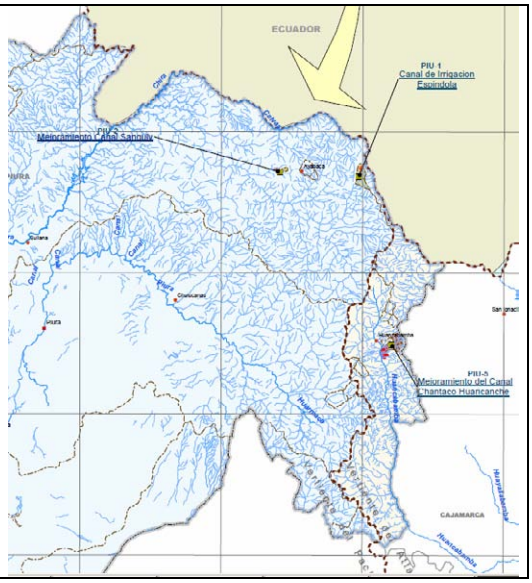
AMAZONAS: The geographical location of its microwatersheds corresponds to the hydrographic units of level 5, according to the classification of the National Agency of Water (A.N.A.): Interwatershed Alto Marañon III, Interwatershed Alto Marañon IV and watershed Uctubamba, that we have named as Subwatersheds, all belonging to the watershaed of Amazonas. The microwatersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

AMAZONAS			
CODIGO	NOMBRE DEL PROYECTO	Microcuenca	Area Microcuenca (km2)
AMA-13	Mejoramiento Canal San Roque Watson	Copallin	**75.79**
AMA-12	Mejoramiento del Sistema de Riego El Pintor - Canal Abad.	El Pintor	**130.10**
AMA-8	Mejoramiento del Sistema de Riego Goncha Morerilla - Canal Gonchillo Bajo	Goncha	**91.42**
AMA-10	Mejoramiento del Sistema de Riego Lumbay Balsas	Jahuay	**125.94**
AMA-14	Mejoramiento Canal Riego La Peca Baja - Canal Brujopata	La Peca	**112.43**
AMA-2	Mejor. del Sist. Riego San Juan Marañón-La Papaya	Marañon	**19,272.32**
AMA-5	Mejoramiento del Sistema de Riego Naranjitos - Canal Naranjitos Nº. 02	Naranjitos	**116.02**
AMA-6	Mejoramiento del Sistema de Riego Naranjos - Canal El Tigre	Naranjos	**136.28**
AMA-11	Mejoramiento del Sistema de Riego Naranjos - Canal Naranjos		
AMA-1	Mejoramiento del Sist. Riego Higuerones-San Pedro	Uctubamba	**6,579.23**
AMA-3	Mejoramiento Bocatoma y Canal Limonyacu Bajo		
AMA-9	Mej.Boc.Rev.Tramo Canal Comunal Huarangopampa		
AMA-4	Mejoramiento del Sistema de Riego Utcuchillo - Canal Aventurero	Utcuchillo	**71.69**
	Subtotal	**10**	



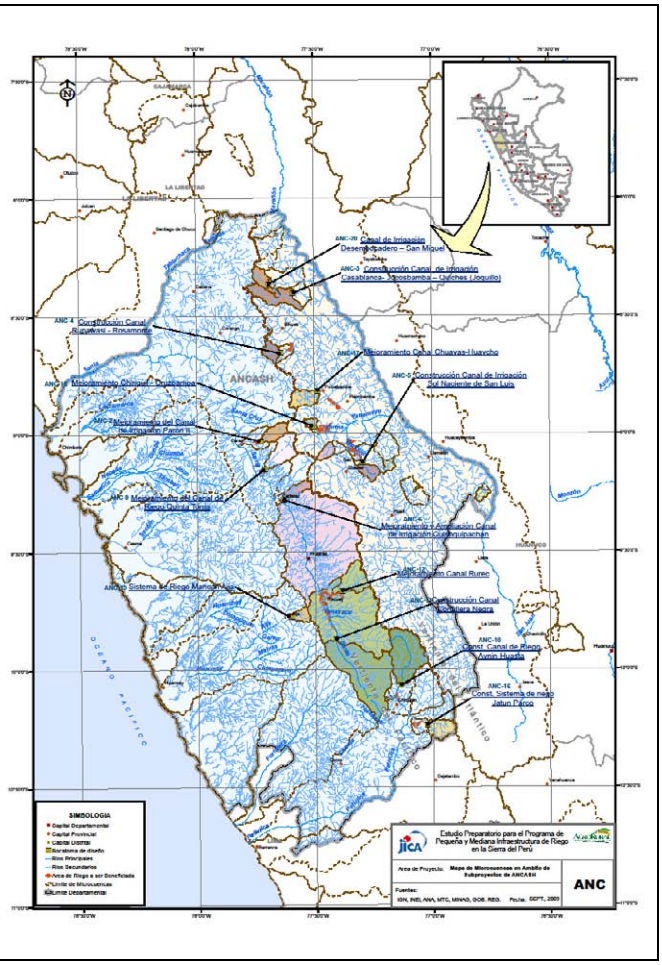
PIURA: According to la A.N.A.'s classification, microwatersheds are located at the corresponding hydrographic units of level 5: Watershed Chamaya, Chira and Piura, it is observed that they belong to the watershed of Amazonas (Chamaya) and the Pacific (Chira and Piura). The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

PIURA			
CODIGO	NOMBRE DEL PROYECTO	Microcuenca	Area Microcuenca (km2)
PIU-1	Canal de Irrigación Espíndola	Espíndola	**28.67**
PIU-2	Mejoramiento Canal Sanguly	Los Molinos	**4.15**
PIU-5	Mejoramiento Canal Chantaco Huaricanche	Chantaco	**49.67**
	Subtotal	**3**	



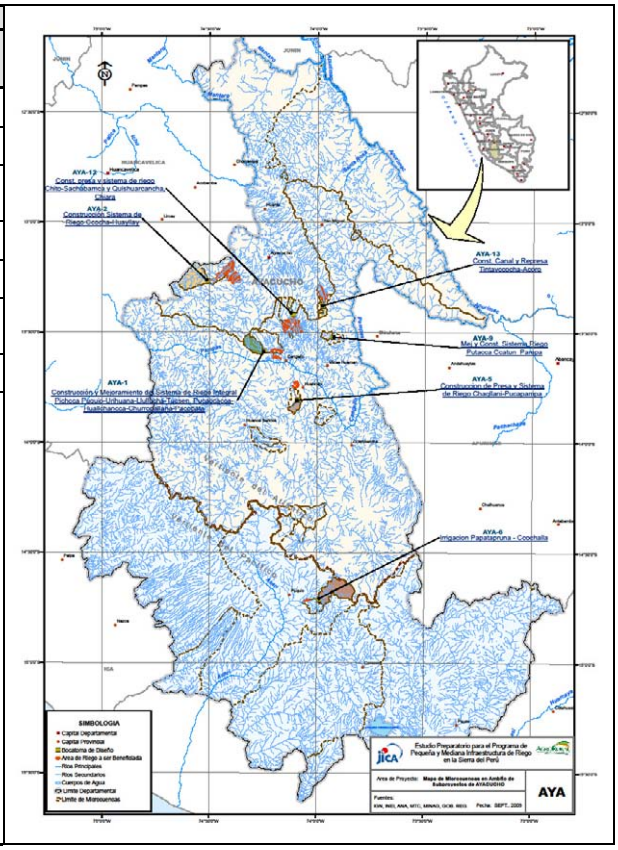
ANCASH: According to la A.N.A.'s classification, microwatersheds are located at the corresponding hydrographic units of level 5: Watershed Santa (Watershed Alta), Watershed Huarmey, Watershed Pativilca and Interwatershed Alto Marañon V, the first belongs to the Hydrographic regions of the Pacific and the last to the watershed of Amazonas. The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

ANCASH			
CODIGO	NOMBRE DEL PROYECTO	Microcuenca	Area Microcuenca (km2)
ANC-4	Construcción Canal Rupawasi - Rosamonte	Andaymayo	**62.11**
ANC-18	Mejoramiento Chinguil - Cruzpampa	Chinguil	**31.28**
ANC-17	Mejoramiento Canal Chuayas-Huaycho	Jancapampa	**93.54**
ANC-3	Construcción Canal de Irrigación Casablanca-Jocosbamba – Quiches (Joquillo)	Llama	**221.15**
ANC-5	Construcción Canal de Irrigación Sol Naciente de San Luis	Tambillo	**181.67**
ANC-20	Canal de Irrigación Desembocadero – San Miguel	San Miguel	**63.85**
ANC-19	Sistema de Riego Mancan Aija	Santiago	**48.66**
ANC-16	Const. Sistema de riego Jatun Parco	Achin	**146.85**
ANC-10	Const. Canal de Riego Aynin-Huasta	Pativilca	**493.64**
ANC-12	Mejoramiento Canal Rurec	Orellos	**147.47**
ANC-2	Mejoramiento del Canal de Irrigación Paron II	Parón	**150.08**
ANC-9	Mejoramiento del Canal de Riego Quinta Toma	Ranrahirca	**149.56**
ANC-11	Construcción Canal Cordillera Negra	Santa	**1,614.62**
ANC-6	Mej. y Ampliación del Canal de Irrigación Quishquipachan		**55.60**
	Subtotal	**13**	



AYACUCHO: According to la A.N.A.'s classification, micro-watersheds are located at the corresponding hydrographic units of level 4: Watershed Mantaro, Watershed Pampas and Watershed Acari, the first two belong to the watershed of Amazonas and the last to the watershed of the Pacific. The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

AYACUCHO			
CODIGO	NOMBRE DEL PROYECTO	Microcuenca	Area Microcuenca (km2)
AYA-1	Construcción y Mejoramiento del Sistema de Riego Cangallo	Pilpicancha	**180.61**
AYA-2	Construcción Sistema de Riego Ccocha-Huayllay	Pacchamayo	**237.76**
AYA-5	Construcción de Presa y Sistema de Riego Chaqllani-Pucapampa	Choccuihuallcca	**59.13**
AYA-6	Irrigación Papatapruna - Ccochalla	Chilques	**187.90**
AYA-9	Mej y Const. Sistema Riego Putacca Ccatun Pampa	Concepción	**46.50**
AYA-12	Const. presa y sistema de riego Chito-Sachabamba y Quishuarcancha, Chiara	Tojiascca	**126.14**
AYA-13	Const. Canal y Represa Tintayccocha-Acoro	Ventanillayoc	**59.28**
	Subtotal	**7**	



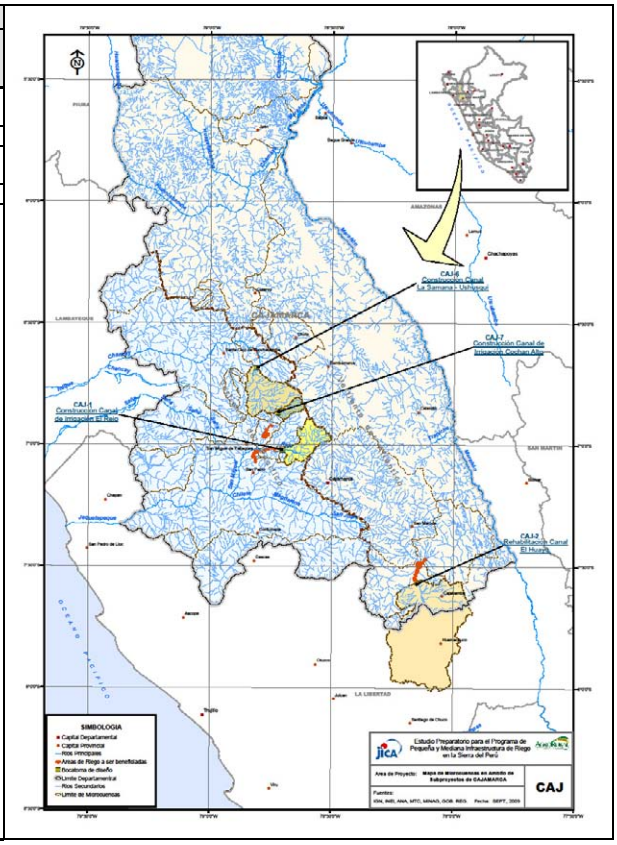
HUANCAVELICA: According to la A.N.A.'s classification, micro-watersheds are located at the corresponding hydrographic units of level 4: Watershed Pisco, Watershed Mantaro, the first belongs to the watershed of the Pacific and the last to the watershed of Amazonas. The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

HUANCAVELICA			
CODIGO	NOMBRE DEL PROYECTO	Microcuenca	Area Microcuenca (km2)
HUANCA-3	Irrigación Cusicancha-Huayacundo-Arma-Huaytará.	Tincoc	**41.01**
	Subtotal	**1**	

CAJAMARCA: According to la A.N.A.'s classification, micro-watersheds are located at the

corresponding hydrographic units of level 4: Watershed Chamaya, Watershed Crisnejas, Watershed Chancay-Lambayeque, Watershed Jequetepeque, the first two belong to the watershed of the Amazonas and the others to the watershed of the Pacific. The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

CAJAMARCA			
CODIGO	**NOMBRE DEL PROYECTO**	**Microcuenca**	**Area Microcuenca (km2)**
CAJ-1	Construcción Canal de Irrigación El Rejo	Rejo	**226.90**
CAJ-2	Rehabilitación Canal El Huayo	Condebamba	**1,935.84**
CAJ-6	Construcción Canal La Samana - Ushusqui	Chancay	**670.17**
CAJ-7	Irrigación Cochán Alto	Llapa	**204.60**
	Subtotal	**4**	

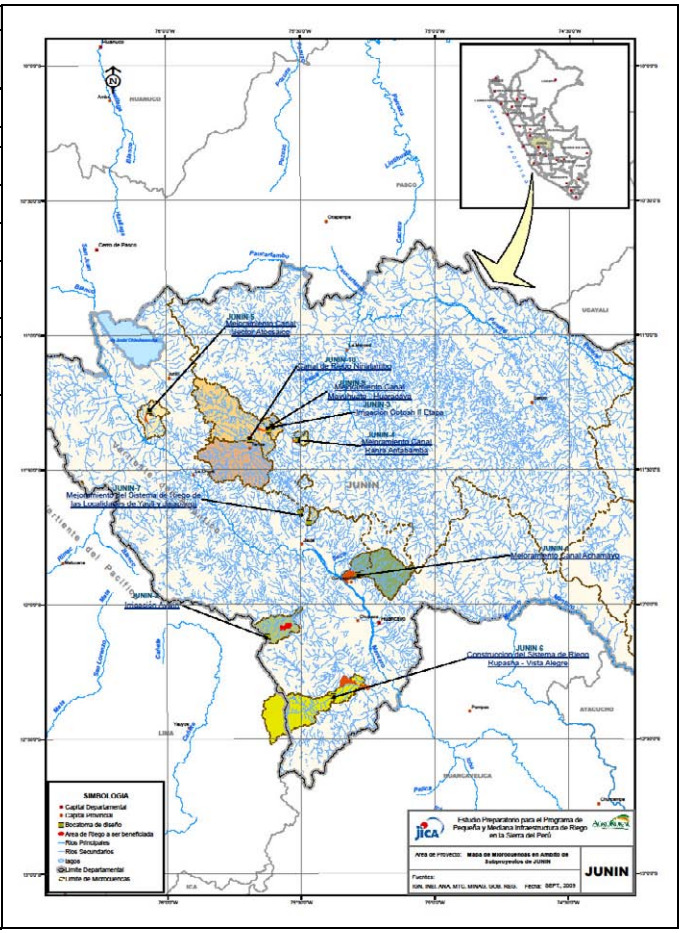


HUANUCO: According to la A.N.A.'s classification, micro-watersheds are located at the corresponding hydrographic units of level 4: Interwatershed Alto Marañon V, Interwatershed Alto Huallaga, belonging to the watershed of Amazonas. The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

HUANUCO			
CODIGO	**NOMBRE DEL PROYECTO**	**Microcuenca**	**Area Microcuenca (km2)**
HUA-1	Construcción Canal de Riego Caracocha	Ragracancha	**21.58**
HUA-2	Construcción Canal de Riego Sogoragra Rondobamba	Sogopampa	**24.74**
	Subtotal	**2**	

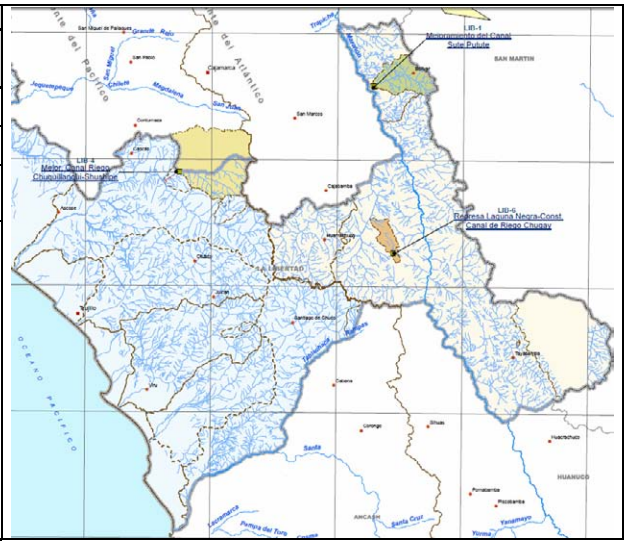
JUNIN: According to la A.N.A.'s classification, microwatersheds are located at the corresponding hydrographic units of level 4: Watershed Mantaro and Watershed Perene, both belonging to the watershed Amazonas. The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

JUNIN			
CODIGO	NOMBRE DEL PROYECTO	Microcuenca	Area Microcuenca (km2)
JUNIN-1	Mejoramiento Canal Achamayo	Chia	**309.68**
JUNIN-2	Irrigación Aywin	Jatun Huasi	**143.73**
JUNIN-4	Mejoramiento canal Ranra Antabamba	Ranra	**19.19**
JUNIN-5	Mejoramiento Canal Sector Atocsaico	Atocsaycco	**126.42**
JUNIN-6	Construccion del Sistema de Riego Rupasha - Vista Alegre	Canipaco	**429.97**
JUNIN-7	Mejoramiento del Sistema de Riego de las Localidades de Yauli y Jajapaqui	Huambo	**68.09**
JUNIN-3	Irrigación Cotosh II Etapa	Tarma	**3.19**
JUNIN-9	Mejoramiento Canal Mayuhuato - Huaracaya		**951.51**
JUNIN-10	Canal de Riego Ninatambo		
	Subtotal	**7**	



LA LIBERTAD: According to la A.N.A.'s classification, micro-watersheds are located at the corresponding hydrographic units of level 4: Watershed Chicama, Watershed Viru, Watershed Santa, la Interwatershed Alto Marañon IV and the Interwatershed Alto Marañon V, the first belong to the watershed of the Pacific and the last two to the watershed of Amazonas. The micro-watersheds with the subprojects to be developed as well as the location in the departments are shown as follows:

LA LIBERTAD			
CODIGO	NOMBRE DEL PROYECTO	Microcuenca	Area Microcuenca (km2)
LIB-1	Mejoramiento del Canal Sute Putute	Sute	**310.15**
LIB-4	Mejor. Canal Riego Chuquillanqui-Shushipe	Chuquillanqui	**911.27**
LIB-6	Represa Laguna Negra-Const. Canal de Riego Chugay	Paccha	**109.24**
	Subtotal	**3**	



3) Agents of Capacity Development

The agents for strengthening the microwatershed management as well to improve the water reload of the collecting watershed are the following:

- Traditional community
- Committee of Irrigation
- Committee of Micro-watersheds Management.

(a) Rural Communities

Traditional community in the "catchments area" at the departments at the sierra where the projects are to be developed (mainly Ayacucho, Apurimac, Huancavelica, Junín, Huánuco and Ancash) will be considered.

Art. 2 of Law Nº 24656, General Law of Traditional community, establishes that "Traditional community are organizations of public interest, with legal existence, integrated by families living and controlling determined territories, linked by ancient, social, economic and cultural connections, expressed in the common property of the land, communal work, mutual help, democratic government and the development of multi-sector activities, with purposes oriented to the full realization of their members and the country. Permanent human settlements located in the communal territory and acknowledged by the General Assembly of the Community are annexes of the Community".

(b) Committee of Irrigation

The Committee of Irrigation, already institutionalized by the Law of Water Resources Nº 29338, Art. 30, establishes that "… the committees of users of superficial waters are organized at a level of minor canal … the structure and functions are determined in the Regulation … and the National Authority acknowledges by administrative resolution that…" The said organizations were born naturally since long time ago in the zone where Components A and B are to be developed and implemented. They follow the Principle of Subsidiary for a better management of water in their canals.

The importance to strengthen or develop capacities of the Water Users' Committees is to assure the maintenance, conservation and operation of irrigation infrastructures, as well as the efficient use of water in the lot and, in general for a good administration and management of the irrigation system. Also, they are natural integrants of the Committees of micro-watershed Management, who will support in the diagnosis; planning and execution of the different actions to improve the aquifer reload in the high parts of the micro-watershed.

(c) Committees of Micro-watershed Management

The Committee of Micro-watersheds Management is the organization that created and promoted the National Program of Watersheds Management and Soil Conservation, PRONAMACHCS, especially during the implementation of the subproject of "Intensive Management of High Andean Micro-watersheds", MIMA. Presently the Program of Productive Rural Agriculture Development, AGRORURAL follows the task of reinforcing it.

This committee is a grass root organization conformed by representatives of the organizations present at the microwatershed (at the beginning the Conservationist Committees were the pillars), in charge of planning–mainly- the activities of conservation and management of natural resources and also to coordinate with all institutions present in this area.

The importance to conform and/or strengthen the Committees of Microwatersheds Management, is that the said organizations are to be in charge of managing the sustainable development of the microwatershed, starting with actions and/or activities related to the water management (conservation, use and sustainable management); later on the sustainable conservation, use and management of the other natural resources and the final objective is to provide support to the institutions and organizations, that accompany the development of communities located at the microwatershed area, being the natural allies and by competence of the local and regional Governments.

4) Methodology for the Capacity Development

The methodology to be used in the reinforcement process is participatory training (educational process of interaction between the facilitator and the trainee, where both of them teach and learn attitudes and abilities and knowledge necessary to improve as persons and to transform the reality they live in). The principle of andragogy is to be applied (adult training).

(a) Method of training

The methods mentioned below are transversal and take into account the new events of awareness raising-motivation and training, to be used with more or less emphasis depending on the type of event and the social actor of the micro-watershed to whom the event is directed. Some of them are mentioned as follows:

- *Inter-learning*

Professionals working in the process of capacity development have to be adequate to their attitudes, from protagonists to facilitators and guides of participatory processes in the different events about organization, management and administration of micro-watersheds; as well as for the improvement of water reload zones in the micro-watershed.

It is named Inter-learning because the integration among participants is an essential element to build the required knowledge and abilities, achieving that participants should be adequate to their attitudes, integrating the elements of learning in a new behavior, both at personal and professional level. The most important input in the courses –and other events of strengthening- is the same experience of the participants that are the base for the exchange Facilitator-Participant.

- *"Learning by doing"*

Its purpose is that persons learn doing things, how to do something to achieve results quicker and with less resources; the how, is the most important. The best way to learn is with other participants. "We can start making mistakes, through them experience is obtained", fundamental tactic of the strengthening process.

- *"Investigation-action"*

The investigation-action is seen as a practical disciplined investigation, conducted by the Facilitator together with the integrants of the organizations, in a collaborative way; with the purpose of improving the management and administration of the micro watersheds as well as the practices in the water reload zones through cycles of "action and reflection".

In our country, agrarian extension is practiced and two techniques have been validated "Field School" and the "Participatory Development of Technologies (P.D.T)". The rural participatory investigation that uses the method "investigation-action" is to be disseminated in training events about soil and water conservation practices at the watershed heads to be implemented and later disseminated through the "farmer to farmer" method.

- *"Farmer to farmer"*

There will be visits to farmers with successful experiences, where they will be the protagonists in the dialogue facilitated by a technician or external agent. For the field days, farmers with successful experiences are to be invited. They have to be innovative farmers who know deeply about the farmer knowledge and many of them are familiar with scientific method through their collaboration in farming investigation.

- Formation and strengthening of leaders /promoters

In order to provide sustainability to the actions of organizations concerned with microwatersheds management, farmer leaders, preferably members of the Committee of Microwatersheds Management are to be selected, to train them as "Promoters for the Microwatersheds Management".

A profile will be defined, there will be a selection process and many training events with the purpose of train them as Promoters for the Microwatersheds Management, Organizational Strengthening,

Formation and Legalization of Committees of Irrigation and Microwatersheds Management as well as in the different technologies to manage the water reload zones of the microwatershed will be provided.

(b) Technology to be used (for a sustainable agriculture)

The technology to be used is the one proposed by the Agro-ecology. Its principles are to be applied mainly in agriculture practices to be executed during the management of native pasture, forest plantation, meadow management and silvopastoral irrigation systems in the zones of water reload of the microwatershed; it is also valid for the management of cattle in this geographic space. According to Altieri and Rosset, 1995, said technologies used in part to achieve sustainable agro eco irrigation systems are the following:

- Vegetation cover as effective measure for soil and water conservation, created by practices of zero cultivation, the use of mulch, the employment of coverage cultivation and other related practices;
- A constant source of organic matter by the constant offer of manure and compost and the promotion of the biotic activity of the soil;
- Mechanisms of nutrients recycling by the rotation of crops, the integration of livestock to cultivation and other related practices;
- Plague control by the increase of activities of biological control agents, obtained through the introduction and/or conservation of natural enemies;
- Diversification of the agro ecosystem in the area (policultivation, agro forestry, etc) and time (rotation, integration of farming and animals, etc.)

In Agro ecology practices, there are small differences concerning application techniques of agro ecologic principles to achieve a sustainable agriculture, but all are aligned with the previously mentioned, Among the main agriculture methods that use said techniques, are the following:

- Organic Agriculture
- Ecological Agriculture
- Sustainable Agriculture with Low External Input
- Good Agricultural Practice

(c) Media Diffusion

Among the media communication and diffusion to be used for the different events of awareness raising-motivation, training and technical assistance, such as call for meetings with the different organizations, call for training and technical assistance events, radios spots of awareness raising-motivation and training, press releases, etc., are the means to be used.

Oral media: Radio is the main communication media, at rural areas most of the population has a battery or electric radio. Radio is the media that accompany them and is their connection with the "outside world". In case where TV is available, it will be also used , according to the type of event and participants.

Print media: To be used at places where print media (newspapers, magazines, etc.) is present. Triptychs, informative bulletins, guides and training manual with issues related to the objectives of the Component and the Program will be prepared also.

5) Events for Development of Capacities

Institutional strengthening is based in three capacity development actions: Awareness raising and motivation, training and technical assistance in issues related to the microwatershed management and practices to improve the zones of microwatershed water reload.

(a) Events of awareness raising and motivation

Awareness - raising is understood as a set of actions by which the members of a farmers' community are invited to think about the water issue: rainfall periods, intensity, shortage of water volume along the years, etc.; being the main causes the over pasture, deforestation and depredation of the meadows. Also the consequences: deficit of water for the irrigation canals and/or reservoirs and consequently for

the cultivation and human consumption.

Motivation is given by the absolute and urgent need to infiltrate rainwater at the microwatersheds heads to maintain the aquifers (springs and ground water). This infiltration is possible through the conduction of a series of practices whose construction requires the active participation of the community through communal works. This event is to take place in the Ordinary General Assembly of the Farmers' Communities with an educational session (seminar) and through campaigns of awareness raising and motivation during the whole year.

(b) Events of training

Training is a fundamental tool to strengthen the management capacities of the microwatershed organizations, with the objective of administration and manage the microwatershed as well as to favor the improvement of the water reloads zones. It is a planned process, systemic and organized to modify, change and extend knowledge, abilities and attitudes of the new/or present personnel, as consequence of the natural process of change, growth and adaptation to new circumstances, internal and external. Events are the following:

- Educational sessions (seminars)
- Workshops
- Courses
- Exchange visits to successful experiences
- Field days

(c) Events of technical assistance

Concerning Technical assistance, they will be in very specific and specialized issues, clearly defined, mainly for the Committees of Irrigation and for the Committees of Microwatershed Management. The issues will consider aspects of organization and planning.

6) Studies for the Management of the Micro-watersheds Collecting Areas

The scientific management of the microwatershed collecting area requires a territorial analysis to determine the actions on the same. In this sense, and considering that watersheds have a spatial, socio-economic and environmental dynamic, it is necessary to know how the structural change of the watershed are to be integrated with the execution of irrigation works and those works to be constructed to improve water reload at the catchments area, determining the zones and actions to be developed in each one of them.

(a) Elaboration of studies for the management of the micro-watershed collecting area.

For this purpose, studies will be conduced, being the most important the Territorial Ordainment that includes the aspects of ecological and economic zoning. This study is complemented by the Inventory and Planning of Water Resources (IPRH) as well as the Silvopastoral Focused Diagnosis, especially for the Catchments area. At the execution of these studies the participation of the population is recommended to determine together the actions to be conducted to improve the collecting watershed and assure its effectiveness.

- *Territorial Ordainment (O.T)*

The objective is to elaborate a physical organizational diagnosis to count on with ecologic units and to determine the zones with higher productive economic potential.

In the territorial ordainment, Economic Ecological Zoning (EEZ) is a basic instrument that allows the area arrangement of relatively uniform units, characterized by physical, biotic and socio-economic factors and evaluated in relation to the potential and tolerance to man's intervention.

It is expected that the present study validate the crops proposed for the irrigation works, proposing better alternatives of agricultural production and so making the use of water resource more efficient. Besides, it will allow a correct location of works to improve infiltration of the reception watershed. Among the advantages are: a) Propose actions to allow the use of the EEZ as technical and scientific basis for Territorial and Environmental Ordainment, oriented toward the national sustainable

development; b) Reinforce the inter-sector coordination in the process of elaboration and consolidation of a national policy of environment, according to Article 67 of the Political Constitution of Peru,; c) Elaboration of short and long term objectives for the implementation of the strategy; d) Propose actions or activities for the implementation of the Strategy; and , e) Propose an organizational structure for the management of activities

- *Inventory and Planning of Water Resources*

It aims to provide information of water balance of the microwatershed and to propose the development of actions to keep the balance.

The said activity includes the set of actors present at the microwatershed through collective compromise, coordination and planning. It evaluates water quantity and quality, users, uses and conflicts, present and potency. It is a tool for planning and the ordained and efficient use of water that has as result the elaboration of a management plan of water resources at the microwatershed, supported by a committee of microwatershed management; to preserve and rationalize the use of water offer, as well as to build a data base of water resources, demands, present and potential use.

- Focused Silvopastoral diagnosis.

The objective proposed is to count on with information of forestry potential and native pasture with purpose of rain water infiltration and livestock production. This study allows to know the main species of natural pasture, tasty and non tasty specie, bearing (quantity of animals by area unit that this pasture area can endure), level of over pasture, situation of the meadows (vegetation that retains much water and it is a species that is the natural pasture for alpacas) indicating the potential of green forage to produce and the type of animal to raise. The same tools of the agro-ecologic study are used.

This activity applies the method of participatory planning and consists of making an inventory of forestry specie, mainly native specie, areas to be reforested and proper for pasture, obtaining as result, a forest and silvopastoral action plan, with areas to be reforested (reforested as clumps or woods or for the installation of silvopastoral), with native or exotic pasture, the proper associations for a livestock activity and the plan of meadows management.

(2) Organizational Strengthening of the Institutional Development Agents

The issue of citizenship participation and the strengthening of social organizations are more important today given the opportunities provided with the decentralization, transparency and transfer of competences toward the local level of governments.

Strengthening considers a process of transfer of knowledge, in order to provide the above mentioned organizations with a capacity of self-sufficiency to conduct the process of strategic development, mainly the micro-watershed management, focusing on activities related with the improvement of the water reload zones, being also part of this concept, the generation of conditions to achieve the success of their objectives and goals, the existential continuity and the assurance of growth and development.

1) Events of awareness raising and motivation to the Farmers Communities.

The said events are to take place during the two General Ordinary Assemblies that usually occur during a year (two educational sessions). The following issues will be considered:

- Environmental problems, especially water (30 minutes).
- Importance of natural resources conservation, mainly water, to filtrate rainwater in the microwatershed head (30 minutes).
- Ends, objectives and role of the Microwatershed Management Committees in the development of the same (30 minutes).
- Exchange of opinions and question and answer (30 minutes).

The equipment and material to be used consist of multimedia or data exposition (when possible), paper sheets and marker pen. The activity will be reinforced through radio spots about environment problems and the importance to conserve it, stressing the water issue (every day, during the year).

2) Events of training about microwatersheds management and administration.

The different events of training to be conducted are related to the objective of conforming operative Committees of Irrigation and of Microwatersheds management with capacity to be efficiently administered, capable of conducting an efficient management of microwatersheds and a proper management of the microwatershed reload zones where the irrigation projects are to be executed. The said training consists of:

- Educational sessions (seminars).
- Workshops.
- Training courses.
- Visits to successful experiences
- Field days.

(a) Educational sessions (seminars).

Educational session is a technique used for the education of adults. It promotes the analysis, the dialogue and the reflection about a determined issue. For the preparation it has to be taken into account:

- Title of the session.
- Course/Module.
- Description of the issue.
- Objectives.
- Material.
- Duration time.

In this type of event the following stages are developed:

1. *Preparation*: In this stage, previous to the same session, it corresponds the preparation of issues, material to be used, local for the meeting, invitation to the participants and in general, to assure a good number of participants.
2. *Start of session*: Introduction of the facilitator, who salutes the audience and organizes dynamics of presentation to break the ice, so the participants know each other better and consolidate the integration.
3. *Development of the session:* In this stage new knowledge is transmitted, but at the same time knowledge from the participants is provided, preferably with the use of visual aids (video projection, photos or drawings). Descriptive questions such as: "What do you see in this drawing, graphic or projection?"; then, analytical questions are made such as: "What this drawing, graphic or projection means to you?" and finally the questions of projection, for example: "How do you place yourself in this drawing, graphic or projection?" The order of the different type of questions has to be respected by the facilitators.
4. *Evaluation:* It is the moment to assure that the messages are clear to the participants, if they have understood as we thought. For that, dynamics should be employed (can be games).
5. *Commitment:* All learning has to generate a change of behavior and the adoption of healthy practices to improve the lives of the people. It is the moment for the participants to assume commitments in relation to the developed issue, in order to put them into practice and disseminate what they have learned.
6. *Closure:* A summary of the issue is made, the next issue is announced and the date for the next session is fixed together with the participants.

(b) Workshops

Workshops are a mean of teaching and study characterized by the integration of theory and practice and the team work that, in the external aspect, means the recollection, irrigation systematization and the use of specialized material in accordance to the issue for the elaboration of a tangible product.

Many times, it is developed together with the course and it takes the name of workshop-course, usually at events of relatively large duration, for example five to seven days. During the Committees

strengthening it will be used in the participatory diagnosis and planning, limits of the microwatershed and in the whole process of studies for the collecting area management.

(c) Training courses.

In this case, training courses will have the objective of training to the person to perform a specific activity, such as organization, management and administration of watersheds and microwatersheds and about conservation techniques and water management at the collecting watershed. Courses to be conducted are to be structured in three modules:

- Organization of Committees,
- Management and administration of watersheds and microwatersheds
- Conservation practices of soil and water (especially collecting watersheds)

The courses about "Microwatersheds Management and Administration" are directed to strengthen the capacities of the Committees of Irrigation and Committees of Management, besides other actors integrating said Committees will participate, mainly the Farmers' Communities. It will have a maximum duration of three days. It is to be designed in three modules, one module per month.

The issues proposed for the module about organization, are the following:

- Aspects of organization, leadership and gender.
- General principles of administration.
- Organization inside the administration.
- Organization Table and Manual of Organization and Functions (MOF)
- General principles of negotiation.
- Solution of conflicts.
- Leader and leadership.
- Internal regulations and Statute.

Practice: Redacting the MOF and the Statute.

The proposed issues for the module of Microwatersheds management and administration are the following:

- Legal framework about watershed management.
- Practices to improve water reload at the microwatershed.
- Problem of soil and water conservation.
- Main practices of soil and water conservation.
- Construction of infiltration ditches for forest installations, silvopastoral and native and exotic pasture systems.
- Dissemination and forest planting especially native species.
- Installation of green houses-seed houses of forest species and native pasture.
- Management of natural pasture areas.
- Management of meadows.
- Field practices of the theory.

Issues proposed for the module of soil and water conservation are the following:

- Problem of soil conservation.
- Construction and use of practical elements for leveling
- Mechanical and structural practices of soil conservation.
- Agronomic practices for soil conservation.
- Basic principles of dissemination and reforestation.
- Agro forestry systems / pastures
- Practice of infiltration ditches construction.
- Practice of dike construction for gully control.
- General principles of meadow management and natural pasture.

(d) Visits for experience exchange

Exchange of experiences among farmers is a method that serves to copy a successful example from

other organized groups, considering the contextual differences that could occur. These visits are very valuable for the change in attitude and aptitude of the population, so they objectively see the advantages of being organized and to count on with a committee; the advantages and importance to build the practices for water infiltration; etc.

It is proposed to carry out visits to successful Committees, Commissions or Board of Users, for example the Commission of Irrigation Users of Madrigal and San Lorenzo in Piura or the Project of Majes in Arequipa. To exchange ideas and experiences about microwatershed administration and management, the microwatershed of Porcón in Cajamarca or the Muyllo-Mullucro in Tarma/Junín should be visited.

(e) Field Days.

These events are carried out mainly to show and socialize the results of an activity, such as a participatory investigation or an investigation conducted at a university or research institutes; or else some successful experience of farmers. If it is conducted with this purpose, it is done through "work stations" previously prepared by specific issues in charge of an expert.

It also can be used as a day for practical demonstration of "how to do" the activity to be taught. For example, the construction of an infiltration ditch, how to plant a tree, or how to prepare compost, etc. The development of a field day should be as follows:

- Grouping and displacement of participants to the meeting point or training site
- Registration and delivery of material to the participants.
- Displacement to the stations, group by group to see each station.

  For example:

- Visit station I
- Visit station II
- Visit station III
- Etc.

3) Technical assistance for organizational strengthening.

This service is to be conducted through consultant services only for the Committees of Irrigation and Microwatershed Management, for two specific and specialized issues, such as, Organization and Planning; whose administration will be in charge of an expert.

Organization: Implementation will be through events of training (educational sessions, workshops and/or training courses). Issues to be developed are the following:

- General principles of rural administration.
- Organization as an important part of administration.
- Organization Table and the Manual of Organization and Functions.
- Organization of the Committee of Irrigation (duties and rights of users, internal regulation, quotas, tariffs).
- Organization of the Committee for Microwatershed Management (duties and rights of integrants, internal regulation, quotas).
- Handling of management tools (accounting book, steps for a successful general assembly, writing minutes of sessions, register of users).
- Regulation and norms about water.
- Workshops for the practical application of the theory about the Manual of Organization and Functions and the Internal Regulation.

The expected results for module of organization are:

a. For the Committee of Irrigation:

   - Direction Board organized and in operation (President, Vice-president, Treasurer, Secretary, Members and a Fiscal)
   - Structure defined through an organization Table.

- Manual of organization and functions (MOF).
- Internal regulation in writing and socialized.
- Organization is part of the structure of communal board of direction as a specialized committee (when Farmers Communities are existent).
- Member of the Committee of Microwatershed Management.
- Registered as participant Agent in the Local Government, to participate in the participatory budget.
- Registered in the Local Water Administration (ALA).
- Registered and associated to a Commission or Board of Users.

b. For the Committee of microwatershed management:

- Board of Directors organized and in operation.
- Structure defined through an organization Table.
- Manual of organization and functions.
- Internal regulation /or Statute in writing and socialized
- Registered at the Public Register as legal entity.
- Registered in the Local and/or Regional Government as Participant Agent to participate in the participatory budget processes
- Registered in the International Technical Cooperation.

Planning. The planning module consists of the following:

- Planning in the administrative system and its importance
- Type of planning at the planning period: Strategic planning, tactics and operation
- Concept of Monitoring and Evaluation
- National System of Public Investment, SNIP and the projects of public investment under the said scheme
- Process of Participatory Budget
- Practical Application: Workshop about strategic planning
- Practical Application: Workshop about formulation of an action plan
- Practical Application: Workshop about formulation of a monitoring and evaluation system

Expected results with the planning module are the following:

a. For the Committee of Irrigation

- A Strategic Plan of Development.
- An Action plan for this year.
- System of Monitoring and Evaluation designed.

b. For the Committee of microwatershed management:

- A Strategic Plan of Development
- An annual Action plan.
- System of Monitoring and Evaluation designed.
- List of Projects, at level of technical records, in all related to infrastructure of irrigation (construction and improvement of canals, reservoirs, dams, etc.), pressurized systems of irrigation and organizational strengthening of the Committee as well as the Committees of Irrigation and other institutions integrating the Committee.
- Besides, technical records formulated with projects for water reload in the watershed of reception of the microwatershed of its competence.

The intangible results, at level of attitudes expected to be achieved by the Committees of Irrigation and Micro-watersheds management, product of the different events of training and technical assistance, are the following:

- Reliability and institutional image, users feel greater closeness and credibility in

their Committees and Board of Users.

- Solution to administrative problems referred to water and fulfillment of integral rules in the commissions and Committees of Irrigation users as well as in the Committee of Micro-watershed committees.
- Users are more interested in putting into practice the irrigation system of planting and irrigation in ditches along contours and use more and more practices of soil and water conservation.
- Users agree in the assemblies to make a re-distribution in the proper roles to improve efficiency of irrigation water distribution.
- Users have started to request training to the Board of Users and to the Committee of Micro-watershed management in issues of use, management and distribution of water at lot level, as well as water conservation in the watershed head.
- Commissions and Committees of Irrigation have started to value the record of water users and request a quick update to each one of the organizations, with the purpose of assuring water management according to users legally registered in the records.
- Committees of Irrigation and Committee of Micro-watershed Management, interested in counting on with Statutes and/or Internal Regulations and to become legal entities (with the purpose of making agreements with Public and Private institutions)
- Greater answer from the personnel of the Board of Users and the Committee of Microwatershed Management to the demands of irrigation committees to be attended immediately.
- Commissions, Committee of Irrigation and Committee of Micro-watershed Management as well as individual users show interest to promote and adapt the pressurized technical irrigation.
- Users are getting conscious about the importance to conserve water and soil, also are interested in properly manage the zones of water reload of the micro watershed.
- Greater awareness and contribution to the development of organic or ecological agriculture: they try to care about water quality, care about the infrastructure and water sources, it could be said that there is more environmental awareness in relation to water.
- Greater quantity of Commissions and Committees of Irrigation decide to make a Cultivation and Irrigation Plan (PCR).
- More credibility of the State Programs about the project that the Committee of Microwatershed Management is implementing with the Program of Productive Rural Agriculture Development (AGRO RURAL).

No kind of technical assistance for activities concerning collecting watershed management practices are planned for it is assumed that with the different events of training, they are sufficiently prepared.

4) Formalization of the Committees of Irrigation

During the training activities and technical assistance to the Committees of Irrigation, the ideas to improve the organization and legalization are drafted; the process is fulfilled through:

- Consolidation of Board of Directors (completing, reelecting or renewing them) with the following posts: President, Vice-President, Secretary, Treasurer, Members (usually have the function of water “deliverers”) and a Fiscal.
- Elaboration of the Internal Regulation (where the duties and rights of irrigation users as well as the functions of the different integrants of the Direction Board, among other important aspects are defined).
- Register in the Local Administration of Water, ALA (ex Technical Administration of the Irrigation District, ATDR).

Also during the process, the idea that all Committees of Irrigation are grouped in one Commission of Irrigators, organization acknowledged by the Law of Water Resources, who also is to be formalized in the Local Water Administration has to be reinforced. The Direction Board of the Commission is to be

composed by representatives of the distinct Committees of Irrigation. For its operation, the support of Local and Regional Governments are to be requested and the Committees of Irrigation will financially contribute with a percentage of their contribution.

5) Formation Committees of Micro-watershed Management

The participation of civil society in decision making about expenses of the State has been developed in the last seven years with very good results, so it is necessary to count on with representative organizations of the watershed to promote actions of management and administration in more important area such as the negotiating tables and participatory budget. With this purpose, the incorporation of actors of the civil society in a larger area named Committee of the Micro-watershed Management is proposed to formalize the actions and to count on with legitimacy and legality.

The Committee of Microwatershed Management is a social organization without profit purposes regulated by the basic principles of solidarity, equality and reciprocity among all communities, actors and sectors integrating the microwatershed. It is a democratic instance for exposition and discussion of ideas from which future decisions about the microwatershed are taken, free elections of directors are held, they are legally acknowledged and design strategies of works based on the participation of communities of the area.

The formation of the Committee of Microwatershed Management consists of the following steps:

(a) Identification of the social actors

In order to obtain full participation of the population, the three levels of organization and the existing social relationship among them have to be identified:

- Family, cell of the society and communal organizations
- Community, a set of families occupying a geographic area defined by the microwatershed; and
- Communities, or inter-communities, that are the relationship among the communities of the microwatershed.

Besides the different grass root organizations that can be conformed by adults and youths (men, women and mixed) that look for specific economic, social and cultural objectives, as well as public and private institutions, local and external.

(b) Awareness raising

The process of microwatershed management should start with the dissemination of the proposal and the dialogue with all social actors of the microwatershed: families of the Farmers' communities and producers, to whom the management proposal at microwatershed level, its importance and the relation with the farmers' communities and other grass root organizations should be explained.

Later, different events will be developed in the microwatershed to analyze – as a whole- the problems and potentials of the microwatershed. A detailed analysis will be conducted about the institutional problems of the communitarian organizations together with the community leaders, with whom the alternatives of solution will be discussed.

Simultaneously, a wide dissemination of the microwatershed management proposal and the importance of inter-institutional agreement and strategic alliances will be conducted, in order to reach integral proposals to maximize the scarce resources, avoiding duplicity of efforts.

The active participation of universities, investigation institutes, municipalities present in the microwatershed is expected; inter-institutional agreements are to be subscribed with them in order to jointly support the management proposal. Later, the Development Plan and the work plan are to be formulated with them for joint actions.

(c) Participation and inter-institutional agreements

The participation and agreement with all external and internal organizations are important; with them the strategic planning will be conducted in order to carry out the microwatershed integral management. From the beginning, the organized participation of the population and external institutions are to be

reinforced for the formulation of the strategic plans, being the fundamental basis of the entire management process, the reinforcement of the social actors organizations present in the microwatershed area with whom the Committee of the Microwatershed Management is to be conformed.

(d) Participatory diagnosis

The process of management should start with a process of planning, being the first step a participatory diagnosis, including inventory and evaluation of natural resources to define the environmental offer, the problems and potential of the same, being in this stage fundamental the active participation of the population in the identification of critical problems that influence the territorial ordainment.

Different methodologies can be employed for the elaboration of the diagnosis, being one of them the quick rural survey, to identify the causes and effects of the problems in the management of the main natural resources identified, influencing in the vulnerability and potential of the same.

The information obtained in this stage allows knowing the reality of the communal organizations of the microwatershed, their needs, potential and limitations, productive and institutional human resources. With this tool it is possible to mobilize the population and organizations to achieve an integral and sustained development; and also to count on with quick development plans, so they can better organize and manage the resources for the execution.

At the same time the studies proposed in the Program can be conducted: Territorial Ordainment, O.T., Inventory and Planning of Water Resources, IPRH and the Focused Silvopastoral Diagnosis DESP. We expect that the said studies show what is evident, that water, soil and vegetation are differentiated at the high, medium and low zones of the microwatershed.

High zones that offer water resources, has more degraded resources due to the topography they have, developing production of subsistence agriculture temporarily, because they depend on the rain.

These conditions influence the over exploitation of soil and vegetation resources, reducing water infiltration as product of less vegetal cover, causing erosion and reducing the flow of water sources in the microwatershed.

Finally, and as alternative, other methods of planning could be used, for example, Strategic Planning that is used in the first part of this diagnosis, the SWOT method: Analysis of the internal (Strengths and Weakness) as the external (Opportunities and Threats) context at the microwatershed. On the other hand, at community's level, the already validated and improved method of Participatory Planning in the PRONAMACHCS (Pcubo): the Global Participatory Diagnosis (D.G.P.).

(e) Participatory Planning

This process starts with the communitarian participatory planning to confirm or discharge the findings of the quick survey in relation to the problems, causes and effects of water, soil and vegetation resources. The information is extended to the identification of the main social actors actuating in the microwatershed area; and it is required the participation of leaders and representatives of population centers (villages), municipal authorities, representatives of the health, education and agriculture sectors as also public and private institutions that actuate in the microwatershed.

This stage should end with the formulation of the Microwatershed Development Participatory and Agreed Strategic Development Plan, in function to the District or Province Participatory and Agreed Strategic Development Plan–according to the location of the Microwatershed- with the purpose of strengthening the participation of the population in the elaboration of development plans under a perspective of Integral Management of the Microwatershed in a consented manner.

Finally, the strategic objectives, the lines of action with the respective ideas of the project, the schedule of implementation and formulation of the Management Committee action plan are defined, and at the end of the process, the following question, as a motivator purpose to start the formation or consolidation (if existing), is made: Who is going to implement or execute this strategic and action plan? Here the idea of the formation or consolidation of the Committee is generated.

(f) Induced Organizations.

There are induced organizations conformed to carry out typical tasks of some institution during the intervention in the microwatershed; it is the case of Conservation Committees, Committees of Works, etc., and many of them still exist. Other like APAFAS (Association of School Children Parents), Vaso de leche (Milk distribution program), Club de Madres (Mothers club), Committee of drinkable water, Committee of Irrigation, Committee of light power, Children's soup kitchen, Mayors of small villages, etc., work isolated, without coordination among them or the community and/or the municipality, so they are weak and have little power of decision making, so they should be invited to integrate the Management Committee.

(g) Conformation of the Microwatershed Management Committee

The Microwatershed Management Committee is an organization that promotes and aims the integral development of communities and villages of the Microwatershed; so it should be composed by all representatives of the previously mentioned social organizations. The external organizations and institutions present in the microwatershed area perform the role of external advisors and facilitators of works that correspond to be developed as institution and to perform the corresponding follow up of activities of their concern, in the process of integral management of the microwatershed.

In order to reinforce the Microwatershed Management Committee in their organization, it is proposed that the Committees of Irrigation play a major role since the aware raising process up to the formulation of the Strategic Plan of the Microwatershed Development and finally, the Direction Board should have one representative in the Committee, even though during the election of the Direction Board this person occupies some other direction post. Besides, in order to provide sustainability and good functioning, representatives of local Governments and NGOs with presence in the microwatershed should be included, for their initial logistic and financial support for the management development, starting with the legalization at the local Government and start the execution of the Strategic Plan.

The organization structure of the Microwatershed Management Committee should be conformed as follows:

- President.
- Secretary.
- Treasurer.
- Fiscal.
- Engineer as Required
- Representatives of the Committees of Irrigation.

Among the main functions of the Committee, there are the following:

- Promote the integral development of the Farmers' Communities and human settlements of the microwatershed.
- Represent the organizations integrating the Committee in the different official events in the Microwatershed and outside it.
- Formulate the Plan of Strategic and Participatory Development of the Microwatershed, with the advisement of the external organizations.
- Formulate the Operation Plans with the respective investment projects, in accordance to the Strategic Plan with advisement of the external organizations.
- Participate in the Dialogue and Work Tables installed in the Microwatershed or at province and region level.
- Participate in the process of Participatory Budget at District, Province and Region levels.
- Sign agreements with the different public and private institutions.
- Promote the permanent organizational strengthening both organizations and families, through integral training.

Expert personnel are in charge of Organization and Planning it has to be conducted according to the proposed technical assistance.

6) Formalization of the Microwatershed Management Committees

This process has two stages:

- First, acknowledgment or public document of the Microwatershed Management Committees, before a Public Notary, this process takes approximately five days, and
- Second, acknowledgment as legal entity, at the office of National Superintendence of Public Register (SUNARP). It is made once the procedure with the Public Notary concludes, it takes approximately 15 days.

Requirements for both registers are the following:

(a) Register at the Public Notary for Public Document

- Book of minutes legalized, containing the MINUTES OF CONSTITUTION AND APPROVAL OF THE STATUTES by the general assembly, as well as the assignment of faculties to the persons to perform the procedures of legalization and constitution (two as minimum and three as maximum).
- List of members.
- Payment of the right of legalization of the minute, signed by a lawyer (Non profit institution, recently charged 45 nuevos soles).
- Payment of the right of Public Document at the Notary, who will provide double copies (recently the amount of 238.00 nuevos soles was paid).

(b) Registration as legal entity at the SUNARP

- Payment for right of procedure annexing a double copy of the Public Document and a diskette of the document (recently S/ 52.00 was paid).
- Copy of the DNI of the persons responsible for the procedures.
- Fill in the Single Form of Procedure FUT.

Up to now, there is the legal formalization, but it can also be formalized at the Regional Government. With the Public Documents, register in Public Register and the Operation Plan of the Microwatershed Management Committees, the register at the Regional Government is requested.

(3) Cost Estimation of the Institutional Strengthening for the Watersheds Management

Cost estimation for the elaboration of studies for the management of the microwatershed collecting area has been conducted, as well as for the organizational strengthening of the Farmers' Communities and the Committees of Irrigation and the Microwatershed Management.

Cost for the collecting watershed management with water reload purposes has not been considered because it is competence of the National Authority of Water (ANA) and the Watershed Council; besides the Regional and Local Governments (as integrants of the National System of Water Resources Management), according to Law No. 29338, Law of Water Resources. Also, it could be said that it is competence of the Program of Productive Rural Agriculture Development (AGRO RURAL), because in its organization structure at the Direction of Rural Services there is a sub-direction in charge of this issue.

Institutional strengthening costs are estimated by micro-watershed by micro-watershed. The Program has 56 projects, however, as some of them are located in the same micro-watershed; the scope of the Program is reduced to 50 micro-watersheds.

1) Cost of studies for the management of the collecting area of the micro-watershed

(a) Territorial Ordainment (O.T.)

This study is conducted by specialized consulting companies. An average cost per microwatershed of S/. 100,000.00, is estimated, considering that AGRO RURAL is going to support in the call of actors of the microwatershed and, some times providing vehicles and technical personnel; and, besides, the

conduction of the inventory and planning of water resources study and the focused silvopastoral Diagnosis, reduces the cost of Territorial Ordainment study as a whole, because a lot of information in both studies are part of this one.

For this study, satellite images and aerial photos and the respective analysis are to be conducted. The cost of a satellite image is $ 1,000 / km2 (one thousand dollars per square kilometer); the average area of the microwatersheds of the Study is 100 km2., but only images for the critical areas are going to be used, assuming that they are around 20 ha, the cost of said material is estimated at S./ 60,000, to be covered by the Program.

The studies are to be conducted progressively in three years; it starts at the first year with 20 microwatersheds, the second for other 20 and at the third the remaining 26 will be covered.

(b) Inventory and Planning of Water Resources (I.P.R.H.)

This study is to be conducted by an expert simultaneously with the Territorial Ordainment. The unit cost per study is S/. 7,500 (amount formerly paid by ex – PRONAMACHCS for these studies).

(c) Focused silvopastoral Diagnosis (D.E.S.P)

This study is to be conducted by an expert in facilitating participatory planning workshops and preferably at the agricultural sciences field. Unit cost is estimated at S/. 5,000. The quantity and period of time is similar to the previous two, as they are complementary.

Table Nº 3.4-49 Cost estimate for the elaboration of studies for the management of the microwatershed collecting area

Studies	Unit Cost .	No. of Micro-watersheds	Total Cost
Watershed Diagnosis Study	S/. 76,620	50	S/. 3,831,000
Inventory and Planning of Water Resources (I.P.R.H.)	S/. 7,500	50	S/.375,000
Focused Silvopastoral Diagnosis (D.E.S.P)	S/. 5,00	50	S/. 250,000
Total Cost	S/. 89,120		S/. 4,456,000

2) Cost of the Organizational Strengthening of the Traditional Community and the Committees of Irrigation and Micro-watershed Management

In order to estimate costs of organizational strengthening, activities are grouped in two actions:

- Training and dissemination; and
- Technical assistance.

Both are to be financed by the Program and are to be executed during the first two years. It is assumed that Training in the following years are to be financed by the local and/or regional Governments as well as by AGRO RURAL or other institutions of development present in the microwatershed; in the case of technical assistance, if necessary, it will also be financed by the before mentioned Institutions.

(a) Training and Diffusion

By effects of cost, this item considers the costs of the training events about technical and organizational aspects as well as the cost of materials for training and diffusion.

- *Events of training about technical aspects*

The expenses of training events are considered by year and by microwatershed, directed to the Traditional Communities and the Committees of Irrigation and Microwatershed Management. They are: educational sessions (26, at S/. 500.00 each), workshops (12, at S/. 1,000.00 each); courses (12, at S/. 3,500.00 each); visits for exchange of experiences (3, at S/. 5,000.00 each) and field days (24, at S/. 1,000.00).

It is assumed that Facilitators are to be the experts and professionals of AGRO RURAL or other institution that accompany them in their development (Local and/or Regional Governments or NGOs), so it is not included in the costs.

Besides, the indicated costs for each event consider only expenses in stationary and educational material, some training material and eventually, refreshments, local transportation and lodgings –mainly for the courses, for they are not included in the other events. Other expenses such as rental of local or some multimedia equipment is to be the contribution of the development promoting institution or the same participants.

- *Training events about organizational aspects*

It considers the expenses with activities of the two most important organizations of the microwatershed administration and management: the Committees of Irrigation and Micro-watershed Management. It includes the execution of the following activities of consolidation: Formalization of the Committees of Irrigation (76, at S/. 1,000.00 each), Formation of Micro-watersheds Management Committees (only 62, because 4 are already conformed, at S/ 2,500.00 each); and the Formalization of the same 66, at S/. 4,500.00 each). Said costs are in function to the support formerly provided by ex – PRONAMACHCS to the Microwatershed Management Committees but not so to the Committees of Irrigation.

It is to be executed in 2 years; in the case of the Committees of Irrigation formalization, 38 each year; Microwatershed Management Committees formation, 31 each year; Microwatershed Management Committees formalization, 33 each year.

- *Materials for training and events of dissemination.*

Considering the importance of this item, every efforts will be made to edit training materials to motivate reading by the target-group members and to so they acquire the habit of reading; besides, the diffusion of training events as well as the different activities will be through the radio and the local and/or microwatershed press (through press releases).

It should be indicated that only printing expenses are considered but not copyrights of authors, for it is assumed that it will be redacted by technicians and professionals of AGRO RURAL or other institutions that accompany the development of the Farmers' Communities, Committee of Irrigation and the Microwatershed Management Committees. The training material is the following: Triptych (5 thousand, at S/. 250.00 each unit); Informative Bulletins (5 thousand, at S/. 300.00 each unit); Training guides (3 thousand, at S/. 12,000 each unit); Manuals of training (3 thousand, at S/. 15,000.00 each unit).

The diffusion is to be by radio (radio spots with several contents, every day at S/. 10.00 each day) and through press releases (1 per month for each target-group, totaling 36, at S/ 500.00 each).

Table Nº 3.4-50 Costs of Training and Diffusion

a. Events of Training about technical aspects	Target Group				
	Farmers' Community	Committee of Irrigation	Subtotal of Events	Unit Cost	Total Cost/ Year/ microwatershed
Educational Sessions (Awareness raising/Motivation)	2	12	14	S/. 500.00	7000
Workshops	0	6	6	S/. 1,000.00	6000
Courses	0	6	6	S/. 3,500.00	21000
Exchange visits of experiences	1	1	2	S/. 5,000.00	10000
Field days	0	12	12	S/. 1,000.00	12000
Total Cost	**3**	**37**	**40**	**S/. 11,000.00**	**S/. 56,000.00**
b. Events of Training about organization aspects	No. de Comité			Costo Unitario del Proceso	Costo Total del proceso
Formation of Committee of Microwatershed Management	1			2500	S/. 2,500.00
Formalization of Committees of Microwatershed Management	1			4500	S/. 4,500.00
Total Cost					**S/. 7,000.00**
c. Material of training and events of dissemination	Target Group				

	Farmers community	Committee of Microwatershed Management	Subtotal	Unit Cost	Total Cost/ Year/ microwatershed

Training					
Triptychs (thousand)	0.5	3	3.5	S/. 250.00	S/. 875.00
Informative Bulletin (thousand)	0.5	3	3.5	S/. 300.00	S/. 1,050.00
Training Guides (thousand)	0.5	1.5	2	S/. 12,000.00	S/. 24,000.00
Training Manual (thousand)	0.5	1.5	2	S/. 15,000.00	S/. 30,000.00
Diffusion					
By Radio – radio spots (every day)	40	200	240	S/. 10.00	S/. 2,400.00
Press release (monthly)	6	18	24	S/. 500.00	S/. 12,000.00
Total Cost					**S/. 70,325.00**

(b) Technical Assistance.

Costs of technical assistance are needed for only two specific and specialized issues: Organizational Strengthening of the Committees of Irrigation and the Microwatersheds Management in Organization and Planning, very important issues that have to do with the launching or re-launching of an efficient management.

- *Aspects of organization*

An expert consultant in Rural Organization specialized in Committees of Irrigation and Committees of Microwatershed Organization will be hired. He/she will organize the two Committees in everything related to organization, as detailed in the previous chapter (Technical assistance for organizational strengthening). Payment will be only once by S/.15,000.00 for each service: Committees of Irrigation, 38 in the first year and 38 in the second; and for the Committees of Microwatershed Organization, 33 in the first year and 33 in the second year. Referential costs have been taken from the guidelines used by ex – PRONAMACHCS to formulate the Annual Work Plans.

- *In aspects of planning*

In a similar way, a specialized consultant in Participatory Planning, especially Committees of Irrigation and Committees of Microwatershed Organization will be hired.

Technical Assistance Events	Farmers community	Committee of Microwatershed Management	**Years**	**Unit Cost**	**Ttal cost of Watershed**
Workshop for Water Management and Preservation		1	3	S/. 11,045.00	S/. 33,135.00
Workshop for Planing, Evaluation and Monitaring of Watershed		1	3.00	S/. 23,000.00	S/. 69,000.00
sub-Total Cost					**S/. 102,135.00**

Source: Procesado por Equipo del Estudio JICA

c) Administrative Expense

Administrative Expense for the Component C will be asignated for the supervision, monitaring and post evaluation of executed project.

Cost for Administrative Events	Unit Cost	Total cost of Watershed
Administrative Expense for the Implementation of the Component C	1,054,000	1,054.000

Source; JICA Study Team

3.4.5 Program Alternatives

For the Implementation of the Program, folowing Alterivates are proposed;

Alternative 1

This Alternatives has been considered to irrigate 38,732 ha, consisting that 37, 612 ha with gravity irrigation system and the tecnical iirigation syste of 1120 ha with pressurized headwater, to benefit at 24,849 families through the following components: Irrigation Infrastructure, Tecnical Irrigation and Institutional Strenthning for the Water Resources Management in 50 Micro watershed for the 56 identified projects.

Alternative 2

In this alternative, it is considered to irrigate 38,720 ha under gravity irrigation system, to benefit at 24,849 families, consisting the following components: Irrigation Infrastructure and Institutional strenthening for the Management of the water resources at 50 Micro Wateshed, atending to 56 identified projects.

The contents of the Program for each alternative, are the following;

Table 3.4-51 Content of the Program

	Item		Alternative 1	Alternative 2
A	Conglomerate "Irrigation Infrastructure"			
	Type 1: Subprojects (more than 10 million) only Canal	Subprojects	2	2
	Type 2-A: Subprojects (between 6 to 10 million) only Canal	Subprojects	1	1
	Type 2-B: Subprojects (between 6 to 10 million) Canal and Dam	Subprojects	2	2
	Type 3-A: Subprojects (between 3 to 6 million) only Canal	Subprojects	10	10
	Type 3-B: Subprojects (between 3 to 6 millions) Canal and Dam	Subprojects	5	5
	Type 4-A: Subprojects (between 1.2 to 3 million) only Canal	Subprojects	21	21
	Type 4-B: Subprojects (between 1.2 to 3 million) Canal and Dam	Subprojects	4	4
	Type 5: Subprojects (less than 1.2 million) only Canal	Subprojects	11	11
	Total	Subprojects	56	56
B	Conglomerate "Technical Irrigation"			
	Works of Technical Irrigation	Modules	56	-
	Training	Modules	56	-
C	Project "Institutional Strengthening for the Watershed Management"			
	Studies	Watershed	50	50
	Promotion of river basin committee	Watershed	50	50
	Total			
D	Management of the Program			
	Administration and national supervision	Unit	1	1
	Management of the Program (Service of Consultancy)	Unit	1	1
	Total Component D			
	TOTAL	Program	1	1

Note: Conglomerates A and B involve Technical Training

(1) Number of Subproject of the Alternative 1

Number of the Subproject of the Alternative 1 are;

Area of Benefit and Beneficiary Families of the Program

Category	Number of Subprojects	Surface (ha)			Beneficiary Families
		Improvement	Incorporation	Total	
Type 1	2	0	2,810	2,810	2,677
Type 2-A	1	0	1,066	1,066	719
Type 2-B	2	1,155	605	1,760	1,532
Type 3-A	10	3,434	4,821	8,255	5,951
Type 3-B	5	2,179	3,693	5,872	4,084
Type 4-A	21	8,699	5,002	13,701	5,169
Type 4-B	4	300	1,679	1,979	2,228
Type 5	11	2,336	953	3,289	2,489
Total	**56**	**18,103**	**20,629**	**38,732**	**24,849**

The list of the subprojects is the following;

No	Province	NAME OF PROJECT	LOCATION		SURFACE (HA)			Beneficiary Families
			Department	Province	Improv.	Incorp.	Total	
1	ANC-11	Construction Canal Cordillera Negra	Ancash	Huaraz		1,300	1,300	2,117
2	CAJ-1	Construction Canal of Irrigation El Rejo	Cajamarca	San Pablo		1,510	1,510	560
		Sub Total Type 1-A			0	2,810	2,810	2,677
1	ANC-5	Construction Canal of Irrigation Sol Naciente de San Luis	Ancash	Carlos Fermín Fitzcarrald		1,066	1,066	719
		Sub Total Type 2-A			0	1,066	1,066	719
1	AYA-1	Construction and Improvement of the Irrigation System Cangallo	Ayacucho	Cangallo	555	105	660	532
2	AYA-13	Const. Canal and Dam Tintayccocha-Acoro	Ayacucho	Huamanga	600	500	1,100	1,000
		Sub Total Type 2-B			1,155	605	1,760	1,532
1	AMA-2	Improv. of Irrig. System San Juan Marañón-La Papaya	Amazonas	Utcubamba	1,322	155	1,477	224
2	AMA-6	Improvement of the Irrigation System Naranjos - Canal El Tigre	Amazonas	Utcubamba	1,052	185	1,237	226
3	ANC-3	Construction Canal of Irrigation Casablanca- Jocosbamba – Quiches (Joquillo)	Ancash	Sihuas	100	463	563	660
4	ANC-4	Construction Canal Rupawasi - Rosamonte	Ancash	Sihuas		550	550	2,050
5	ANC-10	Const. Canal of Irrigation Aynin-Huasta	Ancash	Bolognesi	25	500	525	320
6	ANC-16	Const. Irrigation System Jatun Parco	Ancash	Bolognesi	40	585	625	280
7	ANC-17	Improvement Canal Chuayas-Huaycho	Ancash	Pomabamba	240	410	650	600
8	ANC-18	Improvement Chinguil - Cruzpampa	Ancash	Mariscal Luzuriaga	120	480	600	820
9	CAJ-2	Rehabilitation Canal El Huayo	Cajamarca	Cajabamba	535	893	1,428	321
10	CAJ-7	Irrigation Cochán Alto	Cajamarca	San Miguel		600	600	450
		Sub Total Type 3-A			3,434	4,821	8,255	5,951
1	AYA-5	Construction of Dam and Irrigation System Chaqllani-Pucapampa	Ayacucho	Fajardo	40	1,000	1,040	300
2	AYA-12	Const. Dam and Irrigation System Chito-Sachabamca y Quishuarcancha, Chiara	Ayacucho	Huamanga	500	1,500	2,000	2,000
3	JUNIN-3	Irrigation Cotosh II Etapa	Junín	Tarma	500	601	1,101	1,081
4	JUNIN-6	Construction of Irrigation System Rupasha - Vista Alegre	Junín	Huancayo	899	382	1,281	202
5	JUNIN-7	Improvement of the Irrigation System of the localities of Yauli and Jajapaqui	Junín	Jauja	240	210	450	501
		Sub Total Type 3-B			2,179	3,693	5,872	4,084
1	AMA-1	Improvement of Irrigation Syst. Higuerones-San Pedro	Amazonas	Utcubamba	577	202	779	132
2	AMA-3	Improvement Bocatoma and Canal Limonyacu Bajo	Amazonas	Bagua	403	112	515	132
3	AMA-4	Improvement of Irrigation System Utcuchillo - Canal Aventurero	Amazonas	Utcubamba	401	173	574	101
4	AMA-5	Improvement dIrrigation System Naranjitos - Canal Naranjitos Nº. 02	Amazonas	Utcubamba	514	40	554	97
5	AMA-9	Mej.Boc.Rev. Section Communal Canal Huarangopampa	Amazonas	Utcubamba	630	140	770	113
6	AMA-10	Improvement of Irrigation System Lumbay Balsas	Amazonas	Chachapoyas	240	110	350	350
7	AMA-11	Improvement of Irrigation System Naranjos - Canal Naranjos	Amazonas	Utcubamba	826	67	893	193
8	AMA-12	Improvement of Irrigation System El Pintor - Canal Abad.	Amazonas	Utcubamba	503	74	577	113
9	AMA-13	Improvement Canal San Roque Watson	Amazonas	Bagua	681	190	871	306
10	AMA-14	Improvement Canal Riego La Peca Baja - Canal Brujopata	Amazonas	Bagua	269	71	340	100
11	ANC-12	Improvement Canal Rurec	Ancash	Huaraz	250	550	800	180
12	AYA-6	Irrigation Papatapruna - Ccochalla	Ayacucho	Lucanas	50	445	495	90
13	AYA-9	Imporv. and Const. Irrigation System Putacca Ccatun Pampa	Ayacucho	Vilcashuaman	107	293	400	168
14	HUA-1	Construction Canal of Irrigation Caracocha	Huánuco	Huánuco	8	241	249	120
15	HUA-2	Construction Canal of Irrigation Sogoragra Rondobamba	Huánuco	Yarowilca	13	387	400	157
16	HUANCA-3	Irrigation Cusicancha-Huayacundo-Arma-Huaytará.	Huancavelica	Huaytará		240	240	76
17	JUNIN-1	Improvement Canal Achamayo	Junín	Concepción	1,520		1,520	1,306
18	LIB-1	Improvement of Canal Sute Pututе	La Libertad	Bolivar		529	529	250
19	LIB-4	Improv. Irrigation Canal Chuquillanqui-Shushipe	La Libertad	Gran Chimú	1,000		1,000	250
20	PIU-1	Irrigation Canal Espíndola	Piura	Ayabaca		500	500	150
21	PIU-5	Improvement Canal Chantaco Huaricanche	Piura	Huancabamba	707	638	1,345	785
		Sub Total Type 4-A			8,699	5,002	13,701	5,169
1	ANC-19	Irrigation System Mancan Aija	Ancash	Aija	0	540	540	418
2	AYA-2	Construction Irrigation System Ccocha-Huayllay	Ayacucho	Huamanga		439	439	550
3	JUNIN-2	Irrigation Aywin	Junín	Concepción		400	400	1,110
4	LIB-6	Dam Laguna Negra-Const Canal of Irrigation Chugay	La Libertad	Sanchez Carrión	300	300	600	150
		Sub Total Type 4-B			300	1,679	1,979	2,228
1	AMA-8	Improvement of Irrigation System Goncha Morerilla - Canal Gonchillo Bajo	Amazonas	Utcubamba	241	43	284	77
2	ANC-2	Improvement of Irrigation Canal Paron II	Ancash	Huaylas	400	110	510	350
3	ANC-6	Improvement and enlargement of Irrigation Canal Quishquipachan	Ancash	Carhuaz	250	0	250	160
4	ANC-9	Improvement of Irrigation Canal Quinta Toma	Ancash	Yungay	250	0	250	90
5	ANC-20	Canal of Irrigation Desembocadero – San Miguel	Ancash	Sihuas	120	0	120	162
6	CAJ-6	Construction Canal La Samana - Ushusqui	Cajamarca	Santa Cruz		400	400	309
7	JUNIN-4	Improvement canal Ranra Antabamba	Junín	Tarma	100		100	66
8	JUNIN-5	Improvement Canal Sector Atocsaico	Junín	Junin	200		200	616
9	JUNIN-9	Improvement Canal Mayuhuato - Huaracaya	Junín	Tarma	160		160	229
10	JUNIN-10	Canal of Irrigation Ninatambo	Junín	Tarma	115		115	80
11	PIU-2	Improvement Canal Sanguly	Piura	Ayabaca	500	400	900	350
		Sub Total Type 5-A			2,336	953	3,289	2,489

3.5 Cost of the Program

3.5.1 Definition of Premises for the Cost of the Program

The Program comprises (1) Direct Cost and (2) Administrative Cost. The Direct Cost is cost to be sub-contracted and Administrative Cost is the administrative cost of AGRORURAL to administer the Program.

(1) Basic Condition for the Program Cost Estimation

The cost estimation of the Program has been conducted from the following basic conditions:

a) Base Period, March 2009
b) Exchange rate of USD to Yen and Nuevo Sol (S./), are indicated below:
   1USD = 97.73 Yen (March, 2009)
   1USD = S./ 3.18 (March, 2009)
   1Nuevo Sol = 0.032 Yen (March, 2009)
c) The Base Cost of Construction established in number (2)
d) Incremental cost
e) IGV calculated at 19% applicable to all goods and services attributable to the Program
f) The Structure of Costs of the Program considers the following elements:
   - Basic cost for Infrastructure
   - Cost of Administration
   - Consulting Services
   - Contingencies
   - IGV
g) For Subprojects that have the Perfil already invest amount based on a source of reference, the same data will be used.
h) Base year for construction costs is 2009.

(2) Bases of the Program Cost estimation

The Program has four components:

Component A: Irrigation infrastructure
Component B: Technical irrigation
Component C: Institutional strengthening for Watershed management
Component D: Program Management

- Component A: Irrigation infrastructure includes improvement and construction of irrigation system: canals, reservoirs and other works to improve the efficiency in the use of water. Also, the preparation of Studies (Detailed Design), Environmental Management, Overhead Expenses and International Technical Assistance, Supervision, Training and Technical Assistance, Conformation of Irrigation Committees.
- Component B: Technical irrigation consists in the construction and installation of technical irrigation in 20 ha (modular), training, technical assistance, conformation of irrigation Committee and international technical assistance for each project of Component A. The system is oriented to increase crop productivity, save supply of water resources and to improve the use and distribution of irrigation water at level of lots.
- Component C: Institutional strengthening for Watershed management consists of establishing mechanisms of coordination between the Board of Irrigation Users, local governments and other social agents concerned to improvement of watershed management. The process proposes the conduction of economic ecological zoning

study, study of diagnosis, preparation of inventories and formulation of plans. Conformation and legalization of Micro-watershed Management Committees and International Technical Assistance.

- Component D: Program Management contains the actions and expenses of the administrative process for the Program implementation.

The contents of the Program in the following table classifies the activities by component; referring to irrigation infrastructure, subprojects of the Program are grouped considering the monetary point of view according to the investment amount and from the physical point of view, classifying sub projects with one construction (canal) and dual construction (canal and dam):

Table 3.5-1 Contents of the Program

	Item		Alternative 1	Alternative 2
A	Conglomerate "Irrigation infrastructure "			
	Type 1: Subprojects (more than 10 million)	Subprojects	2	2
	Type 2-A: Subprojects (from 6 to 10 million) only Canal	Subprojects	1	1
	Type 2-B: Subprojects (from 6 to 10 million) with Dam and canal	Subprojects	2	2
	Type 3-A: Subprojects (from 3 to 6 million) only Canal	Subprojects	10	10
	Type 3-B: Subprojects (from 3 to 6 million) with Dam and canal	Subprojects	5	5
	Type 4-A: Subproject (from 1.2 to 3 million) only Canal	Subprojects	21	21
	Type 4-B: Subproject (from 1.2 to 3 million) with Dam and canal	Subprojects	4	4
	Type 5: Subprojects (less than 1.2 million) only canal	Subprojects	11	11
	Total	Subprojects	56	56
B	Conglomerate "Technical irrigation "			
	Technical irrigation works	Modules	56	-
	Training	Modules	56	-
C	Project "Institutional strengthening for Watershed management" Total Component			
	Study	Micro-watersheds	50	50
	Promotion of the Watershed Committee	Micro-watersheds	50	50
	Total			
D	Program Management			
	Administration and National Supervision	Unit	1	1
	Program Management (Consulting Services)	Unit	1	1
	Total Component D			
	TOTAL	Program	1	1

Note: Conglomerates A and B include Technical Training

1) Cost Composition of Component A: Irrigation Infrastructure: As observed in the above table, projects are classified in five types according to the investment cost. Cost includes:

- Direct Cost
- General Expenses
- Profit
- Training
- Works Supervision
- Environmental Management
- Study
- IGV

The details of the cost concepts are the following:

(a) Direct Cost

Direct Cost includes the labor, material and equipment attributable to the works of irrigation

infrastructure that in the Program comprises works of irrigation infrastructure: intake, reservoir, conveyance, distribution and a set of culvert works directed to the efficiency of the irrigation system maintenance and operation, as well as to make maintenance easier.

Direct cost of labor is derived from the payments made by the contractor (outsourced) by concept of real wage to the personnel directly working in the execution of the irrigation infrastructure works.

Direct cost of material corresponds to the payment made by the contractor (outsourced) to acquire all material necessary for the proper execution of the irrigation infrastructure work, fulfilling the norms of quality and the technical specifications.

Direct cost of equipment and tools of construction is derived from the proper use of equipment and tools and necessary for the execution of the irrigation works, according to definitions in the norms of quality and the technical specifications.

(b) General Expenses

General costs of works are applied to 5% of the direct cost, considering the type of works to be executed. General expenses are the indirect costs linked with the administration of the irrigation infrastructure works execution and that do not intervene directly in the construction process, but serves as support or complement for the achievement of the goal or objectives and may be executed in the work site or another installations far from it, and are derived from the activity in itself. These expenses cannot be included in the works or direct costs items. General expenses can be fixed and variable. General variable expenses can include the cost of responsible person or administrator of the works, warehouseman, watchman and the technical assistant such as the work site resident, master builder, connected to the execution period. Fixed general expenses are financial, not connected to the execution period.

(c) Profit

When the work is outsourced, an estimate percentage of 3% to 5 % should be added to the direct cost, as well as the IGV. In the Program, the profit costs are estimated at 3-5% of the construction, considering the type of works to be executed. The Program will apply 5% over the direct cost as profit.

(d) Training Expenses

Expenses in training and technical assistance to users of the irrigation committee are referred as expenses in outsourced training events oriented to the use of operation and maintenance techniques, management and extension in technical irrigation by gravity. The said training costs are estimated at 5% of the direct cost considering the nature and type of works to be executed.

(e) Supervision

The Program has planned to assign 3% over the direct cost for the work supervision and culmination. In the minimal functions oriented to the supervision it is recommended to consider:

- Programming, Execution and Budget Control assigned for the supervision and culmination expenses according to the investment program.
- Consolidate the information of physical and financial progress of the Initial Opening Budget, etc.

(f) Environmental Management

It was obtained from the analysis of the submitted perfiles and by adding the costs of environmental mitigation. Due to the diversity of projects and formulators, they are not homogeneous. In cases where environmental cost were existent, it was maintained and in cases that they were not existent – for the SNIP perfil level the inclusion of environmental costs are not mandatory- an average weighted figure was assumed.

To achieve the considered figure, the average of the existing figures was obtained and according to the type and magnitude of the works, the corresponding amount has been inferred. In this Program 1% over the direct cost will be applied.

(g) Study

The Cost of the Study includes costs of Detailed Design and Environmental Study.

The Cost of the Detailed Design has been estimated at 2 to 4% of the direct cost of works. The said tool, which purpose is for ends of contracting public works, is to be in charge of AGRORURAL in quality of entity to call for tender and includes tender documents, technical description, drawings, technical specifications, bill of quantities, unit costs and budget, studies, (hydrologic, geologic, soils, environmental, etc., as corresponds) etc. for a contract.

The cost of the Environmental Study is calculated based on the Preliminary Environmental Evaluation submitted as annex in this Report, where subprojects are environmentally classified and the level of studies are assigned.

2) Cost Composition of Component B: Technical Irrigation

Direct cost of Technical Irrigation comprises installation and training:

(a) General Plan

The start of the general plan of component for technical irrigation is scheduled with the start of the Component A works: Irrigation Infrastructure. The commencement of works and installation of technical irrigation by sprinklers is planned according to the physical culmination (construction) or availability (improvement) of the canal, which implies a gap of approximately twelve months; besides it is required that the group of beneficiaries are registered, accepted the conditions of the competitive grant and count on with financial resources.

(b) Cost of the component technical irrigation

The cost of component B has been calculated assuming the execution through third party or contractors, modality that considers profits.

3) Cost Composition of Component C: Institutional Strengthening for Watershed Management

The cost of Institutional Strengthening for Watershed Management includes costs of elaboration of studies for the Management of the Micro watershed Collecting Area and the Institutional Strengthening of the Farmers' Communities Organization, Committees of Irrigation and Micro watershed Management.

The costs of Institutional Strengthening are estimated by Micro watershed. The scope of the Program is reduced to for 50 micro-watersheds for the Alternative-1 and 66 for the Alternative-2, and some subprojects of the Program are located in the same micro watershed.

4) Cost Composition of Component D: Program Management

Program Management has the following elements:

(a) Consulting Services

Consulting services include the following items:

- Payment of local and international consultants
- Component of advisement and technical support
- Cost for contracts of Detailed Design

5) Administration

Administration cost includes the items described as follows, to be used in the operation and supervision of the Program:

- Vehicles (Pick up trucks, motorcycles)
- Material and input
- Computers
- Stationery
- Fuel
- Payment or remuneration of technical and administrative personnel

3.5.2 Cost of the Program (Alternative 1)

Estimated Cost for the Program amount to S/. 243.1 million at market prices. The following table is a summary of the cost break down by component:

Table 3.5-2 General Budget of the Program (Alternative 1)

COMPONENTE / ITEMS	Quantity	Unit	Base Cost	IGV (19%)	TOTAL S/.
			a	b=a x 0.19	f=a+b
1. Construction and Acquisition			**187,726**	**35,669**	**223,395**
Component A : Irrigation Infrastructure			**155,860**	**29,614**	**185,474**
Studies	56	Studies	**2,077**	395	2,472
Irrigation Infrastructure (CD+GG+GS+MA+Ut)	56	Projects	134,142	25,487	159,629
Training, Technical Assistance and Formation of Irrigation Committee	56	LS	664	126	790
International Technical Assistance	1	Glob	18,977	3,606	22,583
Component B: Technical Irrigation			**14,582**	**2,771**	**17,353**
Studies	56	Studies	**758**	144	902
Technical Irrigation	56	projects	8,587	1,632	10,219
Training, Technical Assistance & Formation of Irrigation Committee	56	committees	4,183	795	4,978
International Technical Assistance	1	Glob	1,054	200	1,254
Component C: Strengthening in Water Resources Management at Micro Watershed			**17,283**	**3,284**	**20,567**
Preparation of Studies	50	Est	4,456	847	5,303
Institutional Strengthening	50	Committees	11,773	2,237	14,010
International Technical Assistance	1	Glob	1,054	200	1,254
2. Administration Cost					
Component D Program Managements			**12,560**	**2,386**	**14,946**
Cost of National Supervision Service	1	GLB	12,560	2,386	14,946
SUB TOTAL (S./)			**200,286**	**38,055**	**238,341**
3. Price Escalation					
2% of Sub Total		2%	4,006	761	4,767
GRAN TOTAL (S./)			204,292	38,816	243,108
GRAN TOTAL (US$)			64,243	12,206	76,449

Exchange Rate : 1.0 US$ = S./ 3.18 (Fin de Marzo 2009 de Banco Central de Reserva del Perú)

(1) Cost of Component A: Irrigation Infrastructure

Cost at private and social prices for each type of subproject, adding the corresponding administration costs are shown in the following table:

Table 3.5-3 Cost of Program Component A: Conglomerate Irrigation Infrastructure

(Unit: Mil S./)

Category	Study	Direct Cost	Environmental Managements	General Expenses	International Technical assistance	Supervision	Profit	Training	Formation of Committee	sub-total	IGV	Market Price
"Irrigation Infrastructure"												
Type 1	195	17,772	10	710	2,804.98	299	709	17	7	22524	4,280	26,804
Type 2-A	43	5,074	4	183	800.84	85	152	4	3	6348.84	1,206	7,555
Type 2-B	329	11,547	64	773	1,822.48	266	405	258	5	15469.5	2,939	18,409
Type 3-A	375	28,610	57	1,289	4,515.55	614	1,390	68	13	36931.6	7,017	43,949
Type 3-B	445	16,630	30	840	2,624.73	277	676	59	6	21587.7	4,102	25,689
Type 4-A	427	27,485	69	1,299	4,337.99	543	1,197	102	13	35473	6,740	42,213
Type 4-B	160	7,530	19	493	1,188.47	152	376	29	6	9953.47	1,891	11,845
Type 5	103	5,588	14	425	881.96	145	340	71	3	7570.96	1,438	9,009
Sub Total	**2,077**	**120,236**	**267**	**6,012**	**18,977**	**2,381**	**5,246**	**608**	**56**	**155859**	**29,613**	**185,472**

Source: Study Team

The detailed costs of activities according to type of subprojects are shown in the flowing table:

1) Cost of Group Type 1

Cost at private and social prices for each subproject of Type 1 are:

Table 3.5-4 Cost of Program Component A: Conglomerate Irrigation Infrastructure Type 1

(Unit: Million S./)

Category	Direct Cost	General Expenses	Profit	Training	Super-vision	Environ-ment Manage-ment	Study	IGV	Private Price	Social Price
CAJ-1 Construction Canal of Irrigation El Rejo	8,810	572	440	8	148	4	148	1,925	12,056	10,153
ANC-11 Construction Canal Cordillera Negra	8,962	138	269	8	151	4	47	1,820	11,399	9,593
Total	17,772	710	709	17	299	8	195	3,745	23,455	19,745

Source: Study Team

2) Cost of Group Type 2-A

Cost at private and social prices for each subproject of Type 2-A, are the following:

Table 3.5-5 Cost of Program Component A: Conglomerate Irrigation Infrastructure Type 2-A

(Unit: Million S./)

Category	Direct Cost	General Expenses	Profit	Training	Supervisio n	Environment Management	Study	IGV	Private Price	Social Price
ANC-3 Const.Canal Irrig.Sol Naciente, S. L.	5,074	183	152	4	85	4	43	1,054	6,600	5,555

Source: Study Team

3) Cost of Group Type 2-B

Cost at private and social prices for each subproject of Type 2-B are the following:

Table 3.5-6 Cost of Program Component A: Conglomerate Irrigation Infrastructure Type 2-B

(Unit: Million S./)

Category	Direct Cost	General Expenses	Profit	Training	Super-vision	Environ-ment Manage-ment	Study	IGV	Private Price	Social Price
AYA-1: Construction and Improvement of Irrigation System Cangallo	4,646	465	232	252	195	47	245	1,156	7,238	6,142
AYA-13: Const. Canal and dam	6,901	309	173	6	70	17	84	1,436	8,996	7,565

Tintayccocha-Acoro										
Total	11,547	773	405	258	266	64	329	2,592	16,234	13,706

Source: Study Team

4) Cost of Group Type 3-A

Cost at private and social prices for each subproject of Type 3-A are the following:

Table 3.5-7 Cost of Program Component A: Conglomerate Irrigation Infrastructure Type 3-A

(Unit: Million S./)

Name of Project	Direct Cost	General Expenses	Profit	Training	Super-vision	Environ-ment Manage-ment	Study	IGV	Private Price	Social Price
AMA-2: Mejor. del Sist. Irrigation S. J. Marañón-La Papaya	2,464	45	123	2	41	6	21	514	3,216	2,707
CAJ-2: Rehabilitation Canal El Huayo	2,429	243	236	8	102	6	61	586	3,673	3,098
ANC-3: Construction Canal of Irrigation Casablanca- Jocosbamba – Quiches (Joquillo)	3,042	122	122	4	51	8	42	644	4,035	3,397
ANC-4: Construction Canal Rupawasi - Rosamonte	2,051	205	160	20	69	5	42	485	3,036	2,560
ANC-10: Const. Canal Irrigation Aynin-Huasta	3,198	61	96	4	54	4	21	653	4,091	3,442
ANC-16: Const. Irrigation system Jatun Parco	4,102	65	123	4	69	4	42	838	5,248	4,417
ANC-17: Improvement Canal Chuayas-Huaycho	3,600	143	144	10	60	4	38	760	4,759	4,005
ANC-18: Improvement Chinguil - Cruzpampa	2,253	195	113	4	76	6	38	510	3,193	2,691
Total	28,610	1,289	1,390	68	614	57	375	6,157	38,560	32,468

Source: Study Team

5) Cost of Group Type 3-B

Cost at private and social prices for each subproject of Type 3-B are the following:

Table 3.5-8 Cost of Program Component A: Conglomerate Irrigation Infrastructure Type 3-B

(Unit: Million S./)

Category	Direct Cost	General Expenses	Profit	Training	Super-vision	Environ-ment Manage-ment	Study	IGV	Private Price	Social Price
JUN-3: Irrigation Cotosh II Etapa	2,602	233	130	20	44	7	168	609	3,812	3,218
JUN-6: Const. Sist.Irrigation Rupasha - Vista Alegre	2,227	223	111	11	66	6	56	513	3,212	2,708
JUN-7: Mej. System Irrigation Yauli y Jajapaqui	2,717	272	162	20	91	10	68	635	3,975	3,353
AYA-5: C.Dam and S.Irrigation Chaqllani-Pucapampa	4,565	48	137	4	38	4	77	926	5,800	4,881
AYA-12: Const. Dam and system irrigation Chito-Sachabamca y Quishuarcancha, Chiara	4,518	64	136	4	38	4	76	920	5,760	4,847
Total	16,630	840	676	59	277	30	445	3,602	22,559	19,006

Source: Study Team

6) Cost of Group Type 4-A

Cost at private and social prices for each subproject of Type 4-A are the following:

Table 3.5-9 Cost of Program Component A: Conglomerate Irrigation Infrastructure Type 4-A

(Unit: Million S./)

Category	Direct Cost	General Expenses	Profit	Train-ing	Super-vision	Environ-ment Manage-ment	Study	IGV	Private Price	Social Price
AMA-1: Impr.Sist. Irrigation Higuerones-San Pedro	1,768	59	88	4	30	4	25	376	2,355	1,983
AMA-3: Impr.Intake and Canal Limonyacu Bajo	1,346	57	67	4	23	3	17	288	1,805	1,520
AMA-4: Impr.. System of Irrigation Utcuchillo - Canal Aventurero	1,343	36	67	4	23	3	17	284	1,777	1,496
AMA-5: Impr. System of Irrigation Naranjitos - Canal Naranjtios Nº. 02	881	44	44	4	23	2	15	193	1,206	1,016
AMA-9: Impr. Intake Rev.Tramo Canal Comunal Huarangopampa	1,264	59	63	4	21	3	25	274	1,713	1,443
AMA-10: Impr. System of Irrigation Lumbay Balsas	1,088	24	54	4	18	3	13	229	1,434	1,207
AMA-11: Impr. System of Irrigation Naranjos - Canal Naranjos	1,455	59	73	4	24	4	17	311	1,946	1,638
AMA-12: Impr. System of Irrigation El Pintor-Canal Abad.	957	48	48	4	17	2	13	207	1,296	1,091
AMA-13: Impr. Canal San Roque Watson	994	43	50	4	17	3	17	214	1,341	1,130

AMA-14: Impr. Canal Irrigation La Peca Baja - Canal Brujopata	1,041	53	52	4	35	3	21	230	1,439	1,213
ANC-12: Impr. Canal Rurec	2,055	90	62	4	35	5	34	434	2,718	2,288
AYA-6: Irrigation Papatapruna - Ccochalla	1,853	22	37	2	16	5	8	369	2,312	1,944
AYA-9: Impr and Const. System of Irrigation Putacca Ccatun Pampa	1,023	43	31	4	17	3	13	215	1,350	1,136
HUANCA-3: Irrigation Cusicancha-Huayacundo-Arma-Huaytará.	1,309	42	39	4	11	3	10	270	1,688	1,420
HUA-1: Construction Canal of Irrigation Caracocha	1,389	67	42	4	23	4	23	295	1,846	1,555
HUA-2: Const. Canal of Irrigation Sogoragra Rondobamba	1,207	11	36	4	10	3	8	243	1,523	1,281
JUN-1: Impr. Canal Achamayo	1,130	81	57	8	38	3	21	254	1,592	1,342
LIB-1: Impr. Canal Sute Putute	1,370	126	68	8	46	3	39	316	1,978	1,668
LIB-4: Impr.Canal Irrigation Chuquillanqui-Shuship	1,955	184	98	8	66	5	56	451	2,823	2,381
PIU-1: Canal of Irrigation Espíndola	1,074	54	54	4	18	3	18	233	1,457	1,227
PIU-4: Impr. Canal Chantaco Huaricanche	982	98	67	8	33	2	16	229	1,436	1,211
Total	27,485	1,299	1,197	102	543	69	427	5,913	37,036	31,190

Source: Study Team

7) Cost of Group Type 4-B

Cost at private and social prices for each subproject of Type 4-B are the following:

Table 3.5-10 Cost of Program Component A: Conglomerate Irrigation infrastructure Type 4-B

(Unit: Million S./)

Category	Direct Cost	General Expenses	Profit	Train-ing	Super-vision	Environ-ment Manage-ment	Study	IGV	Private Price	Social Price
ANC-19: System of Irrigation Mancan Aija	1,828	91	91	8	31	5	46	399	2,500	2,106
AYA-2: Const. Sist. Irrigation Ccocha-Huayllay	2,228	81	111	4	37	6	21	473	2,961	2,492
JUN-2: Irrigation Aywin	1,969	181	98	8	33	5	50	445	2,790	2,350
LIB-6: Dam Laguna Negra-Const Canal od Irrigation Chugay	1,505	140	75	8	51	4	43	347	2,173	1,833
Total	7,530	493	376	29	152	19	160	1,664	10,424	8,781

Source: Study Team

8) Cost of Group Type 5

Cost at private and social prices for each subproject of Type 5, are the following:

Table 3.5-11 Cost of Program Component A: Conglomerate Irrigation Infrastructure Type 5

(Unit: Million S./)

Category	Direct Cost	General Expenses	Profit	Training	Supervision	Environ-ment Manage-ment	Study	IGV	Private Price	Social Price
AMA-8: Impr. Of Irrigation Goncha Morerilla - Canal Gonchillo Bajo	528	29	26	4	18	1	13	118	737	622
ANC-2: Impr. Canal de Irri Paron II	696	70	70	17	23	2	13	169	1,059	893
ANC-6: Impr.Canal of Irrigation Quishquipachan	730	37	37	8	12	2	12	159	997	840
ANC-9: Impr.Canal of Irrigation Quinta Toma	396	47	40	8	17	1	7	98	613	517
ANC-20: Canal of Irrigation Desembocadero – San Miguel	491	49	35	8	17	1	13	117	731	617
CAJ-6: Construccion Canal La Samana - Ushusqui	593	59	30	4	16	2	10	136	850	716
JUN-4: Impr. canal Ranra Antabamba	214	9	6	4	4	1	5	46	289	244
JUN-5: Impr.Canal Sector Atocsaico	702	35	35	4	14	2	10	152	955	804
JUN-9: Impr.Canal Mayuhuato - Huaracaya	261	13	13	4	4	1	4	57	358	302
JUN-10: Canal of Irrigation Ninatambo	410	20	20	4	7	1	7	89	559	471
PIU-2: Impr.Canal Sanguly	566	57	28	4	13	1	9	129	808	681
Total	5,588	425	340	71	145	14	103	1,270	7,957	6,707

Source: Study Team

(2) Cost of Component B: Technical Irrigation

Cost for component Technical Irrigation amount to a total of S./17.4 million in market prices. The following table is a summary of the cost break down by components:

Table 3.5-12 Cost Composition of Component B (Unit: Million S./)

Department	Number of Subprojects	Study	Technical Irrigation	Supervision	Training and Technical Assistance	Water Users Associations	Administrative Expenses	TOTAL WITHOUTIGV	IGV	Total
Amazonas	13	176,059	1,890,460	102,882	958,035	13,000	244,679	3,385,115	643,172	4,028,286
Cajamarca	4	54,172	581,680	31,654	294,780	4,000	75,286	1,041,572	197,899	1,239,470
Piura	3	40,629	436,260	23,741	221,085	3,000	56,464	781,179	148,424	929,603
La Libertad	3	40,629	436,260	23,741	221,085	3,000	56,464	781,179	148,424	929,603
Ancash	14	189,602	2,035,880	110,789	1,031,730	14,000	263,500	3,645,501	692,645	4,338,146
Huánuco	2	27,086	290,840	15,827	147,390	2,000	37,643	520,786	98,949	619,735
Junín	9	121,887	1,308,780	71,222	663,255	9,000	169,393	2,343,536	445,272	2,788,808
Huancavelica	1	13,543	145,420	7,914	73,695	1,000	18,821	260,393	49,475	309,868
Ayacucho	7	94,801	1,017,940	55,395	515,865	7,000	131,750	1,822,751	346,323	2,169,073
Total	**56**	**758,408**	**8,143,520**	**443,163**	**4,126,920**	**56,000**	**1,054,000**	**14,582,011**	**2,770,582**	**17,352,592**

Source: Study Team

(3) Cost of Component C: Institutional Strengthening for Watershed Management

Concerning the component Institutional Strengthening for Watershed Management the estimated cost amounts to a total of S./20.56 million in market prices. The following table is a summary of the cost break down by components, at private prices and social prices:

Table 3.5-13 Cost Composition of Component C (Unit: Million S./)

Item	Base Cost	IGV	Private Prices	Social Prices
1) Elaboration of Studies	4,456	847	5,303	4,825
2) Organizational Strengthening	11,773	2,237	14,010	12,749
3) Administrative Expenses	1,054	200	1,254	1,141
Total	17,283	3,284	20,567	17,696

Source: Study Team

(4) Cost of Component D: Program Management

Similar to the proposed scheme for the previous component the estimated cost for the Program Management of S./13.6 million. Cost composition at private and social prices is the following:

Table 3.5-14 Cost Composition of Component D (Unit: Millions./)

Item	Base Cost	IGV	Private Prices	Social Prices
Administrative Cost (Supervision)	12,560	2,386	14,946	13,601
Total	12,560	2,386	14,946	13,601

Source: Study Team

3.5.3 Cost of the Program (Alternative 2)

Estimated costs for the alternative 2 of the Program reach an amount of S/. 225.4 million at market prices. The following table is summarized the breakdown cost by components:

Table Nº 3.5-15 Estimated Cost for Alternative 2

COMPONENTE / ITEMS	Quantity	Unit	Base Cost	IGV (19%)	TOTAL S/.
			a	b=a x 0.19	f=a+b
1. Construction and Acquisition			**187,726**	**35,669**	**223,395**
Component A : Irrigation Infrastructure			**155,860**	**29,614**	**185,474**
Studies	56	Studies	**2,077**	395	2,472
Irrigation Infrastructure (CD+GG+GS+MA+Ut)	56	Projects	134,142	25,487	159,629

Training, Technical Assistance and Formation of Irrigation Committee	56	LS	664	126	790
International Technical Assistance	1	Glob	18,977	3,606	22,583
Component B: Strengthening in Water Resources Management at Micro Watershed			**17,283**	**3,284**	**20,567**
Preparation of Studies	50	Est	4,456	847	5,303
Institutional Strengthening	50	Committees	11,773	2,237	14,010
International Technical Assistance	1	Glob	1,054	200	1,254
2. Administration Cost					
Component C Program Managements			**12,560**	**2,386**	**14,946**
Cost of National Supervision Service	1	GLB	12,560	2,386	14,946
SUB TOTAL (S./)			**185,703**	**35,284**	**220,987**
3. Price Escalation					
2% of Sub Total		2%	3,714	706	4,420
GRAN TOTAL (S./)			189,417	35,990	225,407
GRAN TOTAL (US$)			59,565	11,318	70,883

Exchange Rate : 1.0 US$ = S./ 3.18 (Fin de Marzo 2009 de Banco Central de Reserva del Perú)

(1) Cost of Component A: Irrigation Infraestructure

Estimated costs for the alternative 2 of the Program reach an amount of S/. 225.4 million at market prices. The following Table is summarized the breakdown cost by components:

(2) Cost of Component B: Institutional Strengthening for the Water resources Management at Micro watersheds

As for the component of Institutional Strengthening for the Water Resources Management at Micro watersheds, the estimated cost reaches an total amount of 20.56 million at market prices. The same one that has been distributed the same as the alternative 1.

(3) Cost of Component C: Program Managements

In a similar way to the Estimated Cost for alternative 1, the cost for the Program Management is of S/. 14.9 million.

3.6 Benefits of the Program

The program will be benefited to irrigate 38,732 ha, covering at 24,849 beneficiaries families distributed at 9 departments, 44 provinces, 56 districts.

3.6.1 Definition of Premises for the Benefit of the Program

The components of the Program: Irrigation Infrastructure, Technical Irrigation and Institutional Strengthening for the Watershed Management propose to increase the cultivated area and the productivity. The specific contribution of each component to the benefits of the Program is the following:

Component A; Irrigation Infrastructure

The goals and benefits of the Component A are the following:

Alternative	Areas (ha)	Families
1	37,612	24,849
2	38,732	24,849

The functionality of works of this component sub-projects are the following:

Increase the availability of water at the intakes– Dam

1. Save water in main canals to be lined (efficiency increase 20% to 40%)
2. Increase cultivated area in the lot
3. Increase the intensity of land use in the lot; making it possible in some parts, two crops in a year.
4. Through the increase of water availability as consequence of the irrigation infrastructure rehabilitation and improvement works the efficiency of water conveyance and distribution increases, obtaining so an increase in the cultivated areas.

Component B; Technical Irrigation
The execution of technical irrigation works will produce the following impacts and benefits:

	Areas (ha)	Families
	1,120	1,120

Increase the productivity at the lot and increase income of producers
1. Increase the intensity of land use in the lot
2. Increase the cultivated area in the lot
3. Increase water availability

Component C: Institutional Strengthening for the Watershed Management
The benefits are identified and described as follows:

1. The articulation axis of the institutionalization strategy is to materialize the actions identifying actors, criteria, problems, objectives, strategies, Programs of work and finally the execution of Programs and monitoring to allow a balance between the proper use of water resources and management with environmental purposed, contributing to the environmental sustainability and sustainable use of natural resources.
2. The idea of participation in the regional and local level is oriented to achieve the largest number of actors that effectively collaborate and participate in the integrated management of water. Also, the adoption of proper practices that allow the efficient use of water and the acknowledgement of it as a limited economic goods.

(1) Benefit to be accounted

Benefits to be accounted include the increase of production consequence of the new irrigation infrastructures of production, both Irrigation infrastructure and technical irrigation.

(2) Main products to be considered

The main products with larger cultivated and harvested area common to the most departments of the Program in the area of influence of the subprojects are Potato, Amillaceous Maize, Wheat, Barley, Hard Yellow Maize, Dry Beans, Coffee and in less proportion (2 to 5 departments Dry Broad bean, Dry pea, Manioc, Alfalfa, Green pea, Olluco, Choclo maize and Fresh broad bean, excepting rice and sweet potato that are present in the departments of Amazonas and Piura, respectively.

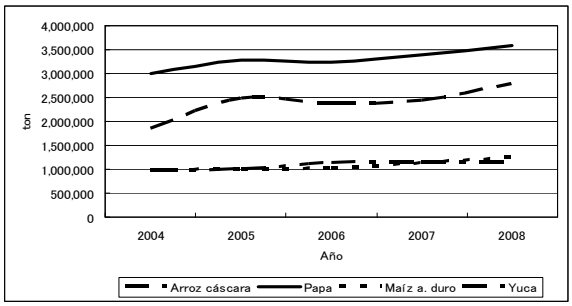
From the said list of products the standard of crop has been selected that is assumed to be the representative of the future situation “with” project, for the Groups of Subprojects located in each department; assuming the interest, grade of acceptation and knowledge of products by the farmers. It is at the same time, in accordance to the technological level and technical assistance services that thy will receive.

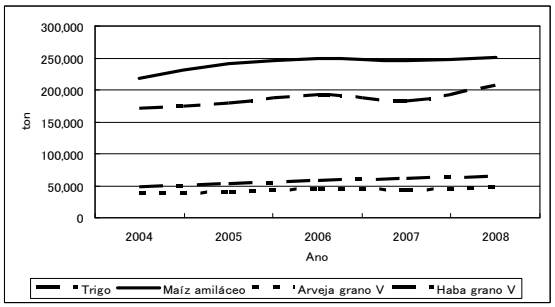
As can be observed in the following table, the national production of the main selected products have increased during the period 2004-2008, process that is basically supported in the internal economy dynamics, clearly visible in the last decade.

Table 3.6-1 Production of Main Crops from 2004 to 2008 National (ton)

Products	2004	2005	2006	2007	2008
Rice	1,847,999	2,468,357	2,363,498	2,435,134	2,782,700
Amillaceous maize	217,717	241,506	249,169	245,326	250,558
Potato	3,005,770	3,289,699	3,248,416	3,383,020	3,588,086
Wheat	170,542	178,460	191,094	181,552	206,286
Hard yellow maize	982,944	999,274	1,019,806	1,122,918	1,228,593
Fresh broad bean	47,176	52,881	57,501	61,325	64,249
Fresh pea	37,852	38,902	44,834	43,326	46,790
Manioc	974,767	1,004,454	1,138,553	1,158,042	1,146,525

Source: Monthly Agriculture Statistics, MINAG



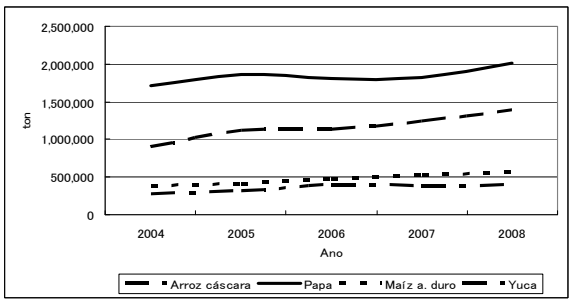


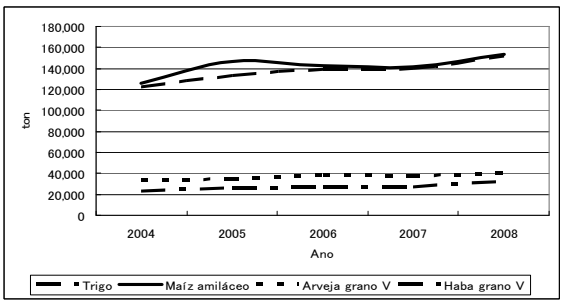
This same trend is repeated at departmental level, showing an average growth of 33% during the period 2004-2008, for the set of products as shown in the following table:

Table 3.6-2 Production of Main Crops from 2004 to 2008
Sub Total 9 Departments (ton)

Products	2004	2005	2006	2007	2008
Rice	890,313	1,119,279	1,121,019	1,234,828	1,391,911
Amillaceous maize	125,475	146,571	142,402	141,907	153,888
Potato	1,709,641	1,855,084	1,807,661	1,816,911	2,012,799
Wheat	121,624	132,833	138,920	139,399	151,493
Hard yellow maize	382,104	409,038	458,862	511,518	552,909
Fresh broad bean	22,983	25,728	27,040	27,000	32,377
Fresh pea	33,862	34,762	38,493	36,917	40,391
Manioc	273,288	313,651	392,136	385,753	389,061

Source: Monthly Agriculture Statistics, MINAG





(3) Determination of Agricultural Productivity

1) Basic Condition:

The base to determine the productivity for the 9 departments is conformed by:

- Information of the Monthly Agriculture Statistics, MINAG 2008 (January 2008-May 2009)
- Productivity for each product has been classified in the three following levels:

Level 1: (Without Project) Low productivity. Defined as area of subsistence

characterized by cultivation in rain fed area and partial irrigation with shortage of water resources (Level 2 x 70%).

Level 2: (With Project) Medium Productivity. Defined as area with average irrigation (the average maximum productivity has been taken from the Monthly Agriculture Statistics, 2008, MINAG).

Level 3: (Technical Irrigation) High Productivity. Defined as irrigation area with optimum water management (Level 2 x 150%).

The following table shows the levels of production in year 2008, by departments and main products that allow configuring a real base for the determination of productivity close to the Program intervention zones:

Table 3.6-3 Production of Crops by Departments 2008 (kg/ha)

Crop	Level	Department								
		AMA	CAJ	PIU	LIB	ANC	HUANU	JUN	HUANCA	AYA
Alfalfa	1	-	34,280	9,610	38,640	21,520	20,800	28,190	28,050	27,850
	2	-	48,965	13,723	55,197	30,749	29,709	40,266	40,067	39,791
	3	-	73,448	20,585	82,796	46,124	44,564	60,399	60,101	59,687
Potato	1	10,830	9,330	10,020	12,620	8,080	13,000	13,460	7,730	13,010
	2	15,466	13,323	14,310	18,031	11,545	18,571	19,223	11,040	18,588
	3	23,199	19,985	21,465	27,047	17,318	27,857	28,835	16,560	27,882
Barley Grain	1	780	670	610	1,170	710	1,060	1,380	1,130	1,050
	2	1,110	959	872	1,678	1,010	1,509	1,967	1,611	1,500
	3	1,665	1,439	1,308	2,517	1,515	2,264	2,951	2,417	2,250
Amillaceous Maize	1	650	1,050	700	1,550	990	1,070	1,350	1,180	880
	2	927	1,500	1,000	2,211	1,407	1,533	1,930	1,682	1,250
	3	1,391	2,250	1,500	3,317	2,111	2,300	2,895	2,523	1,875
Green Pea Grain	1	2,160	1,720	550	3,060	2,570	4,220	4,900	2,770	2,870
	2	3,089	2,454	786	4,370	3,667	6,029	7,004	3,953	4,100
	3	4,634	3,681	1,179	6,555	5,501	9,044	10,506	5,930	6,150
Wheat	1	750	860	780	1,370	720	980	1,480	1,050	1,010
	2	1,068	1,231	1,111	1,962	1,030	1,396	2,114	1,502	1,436
	3	1,602	1,847	1,667	2,943	1,545	2,094	3,171	2,253	2,154
Fresh Broad Bean Grain	1	2,450	2,290	570	4,020	2,610	5,830	4,790	3,070	2,010
	2	3,500	3,269	810	5,742	3,733	8,333	6,847	4,392	2,875
	3	5,250	4,904	1,215	8,613	5,600	12,500	10,271	6,588	4,313
Dry Pea Grain	1	630	1,070	1,130	990	880	1,260	1,220	1,000	860
	2	900	1,528	1,611	1,413	1,250	1,800	1,738	1,434	1,222
	3	1,350	2,292	2,417	2,120	1,875	2,700	2,607	2,151	1,833
Choclo Maize	1	5,690	6,510	5,040	7,130	7,390	6,040	8,660	9,100	5,440
	2	8,124	9,294	7,200	10,188	10,555	8,636	12,369	13,000	7,765
	3	12,186	13,941	10,800	15,282	15,833	12,954	18,554	19,500	11,648
Rice	1	5,120	5,580	6,970	7,330	5,530	4,370	4,320	-	1,460
	2	7,318	7,965	9,960	10,475	7,895	6,249	6,171	-	2,088
	3	10,977	11,948	14,940	15,713	11,843	9,374	9,257	-	3,132
Yellow Hard Maize	1	1,600	4,840	3,490	6,010	3,630	3,840	2,370	1,650	2,100
	2	2,292	6,912	4,982	8,583	5,192	5,482	3,390	2,354	3,000
	3	3,438	10,368	7,473	12,875	7,788	8,223	5,085	3,531	4,500
Manioc	1	10,770	5,960	7,450	10,690	15,050	7,920	8,260	-	7,390
	2	15,050	8,512	10,636	15,267	21,500	11,313	11,803	-	10,556
	3	22,575	12,768	15,954	22,901	32,250	16,970	17,705	-	15,834
Dry Broad Bean Grain	1	1,050	1,000	700	1,020	850	1,080	1,350	1,150	840
	2	1,500	1,428	1,000	1,459	1,213	1,540	1,927	1,636	1,200
	3	2,250	2,142	1,500	2,189	1,820	2,310	2,891	2,454	1,800
Olluco	1	5,440	4,060	2,750	6,050	3,690	12,440	4,520	3,960	3,760
	2	7,767	5,801	3,925	8,643	5,273	17,771	6,456	5,656	5,375
	3	11,651	8,702	5,888	12,965	7,910	26,657	9,684	8,484	8,063
Sweet Potato	1	9,100	5,880	17,620	10,110	12,760	9,740	-	-	8,520
	2	13,000	8,400	25,169	14,442	18,222	13,917	-	-	12,167
	3	19,500	12,600	37,754	21,663	27,333	20,876	-	-	18,251
Dry Bean Grain	1	840	960	700	1,130	1,050	1,290	1,060	1,050	1,460
	2	1,207	1,374	1,000	1,615	1,500	1,848	1,508	1,500	2,083
	3	1,811	2,061	1,500	2,423	2,250	2,772	2,262	2,250	3,125
Coffee	1	590	760	340	700	-	430	800	400	570
	2	837	1,088	488	1,000	-	612	1,139	570	817
	3	1,256	1,632	732	1,500	0	918	1,709	855	1,226

Source: Extracted from MINAG Data

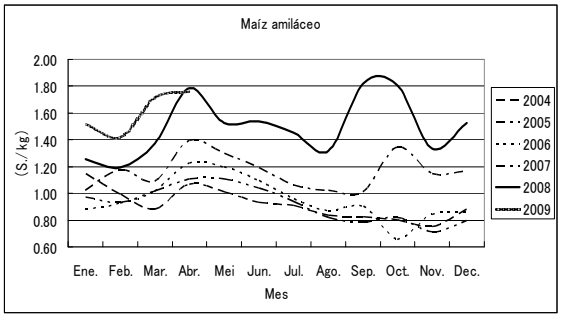
(4) Determination of Prices

1) Basic Condition

Basic information is obtained from the Monthly Agriculture Statistics, MINAG, Average Price Paid to the Producer (in farmland) 2008 (January to December).

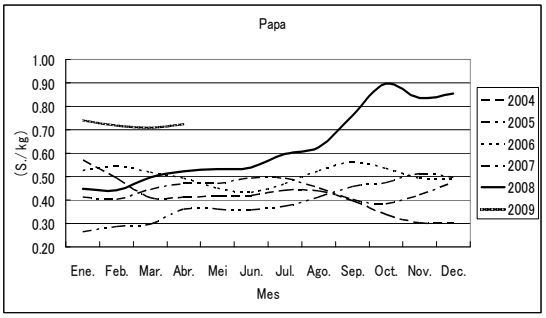
2) Price analysis

Agricultural prices corresponding to 2008 are significantly higher than the prices in force in former periods, trend that is repeated for the other products. As shown in the following figures, in the case of amillaceous maize, potato and manioc; in general all prices of agriculture products show a positive trend from 2008. The average prices of 2008's twelve months have been taken as basis for the calculation of the gross value of production in the Program; according to the guidelines for the determination of prices contained in the Methodological Guide for the Identification, Formulation and Evaluation of Large and Medium Irrigation Projects, of the Ministry of Economy and Finance 2003 and the projections for the Multi-annual Macroeconomic Framework 2010-2012, prepared by the Ministry of Economy and Finance, MEF in May 2009.



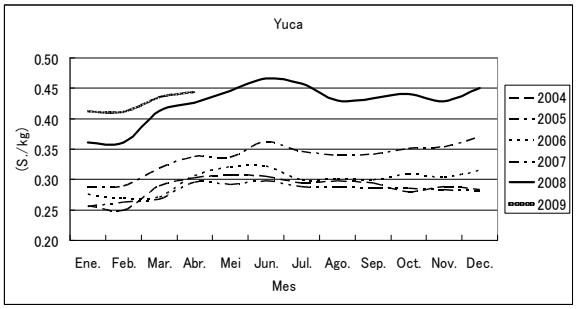
Prices of Amillaceous maize 2004-2009

Source: Study Team based on the Monthly Agriculture Statistics, MINAG2008



Prices of Potato 2004-2009

Source: Study Team based on the Monthly Agriculture Statistics, MINAG2008



Prices of Manioc 2004-2009

Source: Study Team based on the Monthly Agriculture Statistics, MINAG2008

(5) Determination of Cultivated Area

Basic Condition:

- Average of statistic data of MINAG corresponding to period 2002-2007 is used.
- 17 main products are selected (greater frequency of cultivation in terms of area) in the Sierra, to estimate the proportion for each product.
- Rice is considered in the list of products only for the department of Amazonas.
- For Subprojects that do not require Pre-feasibility Study, department estimates the cultivated area of each product.
- Level 1: Land without irrigation system; Level 2: Land with irritation system
- From the total of new irrigation areas, it is estimated that presently (without project)

50% is cultivated in Level 1 and the other 50% is not cultivated. In areas of improvement it is estimated that presently (without project) 50% is cultivated in Level 1 and the other 50% is cultivated in Level 2, so production is estimated based on these parameters.

- It is estimated that production (with Project) increases 150% (except for permanent crops).

(6) Determination of Unit Costs of Production

Production costs are summarized below and its information in details is included in Annex.

Basic Condition:

- Data presented by AGRORURAL in the Perfil will be updated in order to determine the production costs of each product. The same procedure will be adopted for the departments.
- As many cases of low productivity are noticed in each department, the cost of production will be regulated according to the average productivity. An average productivity by product will be calculated to be used as reference. Those products that show productivity superior to the average will not be readjusted and those lower than average will be readjusted according to the difference ration with the average.

3.6.2 Benefits of the Program (Alternative 1)

The Program consists in four components: A, Irrigation Infrastructure, B, Technical Irrigation, C, Institutional Strengthening for Watershed Management and D, Program Management. The implementation will allow increasing cultivated areas and productivity, achieving the following benefits for each type of subproject:

Table 3.6-4 Direct Benefits of the Program (Alternative 1)

Component	Direct Benefit
Comp.A: Conglomerate "Irrigation Infrastructure "	
Type 1	Increase by Irrigation Improvement; 0 has Increase by Irrigation Incorporation; 2,810 has
Type 2-A	Increase by Irrigation Improvement; 0 has Increase by Irrigation Incorporation; 1,066 has
Type 2-B	Increase by Irrigation Improvement; 1,155 has Increase by Irrigation Incorporation; 605 has
Type 3-A	Increase by Irrigation Improvement; 3,434 has Increase by Irrigation Incorporation; 4,821 has
Type 3-B	Increase by Irrigation Improvement; 2,179 has Increase by Irrigation Incorporation; 3,693 has
Type 4-A	Increase by Irrigation Improvement; 8,699 has Increase by Irrigation Incorporation; 5,002 has
Type 4-B	Increase by Irrigation Improvement; 300 has Increase by Irrigation Incorporation; 1,679 has
Type 5	Increase by Irrigation Improvement; 2,356has Increase by Irrigation Incorporation; 953 has
Total	Total: Improvement of Irrigation 18,103 has Total: Increase by Irrigation 20,629 has
Comp B: Conglomerate "Technical Irrigation "	Increase by Technical Irrigation; 1,120 has
Comp.C: Conglomerate "Institutional Strengthening for Watershed Management"	Institutionalization of watershed management and watershed conservation Program.

Source: Study Team

(1) Benefit of Component A: Irrigation Infrastructure (Alternative 1)

The approximate cultivated area of Component A (Alternative 1) by departments have been estimated based on data of crop area in the Program area, recorded in the statistics of the Ministry of Agriculture, as shown in the following table.

Table 3.6-5 Cultivated Area (ha) for Alternative 1

Product	Level	Department									
		AMA	CAJ	PIU	LIB	ANC	HUANU	JUN	HUANCA	AYA	Total
Alfalfa	1	0	0	0	27	477	0	0	34	496	1,034
	2	0	0	0	42	131	0	0	0	214	387
Potato	1	58	501	29	131	853	241	223	45	774	2,855
	2	283	79	23	206	233	8	524	0	335	1,691
Barley grain	1	0	262	15	158	990	55	126	54	766	2,426
	2	0	41	12	247	271	2	295	0	331	1,199
Amillaceous maize	1	101	766	410	89	762	100	93	40	1,000	3,361
	2	494	120	322	140	209	3	218	0	433	1,939
Fresh pea	1	13	177	0	0	0	0	41	12	0	243
	2	64	28	0	0	0	0	95	0	0	187
Wheat	1	14	582	229	167	1,262	66	73	19	575	2,987
	2	71	92	180	262	346	2	171	0	249	1,373
Fresh broad bean	1	0	0	0	0	0	0	35	5	0	40
	2	0	0	0	0	0	0	83	0	0	83
Dry pea grain	1	0	286	96	41	0	0	0	11	188	622
	2	0	45	76	65	0	0	0	0	81	267
Choclo maize	1	15	0	0	0	497	0	81	0	0	593
	2	73	0	0	0	136	0	190	0	0	399
Rice	1	462	0	0	0	0	0	0	0	0	462
	2	2,263	0	0	0	0	0	0	0	0	2,263
Hard yellow maize	1	118	381	447	156	1,369	70	41	0	70	2,652
	2	581	60	351	244	375	2	96	0	30	1,739
Manioc	1	139	164	28	0	0	28	50	0	0	409
	2	683	26	22	0	0	1	117	0	0	849
Dry broad bean	1	0	0	0	23	112	23	0	15	286	459
	2	0	0	0	36	31	1	0	0	124	192
Olluco	1	0	0	0	14	128	13	0	0	126	281
	2	0	0	0	22	35	0	0	0	55	112
Sweet potato	1	0	0	23	0	0	0	0	0	0	23
	2	0	0	18	0	0	0	0	0	0	18
Dry bean grain	1	107	284	74	23	105	31	0	6	0	630
	2	524	45	58	37	29	1	0	0	0	694
Coffee	1	535	0	186	0	0	0	830	0	0	1,551
	2	2,625	0	146	0	0	0	1,946	0	0	4,717
Area Total	1	1,562	3,403	1,538	829	6,554	628	1,593	240	4,282	20,629
	2	7,659	535	1,207	1,300	1,795	21	3,734	0	1,852	18,103

Source: Study Team based in MINAG data (2002 to 2007)

It should be indicated that said cost estimation has taken into consideration determinant aspects for a proper implementation of the Program; such as, factors of altitude compatible with the selected products, agronomic requirements of soil, water and climate; topographic regime of slopes and unevenness to assure the optimum use of water resources, the vegetative period of crops and the representative in the intervention zone.

1) Agricultural Plans

In the situation "without project", the Program will be benefited by the launching of actions to optimize the existing situation, through activities of technical assistance oriented to improve certain cultural tasks to –in certain measure – elevate productivity and/or reduce production costs; scenario that is shown in the following table:

Table 3.6-6 Present Benefit (Alternative 1 and 2)

Type of Cultivated Area	Existing Benefit
Level 1 (50% of rain fed area and 50% irrigation area)	Cultivated area (50% of rain fed area and 50% irrigation area) Number of Crops (1 crop) Productivity (Level 1)
Level 2 (50% Irrigation area)	Cultivated area (50% irrigation area) Number of Crops (1 crop) Productivity (Level 2)

Source: Study Team

In the situation "with Project", with the assurance of counting on with irrigation water in optimum quantities and opportunities, the Program "With Project", has proposed a Plan of Agriculture

Development based on a diversified list of cultivation products and the substantial improvement of productivity; thanks to the introduction of improved technology and the cultivation schedule through the efficient use of soil, projecting campaigns with the end of obtaining a significant net benefit. The benefits to be generated are shown in the following table:

Table 3.6-7 Expected Benefit

Type of Cultivated Area	Expected Benefit (Increase of Production)
Level 2 Area of Improvement (present irrigation area)	With the improvement of irrigation conditions (stable): Number of Crops (1 crop → 2 crops in 50% of the improvement area, except the area for Alfalfa, Manioc and Coffee) Productivity (Level 1 and Level 2→ Level 2)
Level 2 Area of Incorporation (Rain fed Area)	With the improvement of stable irrigation conditions; Number of Crops (1 crop → 2 crops in 50% of the incorporation area, except the area for Alfalfa, Manioc and Coffee) Productivity (Level 2→ Level 2)

Source: Study Team

2) Harvest Areas

The harvest areas are estimated as follows:

Table 3.6-8 Harvest Areas "Without Project " of Component A

Category		Harvest Area (ha)						Total (ha)
		Level 1			Level 2			
		Dry	Irrigation	Subtotal	Dry	Irrigation	Subtotal	
Existing Situation	Type 1	1,028	-	1,028	-	-	-	1,028
	Type 2-A	534	-	534	-	-	-	534
	Type 2-B	250	438	687	-	576	576	1,263
	Type 3-A	2,170	1,718	3,888	-	1,718	1,718	5,606
	Type 3-B	1,846	1,089	2,935	-	1,089	1,089	4,024
	Type 4-A	2,502	4,307	6,809	-	4,350	4,350	11,159
	Type 4-B	839	149	988	-	149	149	1,137
	Type 5	477	1,137	1,613	-	1,167	1,167	2,780
	Total	9,643	8,837	18,480	-	9,049	9,049	27,529

Source: Study Team

Table 3.6-9 Harvest Areas "With Project" of Component A

Category		Harvest Area (ha)						Total (ha)
		Level 1			Level 1			
		Dry	Irrigation	Subtotal	Dry	Irrigation	Subtotal	
Existing Situation	Type 1	-	-	-	-	4,565	4,565	4,565
	Type 2-A	-	-	-	-	2,056	2,056	2,056
	Type 2-B	-	-	-	-	3,064	3,064	3,064
	Type 3-A	-	-	-	-	11,639	11,639	11,639
	Type 3-B	-	-	-	-	7,860	7,860	7,860
	Type 4-A	-	-	-	-	18,531	18,531	18,531
	Type 4-B	-	-	-	-	2,814	2,814	2,814
	Type 5	-	-	-	-	4,612	4,612	4,612
	Total	-	-	-	-	55,141	55,141	55,141

Source: Study Team

3) Benefit in Increase of Production of the Program

It is estimated that in the scope of the Irrigation Infrastructure of the Program, there is a structure of production and productivity as shown in the following table that in general, determine a net increase of agricultural production in 184.8 mil tons:

Table 3.6-10 Increase of Component A Production

Product	Without Project		With Project		
	Cultivated Area (ha)	Production (ton)	Cultivated Area (ha)	Production (ton)	
Alfalfa	882	25,042	1,420	52,063	Increase per Project (ton)) 27,021
Potato	2,986	38,264	7,085	112,756	74,492
Barley grain	2,326	2,498	5,655	7,510	5,012

Amillaceous maize	3,437	3,573	8,247	11,062	7,489
Green Pea	277	1,023	670	2,681	1,658
Wheat	2,730	2,863	6,793	8,850	5,987
Fresh Broad bean	103	574	186	1,254	680
Dry pea	517	575	1,398	2,006	1,431
Choclo Maize	694	5,939	1,535	16,617	10,678
Rice	2,494	15,256	4,088	29,916	14,660
Hard yellow maize	2,990	11,418	6,768	34,407	22,989
Manioc	1,024	11,866	1,258	16,820	4,954
Dry Broad bean	404	389	1,024	1,276	887
Olluco	247	1,145	620	3,730	2,585
Sweet potato	30	588	62	1,560	972
Bean Dry grain	956	974	2,035	2,636	1,662
Coffee	5,435	4,323	6,297	5,986	1,663
Total	27,529	126,311	55,141	311,131	184,820

Source: Study Team

4) Gross Production Values

In monetary terms, this net benefit is reflected in an increase of the gross value of production in the Program, from 143.8 million nuevos soles, according to the following table:

Table 3.6-11 Increase of Production Gross Value

Product	Without Project Production (Million S./)	With Project Production (Million S./)	Increase per Project Production (Million S./)
Alfalfa	5,982	12,436	6,454
Potato	23,424	70,116	46,692
Barley grain	2,762	8,601	5,839
Amillaceous maize	5,234	16,560	11,326
Green Pea	1,172	3,027	1,855
Wheat	3,840	11,799	7,959
Fresh Broad bean	340	745	405
Dry pea	1,005	3,626	2,621
Choclo Maize	4,177	11,715	7,538
Rice	16,019	31,412	15,393
Hard yellow maize	9,076	27,245	18,169
Manioc	6,252	8,976	2,724
Dry Broad bean	569	1,865	1,296
Olluco	1,192	3,944	2,752
Sweet potato	253	671	418
Bean Dry grain	2,085	5,795	3,710
Coffee	22,616	31,256	8,640
Total	106,000	249,789	143,789

Source: Study Team

5) Production Cost

In the other part, fixed and variable production costs increase as consequence of the incorporation of larger cultivated areas, as well as larger volumes of production; that are reflected in a total net increase of production cost of S./108.8 million, as indicated in the following table:

Table 3.6-12 Increase of Production Cost

Product	Without Project Production (Mil S./)	With Project Production (Mil S./)	Increase by Project Production (Mil S./)
Alfalfa	2,328	4,272	1,944
Potato	13,423	40,884	27,461
Barley grain	2,718	7,906	5,188
Amillaceous maize	4,586	12,416	7,830

Green Pea	583	1,609	1,026
Wheat	2,998	8,829	5,831
Fresh Broad bean	267	582	315
Dry pea	644	2,184	1,540
Choclo Maize	1,434	3,783	2,349
Rice	9,922	17,039	7,117
Hard yellow maize	4,930	13,038	8,108
Manioc	3,222	4,449	1,227
Dry Broad bean	452	1,418	966
Olluco	675	2,109	1,434
Sweet potato	107	256	149
Bean Dry grain	1,749	4,232	2,483
Coffee	16,700	19,980	3,280
Total	66,737	144,984	78,247

Source: Study Team

6) Net Production Value

The difference of net incremental benefits and costs of production and production costs results in S./65.5 million of net value of production in the Program Irrigation Infrastructure Area.

Net Production Value (65,542 mil S./) =

Gross Value of Production (143,789 mil S./)

-

Cost of Production (78,247 mil S./)

7) Program Implementation Schedule

The project benefit will be estimated based on the work schedule as shown below:

Table 3.6-13 Validity of the Program Benefits (Unit: Million S./)

	1 Year	2 Year	3 Year	4 Year	5 Year	5>
Work culmination	20%	40%	40%			
Benefit		20%	60%	80%	100%	100%
Investment	32,565	65,130	65,130			
Benefit		13,108	39,325	52,434	65,542	65,542

Source: Study Team

(2) Benefit of Component B: Technical Irrigation

The implementation of the Technical Irrigation system in the frame of the Program, will allow saving the supply of resources improving water distribution at lot level to improve production; as well as to introduce proper practices of operation and maintenance through training activities.

1) Agricultural Plan

With the improvement of irrigation conditions in a sustainable manner, the Program will generate the following benefits:

Table 3.6-14 Expected Benefit

Area of Technical Irrigation	With the condition of technical irrigation: Number of Crops (2 crops in 50% of the incorporated area, except Alfalfa, Manioc and Coffee. Alfalfa, Manioc, Coffee→ 2 crops in 100% of the area, except Alfalfa and Manioc Productivity (Level 2→ Level 3)

2) Harvest Areas

With the introduction of technical irrigation the agriculture soil intensity improves attaining second crops, and cultivated areas would increase 2,206 ha, as observed in the following table:

Table 3.6-15 Production Estimation at the Program Technical Irrigation Area

Nº	Code	Department	Area (ha)	Harvest area(ha)					
				Potato	Amillaceous maize	Manioc	Hard yellow maize	Alfalfa	Total
Technical Irrigation									
1	AMA	Amazonas (13 subprojects)	260	169	78	91	91		429
2	CAJ	Cajamarca (4 subprojects)	80	60	60	20			140
3	PIU	Piura (3 subprojects)	60	42	42	18			102
4	LIB	La Libertad (3 subproject)	60	51	24		27	9	111
5	ANC	Ancash (14 subprojects)	280	210	84		126	70	490
6	HUA	Huánuco (2 subprojects)	40	30	30	10			70
7	JUNIN	Junín (9 subprojects)	180	126	126	54			306
8	HUANCA	Huancavelica (1 subproject)	20	14	14			6	34
9	AYA	Ayacucho (7 subprojects)	140	101	101			39	241
		Total (56 Subprojects)	1,120	803	559	193	244	124	1,923

* Hard yellow corn

3) Production and Benefit in Production Increase

It is estimated that in the Program Technical Irrigation area, the structure of production and productivity as shown below, allows to obtain a net incremental production of 22.9 thousand tons:

Table 3.6-16 Production Estimate in the Program Technical Irrigation Area

Product	Level 2		Level 3		Increase by Project (ton)
	Cultivated Area (ha)	Production (ton)	Increase by Project (ha)	Production (ton)	
Alfalfa	41.7	1,497.9	124.2	6,674.1	5,176.2
Potato	204.9	3,255.9	802.8	18,548.5	15,292.5
Barley grain	161.3	219.5	-	-	-
Amillaceous maize	214.1	293.0	558.8	1,221.4	928.4
Green Pea	18.2	80.0	-	-	-
Wheat	186.6	242.3	-	-	-
Fresh Broad bean	6.0	39.6	-	-	-
Dry pea	31.4	44.9	-	-	-
Choclo Maize	48.9	531.1	-	-	-
Rice	115.1	841.9	-	-	-
Hard yellow maize	190.1	959.9	244.0	1,641.8	681.9
Manioc	35.8	483.1	193.0	3,722.6	3,239.5
Dry Broad bean	26.1	33.5	-	-	-
Olluco	17.3	111.1	-	-	-
Sweet potato	1.4	34.0	-	-	-
Bean Dry grain	54.5	71.4	-	-	-
Coffee	192.3	186.3	-	-	-
Total	1,545.3	8,925.5	1,922.8	31,808.3	22,882.9

Source: Study Team

4) Increase of Production Gross Value

Consequently, the net increase of the production gross value of the Program is estimated according to the table, in an amount of S./11.3 million:

Table 3.6-17 Increase of Production Gross Value

Product	Without Technical Irrigation	With Technical Irrigation	Increase per Project
	Production (Mil S./)	Production (Mil S./)	Production (Mil S./)
Alfalfa	370	1,715	1,345
Potato	2,039	11,484	9,445

Barley grain	224	-	-
Amillaceous maize	440	1,830	1,390
Green Pea	91	-	-
Wheat	327	-	-
Fresh Broad bean	24	-	-
Dry pea	80	-	-
Choclo Maize	374	-	-
Rice	884	-	-
Hard yellow maize	765	1,321	555
Manioc	258	2,177	1,919
Dry Broad bean	49	-	-
Olluco	118	-	-
Sweet potato	15	-	-
Bean Dry grain	160	-	-
Coffee	973	-	-
Total	7,190	18,527	11,337

Source: Study Team

5) Increase of Production Cost

On the other part, the estimated Production cost for the Technical Irrigation area of the Program, increases to a net amount of S./ 6.3 million, as shown in the following chart:

Table 3.6-18 Increase of Production Cost

Product	Without Technical irrigation	With Technical irrigation	Increase per Project
	Cost of Production (Mil S./)	Cost of Production (Mil S./)	Cost of Production (Mil S./)
Alfalfa	125	555	430
Potato	1,176	6,920	5,744
Barley grain	225	-	-
Amillaceous maize	325	1,298	973
Green Pea	47	-	-
Wheat	240	-	-
Fresh Broad bean	19	-	-
Dry pea	49	-	-
Choclo Maize	121	-	-
Rice	480	-	-
Hard yellow maize	367	632	265
Manioc	128	1,033	905
Dry Broad bean	37	-	-
Olluco	59	-	-
Sweet potato	6	-	-
Bean Dry grain	114	-	-
Coffee	613	-	-
Total	4,130	10,437	6,308

Source: Study Team

6) Net Production Value

As a global result, the Net Value of Production estimated for the Program Technical Irrigation area is obtained in S./5.0 million.

Net Production Value (5,029 mil S./) =

Gross Value of Production (11,337 mil S./) - Cost of Production (6,308mil S./)

3.6.3 Benefit of the Program (Alternative 2)

The Program consists in four components: A, Irrigation Infrastructure, B, Institutional Strengthening for Watershed Management and C, Program Management. The implementation will allow increasing cultivated areas and productivity, achieving the following benefits for each type of subproject:

Table 3.6-19 Direct Benefit of the Program (Alternative 2)

Component	Direct benefit
Comp.A: "Infraestructura de Riego"	
Tipo 1	Increase by Irrigation Improvement; 0 has Increase by Irrigation Incorporation; 2,810 has
Tipo 2-A	Increase by Irrigation Improvement; 0 has Increase by Irrigation Incorporation; 1,066 has
Tipo 2-B	Increase by Irrigation Improvement; 1,155 has Increase by Irrigation Incorporation; 605 has
Tipo 3-A	Increase by Irrigation Improvement; 3,434 has Increase by Irrigation Incorporation; 4,821 has
Tipo 3-B	Increase by Irrigation Improvement; 2,179 has Increase by Irrigation Incorporation; 3,693 has
Tipo 4-A	Increase by Irrigation Improvement; 8,699 has Increase by Irrigation Incorporation; 5,002 has
Tipo 4-B	Increase by Irrigation Improvement; 300 has Increase by Irrigation Incorporation; 1,679 has
Tipo 5	Increase by Irrigation Improvement; 2,356has Increase by Irrigation Incorporation; 953 has
Total	Total: Improvement of Irrigation 18,103 has Total: Increase by Irrigation 20,629 has
Comp B: Conglomerate "Technical Irrigation "	Increase by Technical Irrigation; 0 has
Comp.C: Conglomerate "Institutional Strengthening for Watershed Management"	Institutionalization of watershed management and watershed conservation Program.

Source: Study Team

(1) Benefit of Component A: Irrigation Infrastructure (Alternative 2)

Benefit of the Component A of the Alternative 2 has the same beneit with the Alternative 1.(see 3.6.2)

3.7 Evaluation of the Program

The Program evaluation has the objective of verifying that the selected technical solutions optimize economic viability. It means the achievement of efficiency of resources applied in the projects of small and medium irrigation infrastructure, subject of this Program. At this level, it is very important to highlight the results of the social evaluation as expression of social benefits or the increase in the welfare of population by implementation of the projects and to the society in general, in the measure that the program has been designed to act in zones with less socioeconomic development considered as poor. So this Program could be defined as a social productive Program.

3.7.1 Methodology of Evaluation

The Program bases its process of formulation, evaluation, approval, feasibility, construction and evaluation ex post in the "project cycle", in the framework of Law Nº 27293 created by the National System of Public Investment, its regulation, complementary norms and methodological tools, particularly the Methodological Guide for the Identification, Formulation and Evaluation of Great and Medium Risk Projects 2003, formulated by the General Direction of Multi-annual Programming of the Ministry of Economy and Finance, DGPM; whose guidelines consider the following assumptions:

(1) Horizon of Evaluation

The evaluation period of the Program is 14 years including 4 years of construction and 10 of evaluation. Other variables have a foreseen horizon, according to the following schedule:

Table 3.7-1 Chronological Horizon of the Project

Description	Period
Disbursement Period	4 years
Grace Period	7 years
Repayment Period	25 years
Horizon of the project	14 years
Works Execution	4 years
Evaluation Period	10 years after the Work

Source: Study Team

(2) Schedule of Actions

The schedule of actions has two scopes: the first shows the periods for the investment development of the Program according to the components and the second shows the disbursement schedule, consistent with the execution process of the Program.

Concerning the development of the physical execution of the works, the sequence that should exist between the Irrigation Infrastructure (Component A) and the corresponding Technical Irrigation (Component B) should be taken into consideration. The first constitutes a critical route for the second; condition that should be considered in the process of works contracting. The implementation schedule of the Program is as follows:

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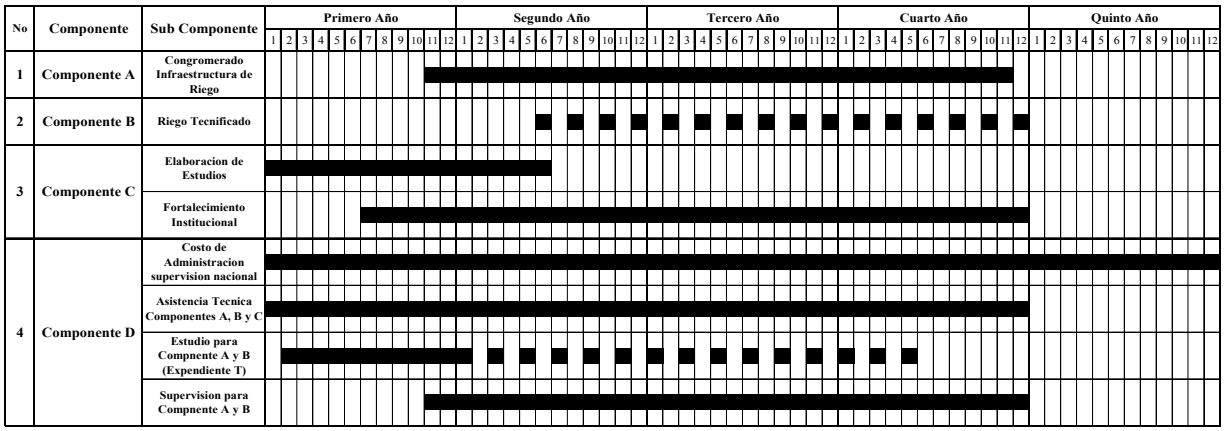

Source: Study Team

(3) Disbursement Schedule (Alternatives 1 and 2)

The Disbursement Schedule is compatible with the Execution Schedule, containing the plan of financial resources provision and assignment necessary for the proper implementation of the Program; as shown below:

Table 3.7-2 Disbursement Schedule (alternative 1)

(Unit: thousand S./)

Components / Items			1 Year	2 Year	3 Year	4 Year	5 Year	Total
1	Component A	Irrigation Infrastructure	10,025	60,153	60,153	55,141		185,474
2	Component B	Technical Irrigation		3,471	6,941	6,941		17,353
3	Component C	Institutional Strengthening of the Water Resources Managements at Micro Watershed	5875	6144	4274	4274		20,567
4	Component D	National Cost of Administration & Supervision	4171	3388	3276	3163	948	14,946
		Contingency	953	953	953	953	955	4767
		Total	21024	74,110	75598	70472	1903	243,108

Source: Study Team

Table 3.7-3 Disbursement Schedule (alternative 2)

(Unidad: thousand S./)

Componentes / Rubros		1 Año	2 Año	3 Año	4 Año	5 Año	Total
1 Component A	Irrigation Infrastructure	10226	61357	61357	56244	0	189,183
Componente B	Fortalecimiento de Gestion de Recursos Hidricos en Microcuencas	5647	6142	4595	4595	0	20978
4 Componente C	Gestión del Programa	3049	3049	3049	3049	3049	15245
	Total	18,922	70,547	69,000	63,887	3,049	225,407

Source: Study Team

(4) Base Period

Prices used in the Program refer to March 2009 prices and are considered as base period.

(5) Conversion of Investment Cost at Social Prices

The National System of Public Investment has Evaluation Parameters contained in Annex SNIP 09, applicable to the evaluation of projects with the purpose of correcting distortions in the economy (IGV, subsidies and tariffs). By conducting the analysis to establish its applicability to the Program of Small and Medium Irrigation Infrastructure in the Peruvian Sierra, it was determined that:

Those factors referred to Tradable Goods, or goods of external sector (Importable/Exportable), whose price CIF/FOB is affected by a Social Price of a factor of 1.08 of the Currency; are not applicable to the Program, for the goods incorporated to the Program's projects structure of costs do not come from the external sector.

Those factors referred to Non-Tradable Goods, or goods of the internal market, whose prices are determined by the Demand and Offer in the country; are applicable to the Program; for the most of all of the goods considered in the Program's structure of costs are tradable in the national market. In consequence, tariffs, subsidies and IGV are to be discounted from the private prices.

The factors of Social Value of Time constitute savings in time generated in projects of automation or transportation. It is not applicable to the Program, for the projects considered do not belong to the category of road or automation.

Social Price of Fuel: It is applicable to the Program for said consumable is immersed in the activities of the project construction. It turns into a social price applying a factor of correction of 0.66

Social Price of Skilled and Non-skilled labor: It is applicable to the Program, because it is included in all activities of construction. It turns into a social price applying the factors of correction 0.91 for skilled labor, and 0.41 for non-skilled labor (this one corresponds to the Program intervention zone in the rural area).

The factors of correction are applicable for each one of the components of the investment cost in irrigation infrastructure, under the following SNIP structure:

Table 3.7-4 Factors of Correction

Description	F. C.*
1. MACHINERY AND EQUIPMENT	
Tradable	0.830
Non tradable	0.840
2. MATERIAL AND INPUT	
Tradable	0.823
Fuel **	0.660
Non tradable	0.840
3. LABOR	
Skilled labor	0.909
Unskilled labor **	0.410
4. GENERAL EXPENSES	
Tradable	0.823

Non tradable	0.840

* Calculated according to the Guidelines for Ident, Form. And Social Eval. Of the PIP at Perfil Level MEF. DGPM. July 2003.
** Source: Annex SNIP 09. DG SNIP

Restriction: There is not a break down database available to build the structure required by SNIP.

Alternative: The Program employs the structure of total cost grouped by major items, according to the following alternative scheme:

Table 3.7-5 Structure for the Conversion of Investment Cost to Social Price

Item	Description	Factor
A.	Detailed Design	0.91
B.	Irrigation infrastructure	0.84
C.	Training	0.91
D.	Technical assistance	0.91
E.	Environmental Mitigation	0.91
	Total	

Source: Study Team based on the typical structure of cost budget.

Support:

- It represents a conservative scenario for the Program as far as certain grouped components of cost are to be corrected with factors of more weight than the corresponding one; so an IRR of the proposed alternative will always be lower than the one obtained by the SNIP break down.
- The type of construction considered in the Program does not require technical complexity, so it will not need sophisticated equipment and industrial machinery.
- The alternative scheme is used only for Program application purposes; later on, each pre-investment study, - provided with the corresponding data base- will be formulated according to the structure of costs required by the SNIP.
- It does not present significant deviations in respect to the breakdown type structure.

(6) Conversion of Production Costs to Social Prices

The conversion of production costs to social prices is affected, in general, by the same factors of correction employed in the conversion of the investment costs to social price and that are in the Annex SNIP-09. However, considering that the agricultural production contained in the geographic area of the Program have characteristics corresponding to a type of closed economy, with low technological level and reduced volumes of production that in the whole configures a regime of rural economy, the assumption of maintaining the same costs of production in the evaluation has been applied, both at private and social prices..

(7) Social Discount Rates

The Social Discount Rate (SDR) represents the cost for the society when the public sector takes resources from the economy to finance projects and it is used to transform to present value the future flow of benefits and costs of a particular project. The use of a single social discount rate allows the comparison of the present net value of public investment, and for the case of the present Program, a SDR of 11% is applied, as indicated in the Annex SNIP 09 (Parameters of Evaluation) that integrates the regulation of the National System Of Public Investment, for the prices used in the calculation of the costs of projects considered in it are expressed at real or constant prices of March 2009.

3.7.2 Evaluation of the Program (Alternative 1)

(1) Program (Alternative 1)

Based on the flow of costs and benefits determined in private and social prices for the Components of the Program, the PNV and IRR are calculated for each case; and the following results were obtained:

Table 3.7-6 Flow of Costs and Benefits (Private Prices)

Year	(1) Investment	(2) O and M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	18,922		18,922		0	-18,922	-18,922
2	74,087	775	67,443	14,114	12,716	-54,728	-73,650
3	76,080	2,324	63,635	42,343	34,367	-29,268	-102,918
4	70,967	3,099	54,156	56,458	41,281	-12,875	-115,793
5	3,049	3,873	4,560	70,572	46,488	41,928	-73,865
6		3,873	2,299	70,572	41,881	39,582	-34,282
7		3,873	2,071	70,572	37,731	35,660	1,378
8		3,873	1,866	70,572	33,992	32,126	33,504
9		3,873	1,681	70,572	30,623	28,942	62,446
10		3,873	1,514	70,572	27,588	26,074	88,520
11		3,873	1,364	70,572	24,854	23,490	112,010
12		3,873	1,229	70,572	22,391	21,162	133,173
13		3,873	1,107	70,572	20,172	19,065	152,238
14		3,873	997	70,572	18,173	17,176	169,414
	243,106	44,929	222,844	818,635	392,258	169,414	

Discount Rate = 11 %

	B/C		IRR		NPV
10 Year	1.76	IRR_{10} =	29.4%	NPV_{10} =	169,414

It can be observed that the private NPV is favorable in the horizon of evaluation, showing a positive IRR and a Benefit-Cost rate much higher than the unit, showing the goodness of the Program.

Table 3.7-7 Flow of Costs and Benefits (Social Prices)

Year	(1) Investment	(2) O and M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	16,281		16,281		0	-16,281	-16,281
2	62,349	775	56,868	14,114	12,716	-44,152	-60,433
3	63,984	2,324	53,817	42,343	34,367	-19,450	-79,883
4	59,723	3,099	45,935	56,458	41,281	-4,653	-84,537
5	2,720	3,873	4,343	70,572	46,488	42,145	-42,392
6		3,873	2,299	70,572	41,881	39,582	-2,809
7		3,873	2,071	70,572	37,731	35,660	32,850
8		3,873	1,866	70,572	33,992	32,126	64,976
9		3,873	1,681	70,572	30,623	28,942	93,919
10		3,873	1,514	70,572	27,588	26,074	119,993
11		3,873	1,364	70,572	24,854	23,490	143,483
12		3,873	1,229	70,572	22,391	21,162	164,646
13		3,873	1,107	70,572	20,172	19,065	183,711
14		3,873	997	70,572	18,173	17,176	200,887
Total	205,057	44,929	191,371	818,635	392,258	200,887	

Discount Rate = 11 %

	B/C		IRR		NPV
10 Year	2.05	IRR_{10} =	36.6%	NPV_{10} =	200,887

Concerning the evaluation at social prices, it also shows the goodness of the Program, through a very

favorable social NPV in the horizon of evaluation, a positive Internal Return Rate and a Benefit-Cost rate that doubles the unit.

(2) Component A: Irrigation Infrastructure

Table 3.7-8 Flow of Costs and Benefits (Private Price)

Year	(1) Investment	(2) O and M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	11,128		11,128		0	-11,128	-11,128
2	59,352	387	53,819	6,554	5,905	-47,914	-59,043
3	59,352	1,162	49,114	19,663	15,959	-33,155	-92,198
4	55,642	2,905	42,809	49,157	35,943	-6,866	-99,064
5		3,873	2,551	65,543	43,175	40,624	-58,440
6		3,873	2,299	65,543	38,897	36,598	-21,842
7		3,873	2,071	65,543	35,042	32,971	11,129
8		3,873	1,866	65,543	31,569	29,704	40,833
9		3,873	1,681	65,543	28,441	26,760	67,593
10		3,873	1,514	65,543	25,622	24,108	91,701
11		3,873	1,364	65,543	23,083	21,719	113,420
12		3,873	1,229	65,543	20,796	19,567	132,987
13		3,873	1,107	65,543	18,735	17,628	150,615
14		3,873	1,107	65,543	18,735	17,628	168,243
Total	185,474	39,312	172,552	665,261	323,167	150,615	

Discount rate= 11 %

	B/C		IRR		NPV
10 Year	1.87	IRR_{10} =	31.9%	NPV_{10} =	168,243

Concerning the evaluation of the component Irrigation Infrastructure, results are equally favorable; showing a positive Internal Return Rate and a Benefit-Cost rate above the unit at private prices, showing the goodness of said intervention.

Table 3.7-9 Flow of Costs and Benefits (Social Prices)

Year	(1) Investment	(2) O y M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	9,460		9,460		0	-9,460	-9,460
2	50,452	387	45,801	6,554	5,905	-39,896	-49,356
3	50,452	1,162	41,891	19,663	15,959	-25,932	-75,287
4	47,298	2,905	36,708	49,157	35,943	-765	-76,052
5		3,873	2,551	65,543	43,175	40,624	-35,428
6		3,873	2,299	65,543	38,897	36,598	1,170
7		3,873	2,071	65,543	35,042	32,971	34,141
8		3,873	1,866	65,543	31,569	29,704	63,844
9		3,873	1,681	65,543	28,441	26,760	90,605
10		3,873	1,514	65,543	25,622	24,108	114,713
11		3,873	1,364	65,543	23,083	21,719	136,432
12		3,873	1,229	65,543	20,796	19,567	155,999
13		3,873	1,107	65,543	18,735	17,628	173,626
14		3,873	1,107	65,543	18,735	17,628	191,254
Total	157,661	39,312	149,540	665,261	323,167	173,626	

Discount Rate = 11 %

	B/C		IRR		NPV
10 Year	2.16	IRR_{10} =	38.3%	NPV_{10} =	191,254

Results at social prices favor significantly the project, by presenting a positive Internal Return Rate and a rate Benefit-Cost that doubles the unit, confirming its profitability.

(3) Component B: Technical Irrigation (Alternative 1)

Table 3.7-10 Flow of Costs and Benefits (Private Prices)

Year	(1) Investment	(2) O y M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	6,941		6,941		0	-6,941	-6,941
2	10,412	56	9,430	503	453	-8,977	-15,918
3		84	68	1,509	1,224	1,156	-14,762
4		112	82	3,772	2,758	2,676	-12,086
5		112	74	5,029	3,313	3,239	-8,847
6		112	66	5,029	2,984	2,918	-5,930
7		112	60	5,029	2,689	2,629	-3,301
8		112	54	5,029	2,422	2,368	-933
9		112	49	5,029	2,182	2,134	1,201
10		112	44	5,029	1,966	1,922	3,123
11		112	39	5,029	1,771	1,732	4,854
12		112	36	5,029	1,596	1,560	6,414
Total	17,353	1,148	16,943	46,013	23,357	6,414	

Discount Rate = 11 %

	B/C		IRR		NPV
10 Year	1.38	IRR_{10} =	18.1%	NPV_{10} =	6,414

The evaluation of the Technical Irrigation component shows favorable results in terms of a positive Internal Return Rate and a rate Benefit-Cost above the unit at private prices, showing the goodness of its implementation.

Table 3.7-11 Flow of Costs and Benefits (Social Prices)

Year	(1) Investment	(2) O y M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	5,833		5,833		0	-5,833	-5,833
2	8,749	56	7,933	503	453	-7,480	-13,312
3		84	68	1,509	1,224	1,156	-12,156
4		112	82	3,772	2,758	2,676	-9,480
5		112	74	5,029	3,313	3,239	-6,242
6		112	66	5,029	2,984	2,918	-3,324
7		112	60	5,029	2,689	2,629	-695
8		112	54	5,029	2,422	2,368	1,673
9		112	49	5,029	2,182	2,134	3,807
10		112	44	5,029	1,966	1,922	5,729
11		112	39	5,029	1,771	1,732	7,460
12		112	36	5,029	1,596	1,560	9,020
Total	14,582	1,148	14,337	46,013	23,357	9,020	

Discount Rate = 11 %

	B/C		IRR		NPV
10 Year	1.63	IRR_{10} =	22.3%	NPV_{10} =	9,020

The results at social prices are significantly favorable to the project, by showing a positive Internal Return Rate and a Benefit-Cost rate where benefits surpass almost twice and a half the costs of the intervention, showing its profitability.

(4) Sub projects

The results of the evaluation of economic flows in private and social prices of the subprojects included in the Program are the following:

Table 3.7-12 List of Sub projects: Conglomerate "Irrigation Infrastructure " Type 1

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase	IRR	B/C	IRR	B/C
CAJ-1 El Rejo	1,510	560	12,056	239	2,908	2,669	11.8%	1.03	16.8%	1.20
ANC-11 Cordillera Negra	1,300	2,117	11,399	852	3,801	2,949	15.3%	1.21	19.2%	1.42

Subprojects of Type 1 show positive IRR at private and social prices with a benefit-cost rate superior to the unit, indicating its profitability.

Table 3.7-13 List of Sub projects : Conglomerate "Irrigation Infrastructure " Type 2-A

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase				
ANC-5 Sol Naciente de S. Luis	1,066	719	6,600	700	3,979	3,279	32.6%	2.26	38.1%	2.64

Subproject type 2-A, Sol Naciente de San Luis, shows positive IRR at social and private prices as well as benefit-cost rate that indicates the benefits of the same, more than doubling the cost.

Table 3.7-14 List of Sub projects : Conglomerate "Irrigation Infrastructure " Type 2-B

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase				
AYA-1 Cangallo	660	532	7,238	714	2,240	1,526	11.0%	1.00	14.4%	1.17
AYA-13 Tintayccocha-Acocro	1,100	1,000	8,996	1,271	3,474	2,203	13.9%	1.14	17.8%	1.34

Subprojects of type 2-B, equally show positive IRR in private and social prices with a benefit-cost rate superior to the unit, indicating its feasibility.

Table 3.7-15 List of Sub projects : Conglomerate "Irrigation Infrastructure " Type 3-A

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase	IRR	B/C	IRR	B/C
AMA-2 San Juan Maryearn-La Papaya	1,477	224	3,216	1,897	3,820	1,923	36.3%	2.34	42.1%	2.67
AMA-6 Naranjos - Canal El Tigre	1,237	226	3,018	1,534	3,203	1,669	34.0%	2.22	39.6%	2.54
CAJ-2 El Huayo	1,428	321	3,673	640	2,005	1,365	21.8%	1.51	26.1%	1.72
CAJ-7 Cochán Alto	600	450	4,290	38	972	934	11.1%	1.00	14.7%	1.17
ANC-3 Casablanca- Jocosbamba – Quiches (Joquillo)	563	660	4,035	475	1,650	1,175	17.8%	1.34	22.0%	1.57
ANC-4 Rupawasi - Rosamonte	550	2,050	3,036	361	1,613	1,252	26.7%	1.86	31.6%	2.16
ANC-10 Aynin-Huasta	525	320	4,091	367	1,528	1,160	17.3%	1.32	21.4%	1.54
ANC-16 Jatun Parco	625	280	5,248	451	1,828	1,376	15.5%	1.22	19.5%	1.43
ANC-17 Chuayas-Huaycho	650	600	4,759	675	1,901	1,226	14.9%	1.19	18.8%	1.39
ANC-18 Chinguil - Cruzpampa	600	820	3,193	519	1,752	1,233	24.8%	1.73	29.5%	2.02
Average							22.0%	1.57	26.5%	1.82

In its turn, subprojects of type 3-A, show positive IRR in private and social prices, that in average are between 22.0 and 26.5%, respectively; the same as the benefit-cost rates above the unit.

Table 3.7-16 List of Sub projects : Conglomerate "Irrigation Infrastructure " Type 3-B

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase	IRR	B/C	IRR	B/C
JUN-3 Cotosh II Etapa	1,101	1,081	3,812	1,503	3,636	2,133	35.5%	2.38	41.1%	2.75
JUN-6 Rupasha - Vista Alegre	1,281	202	3,212	2,180	4,241	2,061	39.4%	2.59	45.5%	2.96
JUN-7 Yauli y Jajapaqui	450	501	3,975	664	1,491	827	10.4%	0.97	13.9%	1.14
AYA-5 Chaqllani-Pucapampa	1,040	300	5,800	654	2,654	2,000	21.8%	1.55	26.2%	1.81
AYA-12 Chito-Sachabamca y Quishuarcancha, Chiara	2,000	2,000	5,760	1,652	5,108	3,455	37.4%	2.48	43.3%	2.85
Average							28.9%	2.00	34.0%	2.30

Subprojects of type 3-B, also show positive IRR in private and social prices that in average are between 28.9 and 34.0% respectively and show benefit-cost rates superior to the unit.

Table 3.7-17 List of Sub projects : Conglomerate "Irrigation Infrastructure " Type 4-A

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase	IRR	B/C	IRR	B/C
Total (21 subprojects)	13,701	5,169	37,036	16,194	37,083	20,889	41.6%	2.61	48.7%	3.00

Subprojects of type 4-A of the conglomerate, evaluated as a set; show positive IRR in private and social prices; benefit-cost rates are largely favorable for benefits more than double costs.

Table 3.7-18 List of Sub projects : Conglomerate "Irrigation Infrastructure" Type 4-B

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase	IRR	B/C	IRR	B/C
Total (4 subprojects)	1,979	2,228	10,424	1,854	6,386	4,531	33.1%	2.19	39.1%	2.55

Similar favorable situation is observed in the subprojects of type 4-B of the conglomerate; IRR in private and social prices is positive and the benefit-cost rate is also positive.

Table 3.7-19 List of Sub projects : Conglomerate "Irrigation Infrastructure " Type 5

Name of the Project	Area (ha)	Benef iciaries	Investment (1,000 S./)	Benefit (1,000 S./)			Private Price		Social Price	
				Without	With	Increase	IRR	B/C	IRR	B/C
Total (11 subprojects)	3,289	2,489	7,957	3,827	7,534	3,708	33.8%	2.11	39.9%	2.42

Finally, subprojects of type 5, also show positive IRR in social and private prices and favorable benefit-cost rates that double the unit.

3.7.3 Evaluation of the Program (Alternative 2)

(1) Program (Alternative 2)

Based on the flow of costs and benefits determined in private and social prices for the Components of the Program, the PNV and IRR are calculated for each case; and the following results were obtained:

Table 3.7-20 **Flow of Costs and Benefits (Private Prices)**

Year	(1) Investment	(2) O and M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	18,922		18,922		0	-18,922	-18,922
2	70,547	775	64,254	13,109	11,810	-52,445	-71,367
3	69,000	2,324	57,888	39,326	31,918	-25,971	-97,338
4	63,887	3,099	48,980	52,434	38,340	-10,640	-107,978
5	3,049	3,873	4,560	65,543	43,175	38,615	-69,362
6		3,873	2,299	65,543	38,897	36,598	-32,764
7		3,873	2,071	65,543	35,042	32,971	207

8		3,873	1,866	65,543	31,569	29,704	29,911
9		3,873	1,681	65,543	28,441	26,760	56,671
10		3,873	1,514	65,543	25,622	24,108	80,779
11		3,873	1,364	65,543	23,083	21,719	102,498
12		3,873	1,229	65,543	20,796	19,567	122,065
13		3,873	1,107	65,543	18,735	17,628	139,693
14		3,873	997	65,543	16,878	15,881	155,574
	225,407	44,929	208,732	760,299	364,305	155,574	

Discout Rate = 11 %

	B/C		IRR		NPV
10 Año	1.75	IRR_{10} =	29.0%	NPV_{10} =	155,574

Source: Study Team

It can be observed that the private NPV is favorable in the horizon of evaluation, showing a positive IRR of 29% and a Benefit-Cost rate of 1.75 much higher than the unit, showing the goodness of the Program.

Table 3.7-21 Flow of Costs and Benefits (Social Prices)

Year	(1) Investment	(2) O and M	(3) NPV(Inv.) +NPV(OM)	(4) Benefit	(5) NPV(Ben.)	(6) NPV(5)-(3)	(7) NPV (Total.)
1	16,281		16,281		0	-16,281	-16,281
2	59,333	775	54,151	13,109	11,810	-42,341	-58,622
3	57,953	2,324	48,922	39,326	31,918	-17,004	-75,626
4	53,692	3,099	41,524	52,434	38,340	-3,185	-78,811
5	2,720	3,873	4,343	65,543	43,175	38,832	-39,979
6		3,873	2,299	65,543	38,897	36,598	-3,381
7		3,873	2,071	65,543	35,042	32,971	29,590
8		3,873	1,866	65,543	31,569	29,704	59,294
9		3,873	1,681	65,543	28,441	26,760	86,054
10		3,873	1,514	65,543	25,622	24,108	110,162
11		3,873	1,364	65,543	23,083	21,719	131,882
12		3,873	1,229	65,543	20,796	19,567	151,448
13		3,873	1,107	65,543	18,735	17,628	169,076
14		3,873	997	65,543	16,878	15,881	184,957
	189,978	44,929	179,348	760,299	364,305	184,957	

Discout Rate = 11 %

	B/C		IRR		NPV
10 Año	2.03	IRR_{10} =	36.1%	NPV_{10} =	184,957

Source: Study Team

Concerning the evaluation at social prices, it also shows the goodness of the Program, through a very favorable social NPV of S/. 184.95 millions in the horizon of evaluation, a positive Internal Return Rate of 36.01% and a Benefit-Cost rate of 2.03 that doubles the unit.

(2) Component A: Irrigation Infraestructure (Alternative 2)

The results of the evaluation of the Alternative 2 is same indicated as the results of the Alternative 1.

(3) Component B: Tecnical Irrigation (Alternative 2)

The evaluation of the component of Tecnical irrigation doesn't show up for not being considered in this alternative.

3.8 Sensibility Analysis of the Program

It has the purpose of determining how much the Present Net Value in social prices (Social) could be affected by variations in the most important items of income and costs that will establish the limit values that said variables could reach without turning the project unprofitable. The Methodological Guide for the Identification, Formulation and Evaluation of Great and Medium Risk Projects, DGPM-MEF 2003 suggests the conduction of the mono-varied sensibility analysis that is the most common method (affecting only one variable each turn), in respect to the changes in prices of agricultural products, price of input, profitability and destination of the production to the market.

In the case of the Program, the field survey conducted as well as the statistic data used (five years in average for profitability of cultivation products), the relative stability of internal prices of agricultural input and the consideration of a conservative scenario both for estimated production volumes and for prices of agriculture products allow to establish the consistency of the variables; however, for methodological purpose, the cost of the irrigation infrastructure (cost of the project investment) and the profitability of production with variations in a range of -10%, -20%, -30% ≤ r ≤ +10%, +20%, +30% are proposed as sensible variables for the project

The following has been calculated:

Case I 10%, 20%, 30% of Increase in the Program Cost

Case II 5%, 10%, 15% of Reduction in the Production

The results of each alternative are the following;

Table 3.8-1 Sensibility Analysis of the Program (Alternative 1); Case I: Increase in the Program Cost

Increase in the Program Cost	IRR		B/C		PNV (1,000 S/.)	
	Private	Social	Private	Social	Private	Social
0%	29.4%	36.6%	1.76	2.05	169,414	200,887
10%	25.9%	32.4%	1.61	1.88	149,282	183,903
20%	22.9%	28.9%	1.49	1.74	129,151	166,918
30%	20.4%	26.0%	1.38	1.62	109,019	149,934

Source: Study Team

Table 3.8-2 Sensibility Analysis of the Program (Alternative 2); Case I: Increase in the Program Cost

Increase in the Program Cost	IRR		B/C		PNV (1,000 S/.)	
	Private	Social	Private		Private	Social
0%	29.0%	36.1%	1.75	2.03	155,574	184,957
10%	25.6%	32.0%	1.60	1.87	136,853	169,175
20%	22.6%	28.6%	1.48	1.73	118,133	153,393
30%	20.1%	25.7%	1.38	1.61	99,413	137,611

Source: Study Team

As it can be observed, the Program bears increases above 30% in investment costs, by maintaining positive Internal Return Rates and Benefit-Cost rates higher than the unit. It means that in the case of a possible increase in the costs of the project above 30%, the economic profitability of the Program still is high.

Table 3.8-3 Sensibility Analysis of the Program (Alt. 1); Case II: Reduction of the Production

Reduction of the Production	IRR		B/C		NPV (1,000 S/.)	
	Private	Social	Private	Social	Private	Social
0%	29.4%	36.6%	1.76	2.05	169,414	200,887
-5%	21.5%	27.3%	1.43	1.66	94,839	126,312
-10%	13.3%	17.9%	1.09	1.27	20,275	51,748
-15%	4.3%	7.7%	0.76	0.88	-54,289	-22,817

Source: Study Team

Table 3.8-4 Sensibility Analysis of the Program (Alt. 2); Case II: Reduction of the Production

Reduction of the Production	IRR		B/C		NPV (1,000 S/.)	
	Private	Social	Private		Private	Social
0%	29.0%	36.1%	1.75	2.03	155,574	184,957
-5%	21.4%	27.2%	1.42	1.65	87,934	117,318
-10%	13.5%	18.1%	1.10	1.28	20,299	49,682
-15%	4.7%	8.3%	0.77	0.90	-47,336	-17,953

Source: Study Team

Concerning the variable production, the table of the results shows that the Program maintains the feasibility in the reduction of 10% of the production at social prices, situation in which still it is profitable.

Finally, it should be stressed that the economic and social feasibility of the Program of Small and Medium Irrigation in the Peruvian Sierra is linked to the Plan of Economic Incentive (PEE), implemented by the Government in an amount that represents 3.2% of the GNP, assigned to attend firstly the most affected sectors by the international crisis. The main goal of the PEE is aimed to increase public investment and social expenses, with the purpose of reducing the gap of irrigation infrastructure, increase productivity and promote the long-term growth. To the date, more than 222 million Nuevos Soles have been transferred to some 1,952 districts for the development of irrigation infrastructure maintenance activities (canals, captions, intakes, gauging devices, micro reservoirs, drainage, etc.). In this way, it is a part of the national policy and strategy directed to the Institutional Strengthening of the productive agricultural sector and to the improvement of the quality of life for important sectors of the population located in the segments of poverty and extreme poverty.

3.9 Private Evaluation

The private (at market prices) Evaluation will be carried out with the purpose to evaluate the potential participation of the private sector in the finance of the project implementation and operation of the project.

3.9.1 Evaluation of Component A (Irrigation Infrastructure)

(1) Mean cost for each type of subproject

Cost for each type of subproject are as follows;

Mean Cost for each type of Subproject

	Improved Area. (ha)	Incorporated Area. (ha)	Total Area (ha)	Number of Beneficiaries	Estimated Cost (S/.)	Investment S/./ Ha	Investment S/. /Fam	Mean Area per Farmers
Type 1	0	2,810	2,810	2,677	23,455,069	8,347	8,762	1.05
Type 2A	0	1,066	1,066	719	6,600,000	6,191	9,179	1.48
Type 2B	1,155	777	1,932	1,532	16,234,039	8,403	10,597	1.26
Type 3A	3,434	4,821	8,255	5,951	38,559,747	4,671	6,480	1.39
Type 3B	2,179	3,693	5,872	4,084	22,558,878	3,842	5,524	1.44
Type 4A	8,699	5,002	13,701	5,169	37,036,064	2,703	7,165	2.65
Type 4B	300	1,679	1,979	2,228	10,424,057	5,267	4,679	0.89
Type 5	2,336	953	3,289	2,489	7,956,720	2,419	3,197	1.32
Total	18,103	20,801	38,904	24,849	162,824,573	4,185	6,553	1.57

Source: Study Team

The investment cost per hectare is among S/. 2,000 to 8,400 and the investment per beneficiary among S/. 3,000 to 10,000.

(2) Beneficiaries

Estimated benefit for each type of subproject are as follows;

Estimated benefit for each type of subproject

	without Project					with Project				
	Area (ha)	Production (t)	Prod, Values (10^3 S/.)	Cost (10^3 S/.)	Net Benefit (10^3 S/.)	Area (ha)	Production (t)	Prod, Values (10^3 S/.)	Cost (10^3 S/.)	Net Benefit (10^3 S/.)
Type 1	1,028	3,963	2,843	1,752	1,090	4,565	21,641	16,869	10,161	6,708
Type 2A	534	2,352	1,594	895	699	2,056	11,046	8,367	4,388	3,978
Type 2B	1,263	9,501	4,822	2,836	1,985	3,064	22,814	13,742	8,028	5,714
Type 3A	5,606	23,006	20,153	13,195	6,958	11,639	58,784	49,389	29,119	20,270
Type 3B	4,024	21,289	16,882	10,228	6,653	7,860	54,549	39,920	22,790	17,129
Type 4A	11,159	48,763	45,647	29,453	16,194	18,531	102,134	89,625	52,542	37,083
Type 4B	1,137	5,991	4,239	2,384	1,854	2,814	18,528	13,633	7,247	6,385
Type 5	2,780	11,442	9,817	5,991	3,826	4,612	21,631	18,240	10,706	7,534
Total	27,529	126,307	105,997	66,734	39,259	55,141	311,127	249,785	144,981	104,801

Source: Study Team

Estimated benefit per beneficiaries for each type of subproject are;

Estimated Benefit per Beneficiary for Each Type of Subproject

	Without Project					With Project				
	Area (ha)	Production (t)	Prod, Values (S/.)	Cost (S/.)	Net Benefit (S/.)	Area (ha)	Production (t)	Prod, Values (S/.)	Cost (S/.)	Net Benefit (S/.)
Type 1	0.38	1,481	1,062	655	408	1.71	8,084	6,302	3,796	2,506
Type 2A	0.74	3,272	2,218	1,245	973	2.86	15,363	11,638	6,104	5,534
Type 2B	0.82	6,202	3,148	1,851	1,296	2.00	14,892	8,970	5,240	3,730
Type 3A	0.94	3,866	3,387	2,217	1,169	1.96	9,878	8,299	4,893	3,406
Type 3B	0.99	5,213	4,134	2,505	1,629	1.92	13,357	9,775	5,580	4,194
Type 4A	2.16	9,434	8,831	5,698	3,133	3.59	19,759	17,339	10,165	7,174
Type 4B	0.51	2,689	1,903	1,070	832	1.26	8,316	6,119	3,253	2,866
Type 5	1.12	4,597	3,944	2,407	1,537	1.85	8,691	7,328	4,301	3,027
Total	**1.11**	**5,083**	**4,266**	**2,686**	**1,580**	**2.22**	**12,521**	**10,052**	**5,835**	**4,218**

Source: Study Team

Estimated agricultural income (Yearly family income, Monthly family and per Capita) are as follows;

Estimated agricultural income

	Without Project			With Project		
	A Year (S/./year)	Monthly (S/./mes.family)	Monthly Per capita (S/. /person)	A Year (S/./year)	Monthly (S/./mes.family)	Monthly Per capita (S/. /person)
Type 1	408	34	8	2,506	209	52
Type 2A	973	81	20	5,534	461	115
Type 2B	1,296	108	27	3,730	311	78
Type 3A	1,169	97	24	3,406	284	71
Type 3B	1,629	136	34	4,194	350	87
Type 4A	3,133	261	65	7,174	598	149
Type 4B	832	69	17	2,866	239	60
Type 5	1,537	128	32	3,027	252	63
Total	1,580	132	33	4,218	351	88

Source: Study Team

With the implementation of the project, the net agricultural income for beneficiary would be improving of S/. 132 monthly to S/. 351 monthly.

(3) Study for the Possibility of the Financial Contribution by Beneficiaries

With the implementation of the Irrigation Infrastructure, the producers will be able to improve their economic conditions. The relationships between the cost and the benefit are shown in the following table;

	Cost		Benefit a Year		
	Total Investment	Contribution of Beneficiaries	Wit Project	Without Project	Increase
Type 1	8,762	1,752	2,506	408	2,098
Type 2A	9,179	1,836	5,534	973	4,561
Type 2B	10,597	2,119	3,730	1,296	2,434
Type 3A	6,480	1,296	3,406	1,169	2,237
Type 3B	5,524	1,105	4,194	1,629	2,565
Type 4A	7,165	1,433	7,174	3,133	4,041
Type 4B	4,679	936	2,866	832	2,034
Type 5	3,197	639	3,027	1,537	1,490
Total	6,553	1,311	4,218	1,580	2,638

Source: Study Team

The IRR shows high ratio values, so much from the point of the State (in the supposition of assuming the whole investment) as of the beneficiaries (to contribute 20% of the investment) showing the following index;

Economic Index of the Irrigation Infrastructure Investment

Paying 100% of the Investment						Paying 20% of the Investment					
B/C		IRR		NPV		B/C		IRR		NPV	
10 years	2.44	IRR_{10} =	38.0%	NPV_{10} =	10,503	10 years	8.65	IRR_{10} =	192.8%	NPV_{10} =	15,745

Discount Rate = 11 %

Source: Study Team

The results of Estimated Economic Index are favorable, being high ratio of economic return. In the result of the economic calculation, the possibility of a contribution of 20% of the investment by the beneficiaries is shown, however to assume this supposition, not serious realist for the small producers for the followings reasons;

- The farmers agricultural Income is of approximately S/. 1580 yearly. With this Income, it is not possible to pay S/. 1311 (20% of the investment), according to the results of farmer's income analysis.
- To pay 20%, the farmer should take a credit in the Market, in which the interest rate is of approximately 3.5 monthly (51.1% of annual interest rate)%.
- In the following table, the sequence of farmer's income and expenditure are indicated, in the situation of having to pay with the yearly interest of 50%of the credit. At the end of payments, the farmer will pay S/. 4,727 in the hypothesis that farmer takes a credit of S/. 1,310.6 for the contribution of the investment.

Year	Principal	Interest	Payment	Balance	Farmers Yearly Income	Yearly Income after the payment of Interest
1	1,310.6	669.8	0.0	1,980.4	1,580	1,580
2	1,980.4	1,012.1	1,318.8	1,673.7	4,218	2,899
3	1,673.7	855.4	1,318.8	1,210.3	4,218	2,899
4	1,210.3	618.5	1,318.8	510.0	4,218	2,899
5	510.0	260.6	770.6	0.0	4,218	3,447
6	0.0				4,218	4,218
		3,416	4,727			

Source: Study Team

- As the financial Market has high financial cost, the farmer, if they pay 20% of investment as a contribution, in fact will not be serious benefited by the investment of the Irrigation infrastructure.
- In case, 20% of the contribution by the beneficiaries is demanded, it would be necessary to consider some agricultural credit lines with reasonable rate of interest (it can be yearly less than 12%). If the agricultural credit line doesn't exist, the contribution would harm to the farmers instead of helping farmers.
- Also, the farmers require to buy the agricultural inputs to increase agricultural productivity. This Financial cost does not considered in this calculation.
- If the farmers does not acquire and use agricultural inputs to increase their production, the productivity would not get targeted yield and income, resulting probable situation of risk of default.
- It is Necessary to mention that this economical assumption was done in the average situation, meaning that that most of the farmers don't have this type of financial capacity.
- The income distribution per farmer in the Program area is the following;

Net Income Distribution per Capita in the Program Area

	Huayo	Rejo	Chantaco	Tintaycocha	Sol Naciente	Total
>1000	2.9%	1.0%	0.0%	0.0%	0.0%	0.9%
1000-500	1.4%	7.8%	0.0%	3.0%	1.3%	4.2%
500-350	7.1%	1.6%	0.0%	3.0%	2.5%	2.7%
350-250	7.1%	6.3%	2.4%	6.1%	1.3%	5.1%
250-200	5.7%	3.6%	2.4%	6.1%	2.5%	4.0%
200-150	2.9%	9.4%	4.8%	9.1%	3.8%	6.9%
150-100	8.6%	13.0%	14.3%	13.6%	15.0%	12.9%
100-50	25.7%	25.5%	38.1%	25.8%	26.3%	26.9%
50<	38.6%	31.8%	38.1%	33.3%	47.5%	36.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Poverty Index	88.6%	89.6%	100.0%	93.9%	96.3%	92.2%
Net Income(s/. /month)	158	167	71	105	84	133

Source: Study Team

- It is important to mention that the net income includes other revenues, such as those coming from works outside of the place and received remittances. Most of the beneficiaries are in situation of poverty, being the average of 92.2% (Estimate)

These results of analysis allow to conclude that the demand of the contribution of appropriate 20% is not adequate for this type of Program, even shows high rate of economic indexes in the calculation benefit-cost.

In the assumption that demand of 20% of the investment for farmers, if consider the economic characteristics of beneficiaries for this program in the poverty and extreme poverty, the Program will not attain successful results, because of the their subsistence economy, without revenues minimum required neither capital.

3.9.2 Evaluation of Component B; Technical Irrigation

(1) Average Cost for Technical Irrigation

The Average cost for the Technical Irrigation are as follows;

Cost of Technical Irrigation

Item	Cost of Irrigation Module (s/. / module)	Cost per Hectare (S/. / hectare)	Beneficiaries Contribution
Direct Cost of Thechnical irrigation	132,200	6,610	
General Expense (5%)	6,610	331	
Profit (5%)	6,610	331	
IGV (19%)	27,630	1,381	
Total	173,050	8,652	1,730
Development of Training Events	38,000	1,900	
Technical Assistance & Agricultural Extension	30,250	1,513	
Environmental Impact Mitigation	4,000	200	
Subtotal	72,250	3,613	
GENERAL EXPENSE (2 %)	1,445	72	
PROFIT (0%)		0	
IGV (19%)	14,002	700	
Total of Training	87,697	4,385	0
Total of Technical Irrigation	260,747	**13,037**	**1,730**

Source: Study Team

The Estimated cost for the Component of the Technical Irrigation is of S/. 8,652 for hectare for work and S/. 4,385 for training. It is estimated that the beneficiary's contribution is of S/. 1,730 for hectare.

(2) Benefit of the Component

The relation between investment, benefit and contribution are as follows;

Relation between investment, benefit and contribution

Technical Irrigation	Area	Investment	Benefit (S./)			Contribution
	(ha)	(S./)	Without	With	Increase	
Amazonas (13 modules)	260	13,037	2,588	4,320	1,732	1,730
Cajamarca (4 modules)	80	13,037	1,396	3,480	2,083	1,730
Piura (6 modules)	60	13,037	1,154	5,756	4,601	1,730
La Libertad (6 subproject)	60	13,037	3,932	14,043	10,111	1,730
Ancash (14 modules)	280	13,037	2,922	8,969	6,047	1,730
Huanuco (2 modules)	40	13,037	4,180	7,079	2,899	1,730
Junin (9 modules)	180	13,037	3,278	7,746	4,468	1,730
Huancaverica (2 modules)	20	13,037	1,984	6,052	4,068	1,730
Ayacucho (7 modules)	140	13,037	2,539	8,500	5,960	1,730
Total (56 Modules)	1,120	13,037	2,733	7,223	4,490	1,730

Source: Study Team

(3) Study for the Economic Possibility of the Contribution by Beneficiaries

The possibility of contribution of 20% of the investment will be the contribution for the infrastructure by beneficiaries, being the value of contribution of S/. 1,533 and the increment of S/. 4,490.

However, the contribution of the beneficiaries is extremely difficult, although it shows favorable values of IRR. Among the reasons, it will be appointed following:

- It will cause a default situation of farmers, if the proper agricultural credit mechanism doesn't exist to pay the contribution.
- In the case of technical irrigation, a quite high risk exists, because technical irrigation require uses of agricultural inputs for its production, requiring the credit lines for the purchase of agricultural inputs.
- However, in Sierra, the introduction of technical irrigation system is necessary due to the limited land resources and water resources.
- The conflicts for the water use are frequent in Sierra.

However, it is recommended to implement the technical irrigation like a model the water use in order to allows more beneficiaries of water use through economized water resources.

3.10 Risk Analysis

The Program, having the superior objective of "increment of the agricultural production of the families located in the environment of smaller development in Sierra", incorporates the activities of 1) to Improve the irrigation system and construction of irrigation infrastructure, 2) to Install the modules of technical irrigation and 3) to build the base for the actions of conservation of the basin to assure the supply of water resources. Through the implementation of the Program, the Program plans to obtain the following goals;

To improve and incorporate the irrigation area 38,732 ha, increasing the number of crops

To Benefit 24,849 families of farmers to increase the agricultural production

Expected benefit by this program are;

Expected Benefit of the Program

Type of Cultivated Area	Expected Benefit (Increase of Production)
Area of Improvement (present irrigation area)	With the improvement of irrigation conditions (stable): Number of Crops (1 crop → 2 crops in 50% of the improvement area, except the area for Alfalfa, Manioc and Coffee) Productivity (Level 1 and Level 2→ Level 2)

Area of Incorporation (Rain fed Area)	With the improvement of stable irrigation conditions; Number of Crops (1 crop → 2 crops in 50% of the incorporation area, except the area for Alfalfa, Manioc and Coffee) Productivity (Level 2→ Level 2)
Area of Technical Irrigation	With the condition of technical irrigation: Number of Crops (2 crops in 50% of the incorporated area, except Alfalfa, Manioc and Coffee. Alfalfa, Manioc, Coffee→ 2 crops in 100% of the area, except Alfalfa and Manioc Productivity (Level 2→ Level 3)

The risk analysis will be carried out to identify and to evaluate the type and level of damages and probable losses that could affect an investment from the point of view of the prospective benefit. The prospective benefits will be been able to obtain through of the followings actions:

- Water Resources stable supply
- Stable yields

The risk analysis will be done for followings points;

- Risk Analysis
- Vulnerability analysis
- Estimation of risk
- Definition of alternative of measures to mitigate the risk and cost estimation
- Evaluation of Alternative
- Selection of the best alternative

(1) Risk Analysis to achieve expected benefit

The risks that can affect the achievement of expected benefits can be identified in the following;

Possible Risk to Achieve Expected Benefit

Fields	Risk
Program	▪ Price Escalation of Construction Cost ▪ Possible Damages in the construction stage by natural disasters that can determine the increment of the construction cost ▪ Disposition of participation of the Community and of the Regional / Local Governments ▪ Lack of Technical Assistance for Production ▪ Lack of Adequate Agricultural Credit system for the purchase of agricultural inputs ▪ Low Price of the Products (not to lower the cost) that don't covers the production cost
Component A	▪ Lack of Efficient maintenance of the canal by the beneficiaries ▪ Lack of Willingness by the beneficiaries for the participation to improvement of the irrigation system (Improvement of lateral canals) system ▪ Inefficient water use by the beneficiaries that cause shortage of the water resource
Component B	▪ Lack of Disposition by the communities for the installation of technical irrigation ▪ Lack of Disposition for the contribution of the irrigation infrastructure (20%) by the beneficiaries' ▪ Lack of Dispositions to improve the traditional agriculture to improved agricultural practices
Component C	▪ Lack of Rural Communities willingness to accept sensitization and motivation of watershed conservation ▪ Lack of disposition to strength organizations by rural communities ▪ Lack of Financial Support of Regional and Local Government

(2) Vulnerability analysis

Level of the vulnerability for each risk classified into high, medium and low are;

Level of the vulnerability for each risk

	Factor of vulnerability	Level of Vulnerability		
		Low	Medium	High
Program	Price Escalation of Construction Cost		X	
	Possible Damages by natural disasters (rain, earthquake etc.)	X		
	No Disposition of participation of the Community and of the Regional / Local Governments	X		
	Lack of Technical Assistance for Production		X	
	Lack of Adequate Agricultural Credit system for the purchase of agricultural inputs			**X**
	Low Price of the Products (not to lower the cost) that don't covers the production cost	X		
Component A	Lack of Efficient maintenance of the canal by the beneficiaries		X	
	Existence of climatologically damages in the Operation Stage (frost damage, Droughts etc)		X	
	Not to be able to commercialize the surpluses of products		X	
	Lack of Willingness by the beneficiaries for the participation to improvement of the irrigation system (Improvement of lateral canals) system		X	
	Inefficient water use by the beneficiaries that cause shortage of the water resource			**X**
Component B	Lack of Disposition by the communities for the installation of technical irrigation		X	
	Non realization of open Competitive Bid		X	
	Lack of Disposition for the contribution of the irrigation infrastructure (20%) by the beneficiaries'			**X**
	Non Existence of high values crop to cover the investment for technical irrigation system			**X**
	Non practice with adequate technology to economize use of water resources and to increase yields			**X**
	Lack of Dispositions to improve the traditional agriculture to improved agricultural practices	X		
Component C	Lack of Rural Communities willingness to accept sensitization and motivation of watershed conservation		X	
	Not to be able to Institutionalize the committees for conservation of the micro basin		X	
	Lack of disposition to strength organizations by rural communities		X	
	Lack of Financial Support of Regional and Local Government		X	
	Rural Communities don't begin the activities of conservation of watershed			**X**

Source: Study Team

(3) Estimation of risk

In this point, the possible risks with high level of vulnerability will be analyzed.

1) Lack of Adequate Agricultural Credit system for the purchase of agricultural inputs

The agricultural credit has an important paper to improve the productivities projected in this program. Although the target yields are moderate, the use of agricultural inputs is required. In the following table, required production cost to achieve targeted yield are shown;

Production Cost Proposed in the Program (S/. / ha)

Crop	Without Project	With Project	Increase
Alfalfa	2,616	3,105	489
Potato	4,246	6,308	2,062
Barley grain	1,199	1,584	385
Amillaceous maize	1,532	1,752	220
Green Pea	2,228	3,093	865
Wheat	1,199	1,529	330
Fresh Broad bean	2,228	3,131	903

Dry pea	1,197	1,639	442
Choclo Maize	1,949	2,499	550
Rice	3,821	4,168	347
Hard yellow maize	1,802	2,132	330
Manioc	2,880	3,699	819
Dry Broad bean	1,197	1,606	409
Olluco	3,321	4,520	1,199
Sweet potato	3,390	4,122	732
Bean Dry grain	2,077	2,455	378
Coffee	3,009	3,229	220

Source: Study Team

Besides the increase of production cost for hectare, the increase of the cropping area exists. This carries the increase of average yearly cost of S/. 1,993 as shown in the following table.

	Without Project	With Project	Increase
Production Cost (Program)	66,737,000	144,984,000	78,247,000
Average Cost of Production for beneficiaries	1,700	3,693	1,993

Source: Study Team

The beneficiaries require to use the average cost of S/. 3,693 yearly. If beneficiaries don't use the agricultural inputs, to obtain the prospective yield will be difficult. This factor is a factor of risk. The beneficiaries are forced of looking for the financial resources to buy agricultural inputs. In the case that the beneficiaries have enough work capital for the purchase of agricultural inputs they would not have problems. However, most of the beneficiaries don't have enough work capital. Also, reasonable agricultural credit line don't also exist in the market. If the beneficiaries take credits prevalent in the market with interest rate (3.5% / month), the risk of default will be increased.

2) Inefficient water use by the beneficiaries that cause shortage of the water resource

In the Program, followings efficient ratio are applied;

Irrigation Efficiency for Different Conditions

Item	Improper maintenance conditions	Present Condition	Condition with canal improvement
Conveyance efficiency	0.40	0.87	0.95
Distribution efficiency	0.50	0.55	0.77
Application efficiency	0.40	0.42	0.55
Irrigation efficiency (%)	0.08	0.20	0.40
Annual net demand for water resources (mm)	790	790	790
Annual gross requirement of water resources (mm)	9,875	3,950	1,975
Water requirement in relation to canal in improved conditions	5 times	2 times	-

Source: Study Team

The Program intends to improve the irrigation efficiency to the 0.40, of the efficiency at the present situation is of 0.20. With this improvement of efficiency, the Program plans to enlarge the area of irrigation reach. In case the beneficiaries don't carry out an efficient use of water, the impact of the program will be very limited. According to the social survey carried out by the Study Team, the conventional irrigation practices are the practices called Melga (to see Square 3.1-4), practice that consumes great quantity of water.

The risk to loosing of water resources by bad use of water is high. The sensitizing of the farmer to realize efficient use of water will be required.

3) Lack of Disposition for the contribution of the irrigation infrastructure (20%) by the beneficiaries'

Taking into Consideration that the beneficiaries of the Program are surviving in situation of poverty and extreme poverty, they lack capital to participate in the system of competitive bid with 20% of contribution. For this reason, high risk exists of not being possible to implement the technical irrigation module. According to the social survey carried out by the Study Team, among the 40 to 72%

of the producers have willingness to access to the credit system to improve their farm system (to see Not Squares 3.1-23), however, the cost of technical irrigation system is of S/. 8,652 /ha, being required the approximate contribution of S/. 1,730 for hectare. Since the farmers lack financial resources, they would be forced to consent to the Credit. This would determine future financial problems with high interest rate.

Also, since the installation of technical irrigation requires a collective area to install the system (20ha), high risk that the some producers have to participate without enough capital to contribute 20%. The probability of including this type of beneficiary is high. According to the social survey carried out by the Study Team, those class of monthly income per capita under S/. 100 reach to more than 60%. Since the lands are distributed in small properties, the probability of incorporating to this type of participants without financial capacity is very high. If the contribution of 20% of the investment, the implementation of the system of technical irrigation by competitive bid style will be very difficult, increasing the risk of not being implemented the Program.

However, the introduction of technical irrigation is extremely important to introduce efficient use of water resources and to resolve the conflicts for the use and distribution of the water.

4) Non Existence of high values crop to cover the investment for technical irrigation system

In the Program, in order to non-overestimating the benefits of the Program, the traditional cropping was proposed. However, to able to introduce the technical irrigation practice, is necessary to also introduce products of high values crop with more profitability. These can be quinoa etc that bring more benefit. In case non-finds, the products of high value, the incorporation of the technical irrigation will be deferred until to find the products that have these characteristics For the introduction of high value crop, agronomic appropriate investigations for each region will be required. However, for it is required the participation of the investigation institutions in the investigation for agricultural practice and commercialization studies to find the market niche.

5) Non practice with adequate technology to economize use of water resources and to increase yields

Another high risk factor will be that the producers don't show disposition to learn the practice of technical irrigation method. This risk is high in the current situation in that technical support doesn't exist for the farmers. According to the social survey carried out by the Study Team, the farmer don't have knowledge of technical irrigation practice. If some mechanism to support the upgrading of agricultural practice doesn't exist, the installation would not be a success.

6) Rural Communities don't begin the activities of conservation of watershed

Regarding to the Institutional strengthening for the watershed conservation, it exists high risk that the communities don't approach to the conservation actions, due to great effort required for their maintenance. The necessity exists of inducing the knowledge of the farmers, about the value of the water and to consider an environmental payment to the farmers for the preservation of the water and of the land.

(4) Definition of alternative of measures to mitigate the risk and cost estimation

The biggest risks in the Program are in the following points;

- Not to find the high profitability Crop that cover the investments, due to lack of investigations or market studies.
- Not to find a adequate credit system that able to do the investment of the producers

It is necessary to accelerate the investigation on the introduction of technical irrigation practice and of high value product with a stable market taking advantage of a module of technical irrigation to be installed for each subproject. With this alternative, one will be able to mitigate at least following risks;

- Inefficient use of water by the beneficiaries
- Non disposition to the contribution of the watering (20%) installation
- That new crops of high value don't find to cover the investment in technical irrigation
- Not to learn the technical irrigation practice to economize the use of water and to increase their productivity

It is recommended to install some investigation center to innovate the farming technologies and of use of technical irrigation practices. It is also recommended to establish a mechanism of agricultural credit system to facilitate the purchase of agricultural inputs to increase the productivity. The Alternatives to mitigate the risks would be:

Alternative 1: To build a Investigation Center, using an module of Technical Irrigation will be installed for each subprojects

Alternative 2: To establish a Agricultural Credit Mechanism for the purchase of Agricultural Inputs

(5) Evaluation of Alternatives

With the introduction of the alternatives 1 and 2, the Program postulates to obtain the positive following impacts:

Alternative	Effects
Alternative 1 (to implement Investigation Center)	▪ Be able to find the appropriate practices for each region and to recommend the introduction of strategic cultivations for each region ▪ Beneficiaries can realize investments with more trust ▪ The risks of the investment of beneficiaries can diminished
Alternative 2 (To Establish Adequate Agricultural Credit Mechanism)	▪ The producers can make investments with more trust ▪ The financial cost it won't affect the activities of the producers The producers they can be capitalized to carry out new investments

(6) Selection of best alternative

It is recommended to begin the application of technical cooperation to improve the farming technologies, using the technical irrigation module. The actions to be carried out are:

- To carry out the investigation of adaptability of the strategic crop for each subprojects
- To Carry out the technological transfer on the use of technical irrigation practices (fertigation, irrigation application, etc.)
- To Carry out the technological transfer on the Introduction of new crops
- To Carry out the production of seeds and to make wide distribution of them

3.11 Analysis for Sustainability of the Program

Sustainability is the ability of a project to maintain an acceptable level of flow of benefits through its economical life that can be expressed in quantitative and qualitative terms. The sustainability analysis starts from the identification of the institutional arrangements feasibility, referred to the conditions that will allow the joint work of the Formulation Unit, the Executing Unit, the Cooperation Entities and the Direct Beneficiaries of the Program. For that, the program of irrigation systems management has been developed during the design stage in the same way as it will be during the execution stage, that is, in a joint manner with the State entities that regulate water resources management and those in charge of the operation and self-administration of the systems (Board of Users).

The Formulating and Executing Unit of the Program of Small and Medium Irrigation in the Peruvian Sierra is constituted by the Program of Productive Rural Agriculture Development - AGRORURAL, created through Legislative Decree Nº 997 of March 13, 2008 as an entity depending on the Ministry

of Agriculture (MINAG) and subordinated to the Vice ministry of Agriculture; product of the merging of OPDs and programs such as PRONAMACHCS, PROABONOS, PROSAAMER, MARENASS, ALIADOS, CORREDOR PUNO CUSCO, PROJECT SIERRA NORTE and PROJECT SIERRA SUR. It is in charge of promoting and administering the actions of the government at different levels (National, Regional and Local) in the different watersheds of the Peruvian Sierra. For the fulfillment of its purposes, said entity counts on with an appropriate technical and operative capacity through the departmental offices and zonal agencies distributed in the Program area. The Co-formulating and co-executing Units of the sub projects are constituted, besides AGRO RURAL, by the Local and Regional Governments, the Agrarian Regional Directions, and the Local Authorities of Water in the framework of their jurisdictions.

A second aspect refers to the evaluation of indirect benefits (positives or negatives) that affects individuals not necessarily included in the benefited population. In general, it is expected from the Program to generate positive impacts in the influence area of the Subprojects, both at environmental level, conserving the ecosystem, and at social level replicating the economic benefits to the zone. Such indirect benefits can be expressed through:

- Availability of water resources downstream, favoring potential cultivation zones not included in the sub- projects influence area; as result of improvements in irrigation management and the efficiency in the use of water in the area of sub projects that reduce loss of resources and the risk of conflict with the neighbors;
- Improved management in the use of pesticides and change in the agricultural uses and habits that cause salinization, erosion of soils, deforestation, etc., that will also benefit the sub projects' surroundings.
- Participation of population not defined as direct beneficiary of the Program, in the irradiation of economic effects of the interventions such as: increase of agriculture activity as consequence of intensive use of soils (double crop) and the incorporation of new cultivation areas demanding more labor, improvement or creation of new road infrastructure and other basic services such as health, education, sanitation; implementation of organizations and commercial practices that will approach the population to the market and that will cause demonstrative effects of improvements in the quality of life in relation to the surroundings.

A third aspect refers to the identification and mitigation of threats and risks to be faced by the Program during the execution or launching; that for the case of Components A: Irrigation infrastructure and B: Technical Irrigation; could mean:

- Difficulty of the Users Boards to get the counterpart contribution to co-finance the works cost.
- Low quality and considerable execution period both for perfiles and for detailed design, due to lack / little availability of qualified personnel for the preparation of this kind of studies.
- Organizational and institutional weakness of the Users Boards that could make it difficult the fulfillment of eligibility criteria to access to financing through competitive grants.
- Possibility that water users, beneficiaries of the sub projects at first would not be in conditions to pay even the balance water tariff.

To all that, the specific risks in the execution of technical irrigation projects oriented to the establishment of demonstration modules of irrigation by sprinklers in the pilot areas of the Sierra, such as:

- The application of the "Competitive grants" process for the implementation of Technical Irrigation projects could be considerably large.
- Difficulty for the conformation of group of beneficiaries for the Technical Irrigation

component that show local continuity; that is, groups of farmers with bordering land (usually interested farmers are not together or in only one block, they are dispersed).

From the experience of similar programs such as the Program Sub sector of Irrigation– PSI Sierra; the following mitigation measures could be taken for the problems identified above:

a. Regional and Local Governments, recipients of royalties, assign part of said resource in the institutional budgets to finance the national counterpart contribution of the Subprojects. Where such source does not exist, Central Government will transfer the necessary resources. This participation would be implemented through a legal norm.
b. Concerning the quality and opportunity of the pre-investment studies and the detailed design, AGRORURAL in its quality of Formulating and Executing entity, should contract said studies, in charge of the budgets of beneficiaries, local or regional governments, as it corresponds; with experts in the elaboration of pre-investment studies registered in the Bank of Experts of the General Direction of the Multi-annual Programming, DGPM-MEF.

3.11.1 Evaluation of the willingness to pay for the irrigation water

The participation of the beneficiaries is fundamental to assure the benefits of the project, so there a clear and precise evidence of the willingness and interest of the beneficiaries to participate in the Program should exist. To contribute to this achievement, the Program should promote tasks of motivation and awareness rising at level of users and directors, to promote and/or reinforce the willingness to pay for the irrigation water.

The regulation in force (Supreme Decree Nº 003-90 AG) establishes that the water tariff should be such as to cover the expenses of operation, maintenance, general expenses and the reimbursement of the investment to the State during the project useful life. This condition is expressed through three components of the water tariff:

- *Board of Irrigation Users (JUR)*. Expenses of maintenance, insurance, replacement and administration of the Boards of Users and Irrigation Users Committees.
- *Royalty of water*. 10% of the irrigation water tariff assigned to finance the budget of the Autonomous Authority of the Watershed.
- *Repayment of the investment*. Part of the tariff assigned to the recovery of investments made by the State in the project.

Actually, there is a consensus that once the water tariff of balance is calculated (value of the water tariff when the NPV is zero) it is compared with the water tariffs of the region in force at the moment of developing the sub projects (information available in the existing board of irrigation water users); with the purpose of knowing if the water tariff is sustainable in time, if the potential farmers will be able to assume the payment, if the tariff paid before by the farmers benefited with the improvements is higher or lower than the water tariff of balance and analyze said tariff in the regional scope.

Considering maintenance costs that will be required for the conservation of canals and reservoirs (intervention only of Component A) we would have:

Cost of maintenance /ha = S/. 5,340,000 per year / 79,995 ha = S/. 66/ha/year

It means that S/. 66/ha/year would have to be assigned to the water tariff collected by the organization of irrigation water users so the conservation of the intervened irrigation infrastructure would be sustainable. It should be indicated that the present tariff in the prioritized Board of Users is in average S/. 40/ha/year, reaching levels of S/. 60/ha/year in some areas; so under good management, maintenance costs of the works to be executed could be covered.

As evidence of the willingness to pay for the use of irrigation water, the results of the Socioeconomic Survey to Beneficiary Farmers of the sub-projects developed in the scope of the Program are illustrative, and the following could be concluded:

- 98.5 per cent of farmers are willing to participate in the construction of irrigation infrastructure; (95.5%) with labor force.
- 59.1 per cent of farmers are willing to pay a tariff for operation and maintenance of the irrigation infrastructure. Those not willing to pay, would do by providing labor force (59.3%), communal tasks (14.8%).
- 59.1 per cent is available to participate in the system of water tariff collection.
- 97 per cent declared that if the government pays 80 per cent they would pay the remaining 20 per cent to improve the system of Technical Irrigation. 82 per cent declared that they would be willing to pay it with labor.

3.11.2 Participation of the Community in Operation and Maintenance

The necessity to count on with an organization of users provided with regulations and agreements, explicit or implicit, is proposed to assure the correct administration of water and the irrigation infrastructure. The sustainability of the irrigation system requires the reinforcement of the organizational structure of the board of users to show solidity in the operation of the minor irrigation infrastructure and also an organizational level appropriate for the maintenance of the larger irrigation infrastructures; assuring the sustainability of the system as a whole, that means:

a. Self-financing of irrigation systems through real tariff collection based in two variables, the first variable is the fixed cost calculated by hectare and the second variable is calculated based in a determined volume or based in the cultivation module installed.
b. Training and technical assistance that allow the continuity for the preparation of the actors involved in the management of irrigation systems.

The said strategy should establish measurable commitments and goals defining responsibilities and terms; that can be materialized in investment commitment letters signed by all beneficiaries, manifesting their knowledge about the project and the costs they have to assume after the execution stage.

3.12 Environmental Impact

The environmental impacts that could be generated by the Program depend on the particular characteristics of the activities to be conducted and the natural sensitiveness of the intervention site.

Environmental impacts have been determined and evaluated by the use of checklists and evaluation matrix. (See Tables 3.10-3, -4 and -5).

The present chapter shows the legal base and the institutional framework of environmental management, describes the Program and formulates the impacts and the plan of environmental management.

3.12.1 Legal and Institutional Framework

(1) Legal Frameworks

Regulation	Description
Political Constitution of Peru	The major legal norm of Peru, besides the essential rights of the human person, it stresses the right to have a balanced and proper environment for live development.
General Law of Environment (Law N°28611)	Legal regulation framework for environmental management in Peru. Establishes the basic principles and norms to assure the effective exercise of the right to healthy, balanced and proper environment for the full development of life.

Regulation	Description
Law of the National System of Environmental Impact Assessment (Law N°27446) and Regulation	Creation of the National System of Environmental Impact Assessment (SEIA), as a single and coordinated entity of identification, prevention, supervision, control and correction of negative Environmental Impacts, derived from human actions through investment projects The Regulation is still under discussion by the different sectors.
Frame Law of the National System of Environmental Management (Law N°28245)	Assures the fulfillment of the environmental objectives of public entities, reinforcing trans-sector mechanisms in the environmental management. Establishes the tools of environmental management and planning.
Law of Water Resources (No 29338)	This law recently promulgated creates the National System of Water Resources Management with the objective of articulating the actions of the State to conduct processes of integrated management and conservation of Water Resources. Regulates about the structure of this System, creating the National Authority of Water
Law of Protected Natural Areas (Law No26834) and its modification (SUPREME DECREE N°015-2007AG)	Regulate aspects related to the management of Protected Natural Areas and their conservation. In national parks, as in all other cases, the nature of intangibility does not imply that interventions in the area with management purposes to assure the conservation of said elements of biological diversity that so specifically requires cannot be conducted.
Law of Development and Strengthening of Agrarian Organizations (LAW N°28062)	Its objective is to promote the conformation of rural organizations among farmers as legal persons with private right, to create funds through voluntary contribution for the development and strengthening of their organizations and the improvement of their productive works.
Creation of the Program of Technical irrigation (Law N° 28585)	The creation of this program is declared of public necessity and utility with the purpose of promoting the progressive replacement of traditional irrigation systems in the agriculture sector.
Law on the Conservation and Sustainable Use of Biological Diversity (No 26839)	This norm regulates the sustainable use of the biological diversity components. Defines the concepts of conservation and sustainable use. This rule applies the agreement of Biological Diversity held in Rio de Janeiro on June 5, 1992.

Source: Study Team

(2) Institutional Framework

Organism / Institution	Functions
Regional Government	Among the competences there is the sustainable management of natural resources and improvement of environmental quality, preservation and administration of regional protected natural reserves and areas.
Local Government	Function of municipalities: care for the conservation of local flora and fauna and promote actions necessary for the development, rational use and recovery of natural resources located in the territory under their jurisdiction, regulate and control activities related with environmental sanitation, disseminate Programs of environmental education and promote campaigns of forestation and reforestation.
Local Authority of Waters	Entity in charge of watching over the water resource in the corresponding area. Analyses and authorizes the water availability in the project zone
General Direction of Environmental Affairs – Ministry of Agriculture	Competent Sector Authority for projects of water resources. It is under the Ministry of Agriculture
SERNANP – National Service of Natural Protected Areas	Official entity in charge of the administration and all concerned with Natural Protected Areas in Peru.

Source: Study Team

3.12.2 Environmental Baseline

In the following Table the environmental base line is presented, listing the departments that are part of the Program, as well as the problems of the region of intervention. The Natural Protected Areas concerned with the Program are indicated and the flora and fauna of the zone are briefly described.

Items	Description
Concerned Departments	Departments included in the Program area are nine: Amazonas, Ancash, Cajamarca, Piura, La Libertad, Ayacucho, Junín, Huancavelica and Huanuco
Zones in the departments	The projects are located at the sierra zone with altitude superior to 1000 amsl.
Concerned watersheds	Projects of the Program are located in 17 watersheds that are: watersheds of Alto Marañon, Rio Utcubamba, río Jequetepeque, río Crisnejas, río Chancay – Lambayeque, río Chamaya, río Piura, río Chinchipe, río Chicaza, rio Santa, río Pativilca, río Perene, Alto Huallaga, río Mantaro, río Pisco and río Pampas.
Problems in the Peruvian Sierra	There are problems of smallholdings, desertification, weak organizations, lack of financial tools, extreme poverty indicators and lack of water resources in the zone
Flora	It is the most remarked characteristic in respect to altitude in the sierra, each altitudinal stage has a characteristic flora, among them the willow, the pepper tree, the reed, tara, alder, orchids, cañihua, tarwi. In higher parts there are the ichu, moss and litchen.
Fauna	Auquenids (llama, alpaca, guanaco and vicuña), birds (gulls, marihuanas, ducks, etc), mamals (fox, vizcachas, deer) and fish (trout).
Natural Protected Areas	From the 63 official Natural protected areas, 32 are located in the Program area (SERNANP data), this analysis is by department. The analysis by projects is presented in 3.14.7.

Source: Study Team

3.12.3 Direct and Indirect Influenced Area

For the distinct components considered in the Program, two types of influence area can be characterized: direct and indirect.

The area of direct influence is located in the geographic spaces where activities are to be implemented and where the first instance of the effects are to be felt.

The area of indirect influence is where the impacts are to be noticed with less intensity, but the impacts are measurable.

The following influence areas have been established for the Program:

Component of the Program	Area of Direct Influence	Area of Indirect Influence
Component A. Irrigation infrastructure	Immediate zone concerned with civil works	Area irrigated by the constructed or rehabilitated system
Component B. Technical Irrigation	Area irrigated by the Technical irrigation	Benefited population by the system
Component C. Institutional Strengthening	Irrigation Users Committee or irrigation organizations	Area of action of the irrigation committee or organization

Source: Study Team

3.12.4 Analysis of Impacts

Impacts of the three components have been evaluated employing the checklist developed based in the Guidelines of Socio-Environmental Considerations of JBIC (2003) of the Japan International Cooperation Agency (JICA).

According to the impact evaluation information, the expected impacts by component and by stage of the project are described.

(1) Scope of the Program

The Program has three components: A. Irrigation infrastructure, B. Technical irrigation and C. Institutional Strengthening for Watershed Management. This Program is to be applied in the sierra of 09 departments in Peru. The analysis of impacts is to be made by component of the Program and by the stages of the project.

The projects in component A refer to physical works of water caption and conveyance. It includes the construction of dams and conveyance by pipelines. Projects of component B are 1 module of technical irrigation (sprinkler) by each project totaling 76 modules (Alternative 2). This component aims to improve the efficiency of irrigation application.

(2) Component A. Irrigation infrastructure

Irrigation infrastructure allows a better supply of water. However, during the execution stage, presents several impacts, although minimum and localized, should be taken into account for the Program design. The impacts of this component during the stages of planning and formulation, execution, and operation and maintenance are analyzed.

1) Planning and formulation

(a) Conveyance and Distribution of Irrigation Water

Impacts produced during the planning stage are described with the purpose of taking them into consideration for posterior studies of the project or in the detailed design of the works. The said impacts are applicable to the 76 subprojects.

Item	Evaluation
Conflict in use of water at irrigation land	Some farmers see the opportunity to extract water from canals without authorization or to take more quantity than the established one, generating a conflict in distribution.
Loss of water by evaporation and infiltration	Worn out canals generate loss of water by infiltration and the improper use causes loss of evaporation along the canal.
Flood (increase of underground water)	It is produced when there is not a proper irrigation control system; reducing water efficiency and deteriorating the existing soil and vegetation at the zone, generating in some places instability of soils that could affect other irrigation infrastructure by the generation of environmental impacts in chain.

Source: Study Team

(b) Works of regulation, protection and/or modernization in existing dams

Impacts foreseen for the formulation stage at existing dams or lagoons to be incremented are described in order to be taken into account at later stages of the project. It should be mentioned the possible contamination by transport of sediments. Said impact is applicable to the 76 subprojects.

Item	Evaluation
Impoverishment of soil	By modifying the flooding regime, it avoids the soil to receive particle matter transported by sedimentation, such as lime to maintain the alluvial soil fertile, causing rapid contamination by soils fertilization.

Source: Study Team

(c) Construction of new reservoirs or dams

Construction of new dams could generate conflicts in the use of land, so the importance of legalize, make an inventory and obtain the respective permit to use the spaces for the dam. Said impact is applicable to the 17 projects (alternative 2) that present dams: ANC-1, ANC-19, AYA-1, AYA-2, AYA-5, AYA-10, AYA-12, AYA-13, CAJ-8, JUNIN-2, JUNIN-3, JUNIN-6, JUNIN-7, LIB-2, LIB-6, LIB-7 y PIU-4

Item	Evaluation
Conflict for the use of land for dam construction	At the moment of planning a dam, it should be taken into account to avoid conflicts due to land property

Source: Study Team

2) Execution

(a) Conveyance and Distribution of Irrigation Water

Impacts in the execution stage are in function to the magnitude and nature of works. Projects CAJ-1, ANC-11, ANC-5, AYA-13, present the highest possibility of impact, because they are canals of large extension (32 km in CAJ-1) and carry high flow.

Item	Evaluation
Alteration of land talus	The line of the canals favors the cut of talus in the slopes, so during the rainy season landslides could occur, risking the irrigation infrastructure and water supply, interrupting the corresponding flow of water.
Water, soil and air contamination	All construction process implies alterations in the environment that should be prevented and mitigated through low cost practical measures, so they do not occur.
Modification of landscape	The physical presence of works could cause moderate negative visual impacts, affecting the landscape panoramic view, considering the case of projects at areas with little intervention.
Erosion	Works to be conducted would cause erosion in the land used for works, or by flood in the conveyance through canals they generate hydraulic erosion of soils.

Source: Study Team

(b) Systems of Caption in rivers of creeks

Caption or intake systems are structures implemented to catch water from a river, usually of concrete that produce impacts in the river and surrounding areas. Affected projects are: CAJ-1, CAJ-6, PIU-1, PIU-2, LIB-1, LIB-6, LIB-7, LIB-8, ANC-4, ANC-5, ANC-7, ANC-11, ANC-15, ANC-19, ANC-20, HUA-1, HUA-2, JUNIN-6, JUNIN-7, HUANC-3, AYA-5, AYA-10, AYA-12 and AYA-13.

Item	Evaluation
Reduction of minimum flow in rivers (ecological flow)	The alteration or reduction of water flow regime directly affects the aquatic flora and fauna, affecting the mortality of existing species in the river and the riverbed, as also affecting the water supply to attend the water demand downstream.
Change in the natural course of water bodies	The improper use of water sources could generate alterations in the water system hydrology downstream (new water sources, hydromorphic zones, landslides, etc.)
Erosion of river banks by tree cuts	It is produced in the riverbanks as consequence of the weakening and erosion increasing risks of flood and loss of cultivation land.

Source: Study Team

(c) Construction of new dam or reservoirs

These impacts are applicable to the 17 projects that present dams: ANC-1, ANC-19, AYA-1, AYA-2, AYA-5, AYA-10, AYA-12, AYA-13, CAJ-8, JUNIN-2, JUNIN-3, JUNIN-6, JUNIN-7, LIB-2, LIB-6, LIB-7 and PIU-4

Item	Evaluation
Alteration in the river flow regime	Due to the river regulation, the natural regime of the river that in the sierra zone shows a marked difference between rainy and dry season will be modified.
Change in the natural course of water bodies	The improper use of water sources could generate alterations in the water system hydrology downstream (new water sources, hydromorphic zones, landslides, etc.)
Sedimentation and silting of riverbed downstream	Due to the modification of flow regime, silting at the river bed could occur due to the irregular transport of sediments that accumulates rocky/or stony material during the rainy season.
Microclimate creation or modification	The water deposit of the reservoir creates a microclimate that can be conveniently used for tourist purposes, as also to use the reservoir for aquiculture purposes.

Source: Study Team

(d) Other impacts

In this item, other important impacts that can be applicable to the 76 projects of component A (Alternative 2) are described.

Item	Evaluation
Noise	Slight increase of noise level due to the machinery of transportation and works in

	the project zone. If there is some quarry, evaluate the impact
Soil	It could present some alteration in soil quality, loss of vegetal cover and useful layer of soil
Fauna and flora	It could show loss of local fauna and flora due to activities of land excavation or cleaning.

Source: Study Team

(e) Positive Impacts

The positive impacts to be generated through the execution of the physical works of component A are listed.

Item	Evaluation
Employment	Generation of local employment at the influence area of the project.
Commercial Activity	The demand of products and services at the zone will increase for the presence of personnel in the works

Source: Study Team

3) Operation and Maintenance

(a) Conveyance and Distribution of Irrigation Water

In the operation and maintenance stage impacts are to be produced by the way the system is managed, the previous design of the works is important. Said impacts are applicable to all projects of component A.

Item	Evaluation
Landscape	Modification of the landscape view
Ecosystems	In the case of new constructions, the pre-existent natural systems are going to be altered
Health	Due to the longitudinal connections of culverts, the lack of cleaning and hygiene could generate infectious vectors, transmitting diseases by water contamination.
Salinization	Due to the excess of irrigation by bad management, the improper maintenance and lack of drainage, salinization of cultivation land implies loss of production and productivity.

Source: Study Team

(b) Works of regulation, protection and/or modernization at existing dams

Impacts at the existing reservoirs or at existing lagoons are presented.

Item	Evaluation
Regulation and more quantity of water for irrigation	The improvement of the existing irrigation infrastructure and the proper protection measures, assure a better use in water delivery.

Source: Study Team

(c) Construction of new reservoirs or dams

The impacts of operation and maintenance on dams are very important for they condition the mitigation measures to be applied. In dams, care should be taken in the fact that it is an artificial storage of water in a zone where previously a creek existed. These impacts are applicable to the 17 projects that have dams: ANC-1, ANC-19, AYA-1, AYA-2, AYA-5, AYA-10, AYA-12, AYA-13, CAJ-8, JUNIN-2, JUNIN-3, JUNIN-6, JUNIN-7, LIB-2, LIB-6, LIB-7 and PIU-4

Item	Evaluation
Eutrophication and contamination	The excess of nutrients causes an excessive growth of aquatic vegetation and as consequence there is degradation of water quality in reservoirs or at reception water bodies (proliferation of algae, aquatic weeds, etc.).
Presence of plagues and agricultural diseases	Improper application of fertilizers and/or plaguicides, and an improper phytosanitary control can generate infectious factors affecting not only crops but also the health of farmers.
Reduction of hydro biological biomass (fishery)	Fishery activities are deteriorated due to changes in the regime of flow that does not allow the maintenance of aquatic fauna. Worse when the ecological flow is not considered.
Negative impact to housings downstream during the maintenance	It adds the danger of dam overflow that could generate damage downstream the dam. It would depend on the analysis of magnitude and location.
Health	The possibilities to increase diseases produced by water stagnation during a certain period, besides other kind of vectors could show, to propagate diseases. Possibilities of water overflow

Source: Study Team

(d) Positive Impacts

The positive impacts in the operation and maintenance stage are multiple, for the construction or improvement of physical works will impact in the living conditions or life quality of the beneficiary population, allowing the increase of jobs, commercial activities and capacity of expenses of the population.

Item	Evaluation
Agriculture Activity	Better income are generated and so the life quality of farmers will improve
Commercial activity	Supply of agriculture products will increase due to a better distribution of water on time.

Source: Study Team

(3) Component B. Technical Irrigation

The impacts that could be generated by the component B in the Program scope are following described. It is applicable to the 76 projects of the Program for each of them will have one module of technical irrigation totaling 76 modules. The impacts by stage of the project are described: Planning and formulation, execution and operation y maintenance.

1) Planning and formulation

In the planning stage it is very important to consider the following impacts for they will have to be evaluated to offer to the beneficiary an optimum design and according to the topography, requirements and possible supply of agriculture products.

Item	Evaluation
Alteration of habits and culture of the communities	Change in irrigation type brings together new habits in the use of modern technologies (at least for the poorest and most abandoned zones of Peru), generating changes of cultural, social and historic patterns. As technical irrigation systems by sprinklers are considered, it implies a change in the system of irrigation
Impact of technological change in women	The agriculture works incorporate a greater number of women given the new conditions of development in a modern agriculture. Women's participation is increasing in the productive sector constituting a modern impact in commercial relations.
Acceptance in changing cultivation products	At the moment of the project formulation, the acceptance to change cultivation products by farmers should be taken into account to make it sustainable.

Source: Study Team

2) Execution

At the works execution stage, the environmental impacts will be present in a localized manner at the zone of influence of the project, as there is one module, impacts will be soft and during a short period.

Item	Evaluation
Increase in the level of emissions in the air	During the construction stage, emission levels that is environmental quality will increase due to the dust resulting from earth works, eolic erosion, exposition of material sources, as well as gas emission derived from the machinery operation. The effects of this impact are temporary and specific.
Increase in noise level	The construction stage and in a less measure at the maintenance stage, machinery used in earth works as well as transportation of material produce noise levels that cause problems of physiology, communication and reduction of labor productivity of workers and distract the population.
Soil Desestructuring and compacting	This impact refers to the change of soil structural and compacting properties due to the transport of material to the zone such as pipes with high load trucks.
Deterioration of water quality	Many of the construction activities cause the deterioration of water quality downstream mainly due to the increase of suspended solids for the movement of material.
Modification of flora composition	Produced mainly by tree fells and introduction of new species. There are colonizing vegetal species of rapid growth and easy dispersion that could displace the native species.
Disturbance to the fauna	The presence of a great number of persons during construction will produce the emigration or alteration in the behavior of the majority of vertebrate species. The effect is aggravated if there is movement of vehicles and heavy machinery for the noise produce by the engines affect the system of some species

Source: Study Team

3) Operation and Maintenance

In the stages of operation and maintenance generated impacts will favor environment with a reduction in the probability of erosion by using less water and less aggressively than irrigation by gravity and the protection of ecosystems.

Item	Evaluation
Soil impoverishment	As consequence of the improper use of the system of irrigation for the application of fertilizers, as well as carelessness in control and/or monitoring of irrigation water quality.
Contamination by use	Lack of good practices in the use of plaguicides can cause processes of soil and water pollution, affecting health of persons.
Efficient use of water	Dripping irrigation generates a greater availability for the efficient use of water, avoiding loss by filtration, evaporation, over-irrigation.
Control of erosion	Due to irrigation water rotation that tends to an exact quantity of water for plant, soil receives the necessary humidity not affecting its physical structure.
Protection of ecosystems	Due to the new socio-cultural conditions that implies the productivity increase by irrigation, forests and wild land of the zone are protected because of the higher level of knowledge and awareness of the local population

Source: Study Team

(4) Component C. Institutional Strengthening for Watershed Management

Watershed management will allow that works proposed in component A and component B, to be properly handled in environmental terms. That is why it is important to analyze the impacts in this item.

1) Planning and Formulation

Impacts are present during the formulation process; at the moment to choose actions and places to

implement said actions of the component.

Item	Evaluation
Choosing the watersheds	At the moment of planning the intervention method in the chosen micro watersheds, the organization capacity of population to improve poverty levels is to be sought.

Source: Study Team

2) Execution

During the execution stage, positive impacts will show for during the process of training and territorial ordainment, environmental conditions tends to improve.

Item	Evaluation
Environmental Care	During the Program execution the irrigation committees and the watersheds management committees are going to be the main actors and the micro watershed environmental care has to be taken by them.
Land use	Concerning land and natural resources use, the proper use of agriculture land will be promoted.
Training	The improvement of organizations and their capacity will be through training events.
Territorial Ordainment	The involvement of social, economic, political and technical actors in the decision making through concerted decisions are going to be through actions of Territorial Ordainment, for the ordained occupation and sustainable use of the micro watershed.

Source: Study Team

(5) Operation and Maintenance

During the operation and maintenance stages positive impacts will show as result of training toward leaders and beneficiaries applied to a better management of resources and better opportunities to commercialize agriculture products.

Item	Evaluation
Management	When the irrigation committees start to operate, they will arrange the distribution of the irrigation infrastructure built and will manage water resources in the project.
Disasters	Watershed management committees, through their tools, will orient towards the reduction of risks due to natural phenomena, by managing the whole micro watershed.

Source: Study Team

3.12.5 Environmental Management Plan

(1) Environmental Management

The Plan of Environmental Management contains procedures for project evaluation, alternatives of mitigation and supervision, accordingly to the national environmental laws and the guidelines for the socio-environmental considerations on the matter.

In the mentioned procedures there is the environmental classification of projects that, at this level is preliminary for there is not complete information about the projects. This classification will generate levels of studies for the projects that are conducted by the proposing entities.

Then, AGRORURAL, as responsible organization, will be in charge of supervising the fulfillment of environmental rules and the proposed mitigation measures and finally will close the cycle by preparing a final report before the execution.

The tools to be used in this process are:

- Environmental Categorization Form - FCA
- Report of Preliminary Environmental Evaluation - EAP
- Report of Environmental Control and Follow Up - RCSA
- Final Environmental Report – RAF

The following Table explains the processes and cycles to be followed by the project in order to fulfill the environmental requirements.

Process Cycle	Description	Environmental Tool
Environmental Categorization	Beginning of the process for a preliminary classification of the project to be submitted to evaluation to the General Direction of Environmental Affairs DGAA-MINAG	▪ Environmental Categorization Form
Environmental Studies	A level of environmental study will be assigned according to the DGAA approval, to obtain the corresponding environmental certification.	▪ Environmental Impact Statement ▪ Semi detailed Environmental Impact Study ▪ Detailed Environmental Impact Study
Control and follow up	In this process the fulfillment of measures and actions established in the environmental studies are revised and supervised	▪ Report of Environmental Control and Follow up - RCSA
Final Environmental Report	Fulfillment of the measures established in the studies for approval, once the execution of projects is finished	▪ Final Environmental Report

Source: Study Team

(2) Tentative environmental classification

Environmental impact studies related to irrigation are subject to the National System of Environmental Impact Evaluation (SEIA), and the supervision is in charge of the Ministry of Agriculture, through the General Direction of Environmental Affairs. Its regulation is under process of promulgation. The tentative classification has been implemented according to the following process:

1. Classification of Irrigation infrastructure types and works to determine three type of risks, Type-1, Type -2 and Type -3.
2. Classification by sensibility for 3 levels: High, Moderate and Low.
3. Results of the classification by type and sensibility are compared. Projects are classified according to three levels: Level 1, Level 2 and Level 3.

The result of the tentative categorization is the following:

Table 3.12-1 Component A, Levels of Environmental Studies

Level	Required Environmental Study	Nº of Sub projects	Special items considered for classification
Level 1	Environmental Impact Statement	41	
Level 2	Semi-detailed EIA	15	Dam, Slope, Natural Protected Area
Level 3	Detailed EIA	0	

Source: Study Team

3.12.6 Analysis of Natural Protected Areas

(1) Classification of Projects in relation to protected natural areas

Analysis was conducted according to the System of Geographic Information, the same that indicates the possibility of intersection with a natural protected area. In the following Table the projects near natural protected areas are listed.

Table 3.12-2 Projects with possibility of intersection with NPA

Code	Name of Project	NPA- Intersection	Number of projects
ANC-2	Improvement Canal Irrigation Paron II	National Park (NP) Huascaran	1
ANC-5	Construction Canal of Irrigation Sol Naciente de San Luis	Buffer NP Huascaran	6
ANC-11	Construction Canal Cordillera Negra	Buffer NP Huascaran	
ANC-12	Improvement Canal Rurec	Buffer NP Huascaran	
ANC-17	Improvement Canal Chuayas-Huaycho	Buffer NP Huascaran	
ANC-18	Improvement Chinguil - Cruzpampa	Buffer NP Huascaran	
AYA-9	Improvement and Cons System of Irrigation Putacca Ccatun Pampa	Protected Wood Titankas – Proposal GR	
ANC-10	Construccion Canal Aynin-Huasta	Less than 1 km NPA – NP Huascaran	2
ANC-9	Improvement Canal of Irrigation Quinta Toma	Less than 1 km NPA – NP Huascaran	

Source: Study Team

Table 3.12-3 Social Environment Check List

		Components / Environmental Items	Total Evaluations	Component 1(Irrigation infrastructure)				Component 2 (Technical irrigation)				Component3 (Institutional and Organizational Strengthening)			
				Planning and formulation	Execution	Operation and Maintenance	Description	Planning and formulation	Execution	Operation and Maintenance	Description	Planning and formulation	Execution	Operation and Maintenance	Description
Social Environment	1	Resettlement of affected population	-	-	-	-	There is no identified impact	−	−	−	There is no identified impact	-	-	-	There is no identified impact
	2	Housing and life style	A+	-	B+	B+	Improvement in quality of life for farmers is part of the Program's objective and the execution of sub-projects generates job opportunities and irrigation operation improves agriculture productivity	-	A+	A+	Execution and operation of irrigation systems improve agriculture productivity.	-	B+	B+	Through strengthening activities population will be motivated to care for the micro watershed, the life style and especially the environment will improve.
	3	Land use and local resources	B+/C-	C-	C-	B+/C-	Improvement in land use is is part of the Program's objective, increase of agriculture land is proposed. Little conflict about water use in irrigated land would possibly be generated (establishment of drainage net at the planning stage and present use in the stages of execution and operation) if proper information is not provided. Communal land will chage to permanent water bodies by the construction of new dams (all land for dam are communal land).	C-	C-	C-	Little conflict about water use in irrigated land would possibly be generated (establishment of drainage net at the planning stage and present use in the stages of execution and operation) if information provided is not transparent	-	B+	B+	Through strengthening activities population will be motivated to care for the micro watershed, the life style and especially land use will improve.
	4	Social institutions, social organizations and the local decision making process	B+	-	-	-	There is no identified impact	-	-	−	There is no identified impact	B+	B+	B+	Through strengthening activities decision making process will improve.
	5	Irrigation infrastructure and existing social service	-	-	-	-	There is no identified impact	-	-	−	There is no identified impact	-	-	-	There is no identified impact
	6	Vulnerable or poor population, Native communities	B+	-	B+	B+	Program areas show high levels of poverty, life quality is expected to improve by increase of jobs during execution and by increase of agriculture productivity.	-	B+	B+	Program areas show high levels of poverty, life quality is expected to improve by increase of jobs during execution and by increase of agriculture productivity.	B+	B+	B+	Program areas show high levels of poverty, life quality is expected to improve by organizational strengthening
	7	Unequal distribution of benefits and risks	-	-	-	-	There is no identified impact	-	-	−	There is no identified impact	-	-	-	There is no identified impact
	8	Cultural Heritage	-	-	-	-	There is no identified impact	-	-	−	There is no identified impact	-	-	-	There is no identified impact
	9	Sanitation/Health (Diseases caused by water)	C-	-	-	C-	Risk of diseases originated by water will increase with dams and reservoirs although most of them are located at the high zones that impede the easy proliferation of microorganisms.	-	-	-	There is no identified impact	-	-	-	There is no identified impact
	10	Right of water and communal land	B+/C-	-	-	C-	Increase of cultivation area in the operation stage could change rights of communal land.	C-	C-	C-	Conflict in water use by irrigated land would occur if there is not good communication among farmers.	B+	B+	B+	Through strengthening activities, right in use of water are assured and formalized.
	11	Risk of natural phenomenon (Flood, landslides, forest fire, etc) and infectuous diseases (HIV/AIDS)	C+/C-	-	C-	C-	External works probably will increase the risk of infectious diseases in far away communities. a)Erosion of riverbanks by cut of trees produced in riversides as consequence of weakness and erosion increasing risks of flood and loss of cultivation areas. b)Sedimentation and silting of water downstream by construction. Due to modification of flow regime, riverbed silting by irregular transportation of sediments that accumulates rocky/stony material in rainy season. c)Possible personal accidents with the population during water discharge in the canal	-	-	-	There is no identified impact	-	-	C+	Through strengthening activities, knowledge on environmental conservation will increase or will be oriented to the reduction of risks by natural phenomenon.

Source : Study Team

Table 3.12-4 Natural Environment Check List

		Components / Environmental Items	Total Evaluations	Component 1(Irrigation infrastructure)				Component 2 (Technical irrigation)				Component3 (Institutional and Organizational Strengthening)			
				Planning and formulation	Execution	Operation and Maintenance	Description	Planning and formulation	Execution	Operation and Maintenance	Description	Planning and formulation	Execution	Operation and Maintenance	Description
Natural Environment	1	Topography	B-	B-	B-	-	In the Sierra, topography with high sloped in general, massive cuts have to be avoided in planning and execution not to produce erosion	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	2	Geology	-	-	–	-	There is no identified impact	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	3	Soil	B-	-	B-	B-	New irrigation area can be exposed to the possibility of erosion, requiring measures such as soil conservation. By changing flood regime, it avoids soils to receive particle matter transported by silting, such as mud to keep alluvial land fertile, causing rapid contamination by soil fertilization. Works to be conducted will cause land erosion, or by flood in conveyance through canals of generate water erosion of soils.	-	-	B-	Desestructuring and compacting of soils refers to changes in structural properties and soil compacting due to the transportation of material to the zone such as high load trucks	–	–	–	There is no identified impact
	4	Fauna	B-	-	B-		Temporal impact of fauna is predictable during execution Loss of natural habitat will occur with the construction of dam near Natural Protected Areas, so an environmental study has to be generated for the project zone.	–	–	–	There is no identified impact	–	–	–	There is no identified impact
	5	Flora	B-	-	C-		With the construction of new dam and canal, impact in flora is foreseen as well as part of vegetation is to be removed.	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	6	Groundwater	C-	-	-	-	There is no identified impact	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	7	Hydrological conditions (Rivers, lagoons, etc)	B-	-	B-	B-	Impact in water flow is foreseen by reduction or loss of water by evaporation and infiltration during operation stage, especially in the case of new dam construction.	-	B-	B-	Impact in water flow is foreseen, it will reduce due to loss of water by evaporation and infiltration in the operation stage, especially in the case of new dam construction	–	–	–	There is no identified impact
	8	Coast	-	-	-	-	There is no identified impact	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	9	Ocean	-	-	-	-	There is no identified impact	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	10	Natural Protected area	C-	C-	C-	-	Although small scale sub-projects, 10 projects are planned near Natural Protected Areas, additional studies are required in the progress of planning	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	11	Micro meteorological	-	-	-	-	There is no identified impact	-	-	-	There is no identified impact	–	–	–	There is no identified impact
	12	Global Warming	C+	-	-	-	Increase of irrigation areas, there are expectation of vegetation growth in presently naked areas.	-	-	C+	By increasing irrigated area, vegetation will increase in presently naked land.	–	C+	C+	There is no identified impact

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Table 3.12-5 Pollution Check List

	No.	Components / Environmental Items	Planning and formulation Planning and formulation	Execution				Operation and Maintenance				Description			
				Execution	Operation and Maintenance	Description	Planning and formulation	Planning and formulation	Execution	Operation and Maintenance	Description	Planning and formulation	Execution	Operation and Maintenance	Description
Environmental Contamination	1	Air Quality	B+/B-	-	B-	-	In the construction stage, suspended particles in the air increases with excavation works and material quarry	-	C+/C-	B+	With irrigation in dry season, irrigation will temporarily increase suspended particles in the air that will reduce in time.	-	-	-	There is no identified impact
	2	Water Quality	B-	-	B-	B-	Water reduction could produce water pollution in the low parts of the watershed. In the construction stage, the increase of turbidity could temporarily occur, so it should be prevented and mitigated through low cost practical measures.	-	C-	B-	During operation stage, water turbidity will increase by loss of useful layer of agriculture land and also there is the possibility of increasing level of chemical contents and organic material downstream	-	-	-	There is no identified impact
	3	Soil Contamination	C-	-	C-	C-	In the construction stage, discharge of machinery lubricant oil could cause contamination of agriculture soil that requires proper treatment.	-	-	C-	In agricultural zones of the project, salinization of soil is possible if irrigation practices are improper along the time	-	-	-	There is no identified impact
	4	Solid waste and industrial discharge	B-	-	B-	-	In case of large works that require external labor force during the execution, could increase solid residues in the high parts.	-	-	-	There is no identified impact	-	-	-	There is no identified impact
	5	Noise and vibration	B-	-	B-	-	During execution and temporarily in case of large works that require machinery, noise and vibration are produced.	-	-	-	There is no identified impact	-	-	-	There is no identified impact
	6	Soil subsidence	-	-	-	-	There is no identified impact	-	-	-	There is no identified impact	-	-	-	There is no identified impact
	7	Bottom sediments	B-	-	-	B-	There is no identified impact	-	-	-	There is no identified impact	-	-	-	There is no identified impact
	8	Offensive odor	-	-	-	-	There is no identified impact	-	-	-	There is no identified impact	-	-	-	There is no identified impact
	9	Landscape	C-	-	C-	-	Physical presence of works could cause moderate negative visual impacts, affecting the esthetics of panoramic view, considering the case of projects in areas with little intervention.	-	-	-	There is no identified impact	-	-	-	There is no identified impact

Note	
	A – High significant change is foreseen B – Low significant change is foreseen C - Low significant change – Requires more information - - Very low impact / Not to validate A+, B+, C+ indicate positive changes A-, B-, C- indicate negative changes; A+/A-, B+/B-, C+/C- indicate positive changes together with negative changes

Source: Study Team

Table 3.12-6 Classification by Type of Program of Small and Medium Irrigation infrastructure in the Peruvian Sierra (Tentative categorization in the Program stage)

N°	CODEO	NAME OF THE PROJECT	Classification by Types	Environmental Sensitivity	Study level	Environmental items needed to be considered
1	AMA-1	Improvement Sist. Irrigation Higuerones-San Pedro	I	B	1	-
2	AMA-2	Improvement Sist. Irrigation San Juan Marañón-La Papaya	I	B	1	-
3	AMA-3	Improvement Intake and Canal Limonyacu Bajo	I	B	1	-
4	AMA-4	Improvement System of Irrigation Utcuchillo - Canal Aventurero	I	M	1	Endemic Flora
5	AMA-5	Improvement System of Irrigation Naranjitos	I	B	1	-
6	AMA-6	Improvement System of Irrigation Naranjos_Canal El Tigre	I	M	1	Endemic Flora
7	AMA-8	Improvement del System de Irrigation Goncha Morerilla	I	B	1	-
8	AMA-9	Impr.Intake .Rev.Tramo Canal Comunal Huarangopampa	I	M	1	Endemic Flora
9	AMA-10	Improvement System of Irrigation Lumbay Balsas	I	B	1	-
10	AMA-11	Improvement System of Irrigation Naranjos - Canal Naranjos	I	B	1	-
11	AMA-12	Improvement System of Irrigation El Pintor - Canal Abad.	I	B	1	-
12	AMA-13	Improvement Canal San Roque Watson	I	M	1	Endemic Flora
13	AMA-14	Improvement Canal Irrigation La Peca Baja - Canal Brujopata	I	M	1	Endemic Flora
		Sub-Total	13			
14	CAJ-1	Construction Canal of Irrigation El Rejo	II	M	2	Pending
15	CAJ-2	Rehabilitation Canal El Guayo	I	B	1	-
16	CAJ-6	Improvement Canal La Samana - Ushusqui	II	B	1	-
17	CAJ-7	Irrigation Cochán Alto	I	B	1	-
		Sub-Total	4			
18	PIU-1	Canal of Irrigation Espíndola	II	M	1	Pending
19	PIU-2	Improvement Canal Sanguly	I	B	1	-
20	PIU-5	Improvement Canal Chantaco Huaricanche	I	B	1	-
		Sub-Total	3			
21	LIB-1	Improvement Canal Sute Pututе	II	B	1	-
22	LIB-4	Improvement Canal Irrigation Chuquillanqui-Shushipe	I	B	1	-
23	LIB-6	Dam Laguna Negra-Const Canal of Irrigation Chugay	III	B	2	Dam
			3			
24	ANC-2	Improvement Canal of Irrigation Paron II	II	A	2	NPA NP HUASCARAN
25	ANC-3	Construction Canal of Irrigation Casablanca- Jocosbamba – Quiches (Joquillo)	II	B	1	-
26	ANC-4	Construction Canal Rupawasi - Rosamonte	II	B	1	-
27	ANC-5	Construccion Canal of Irrigation Sol Naciente	II	M	2	BUFFER NPA NP HUASCARAN
28	ANC-6	Improvement and extension Canal of Irrigation Quishquipachan	II	B	1	-
29	ANC-9	Improvement Canal of Irrigation Quinta Toma	I	B	1	-
30	ANC-10	Const. Canal of Irrigation Aynin-Huasta	II	B	1	BUFFER NPA NP HUASCARAN
31	ANC-11	Construction Canal Cordillera Negra	II	M	1	BUFFER NPA NP HUASCARAN
32	ANC-12	Improvement Canal Rurec	I	M	1	BUFFER NPA NP HUASCARAN
33	ANC-16	Const. System of irrigation Jatun Parco	I	B	1	-
34	ANC-17	Improvement Canal Chuayas-Huaycho	I	M	1	BUFFER NPA NP HUASCARAN
35	ANC-18	Improvement Chinguil - Cruzpampa	I	M	1	BUFFER NPA NP HUASCARAN
36	ANC-19	System of Irrigation Mancan Aija	III	B	2	Dam
37	ANC-20	Canal of Irrigation Desembocadero – San Miguel	I	B	1	-
		Sub-Total	14			
38	HUA-1	Construction Canal of Irrigation Caracocha	II	B	1	-
39	HUA-2	Construction Canal of Irrigation Sogoragra Rondobamba	II	B	1	-
		Sub-Total	2			
40	JUNIN-1	Improvement Canal Achamayo	I	B	1	-
41	JUNIN-2	Irrigation Aywin	III	B	2	Dam
42	JUNIN-3	Irrigation Cotosh II Etapa	III	B	2	Dam
43	JUNIN-4	Improvement canal Ranra Antabamba	I	B	1	-
44	JUNIN-5	Improvement Canal Sector Atocsaico	I	B	1	-
45	JUNIN-6	Improvement Canal Sector Ricrán	III	B	2	Dam
46	JUNIN-7	Improvement System of Irrigation de las Localidades de Yauli y Jajapaqui	III	B	2	Dam
47	JUNIN-9	Improvement Canal Mayuhuato - Huaracaya	I	B	1	-
48	JUNIN-10	Canal of Irrigation Ninatambo	II	B	1	-
		Sub-Total	9			
49	HUA-3	Irrigation Cusicancha-Huayacundo-Arma-Huaytará.	II	M	2	Pending
		Sub-Total	1			
50	AYA-1	Construction and Improvement System of Irrigation Integral Pichcca Puquio-Urihuana-Llullucha-Tucsen, Pucaccacca- Huallchancca-Churropallana-Pacopata	III	B	2	Dam
51	AYA-2	Construction System of Irrigation Ccocha-Huayllay	III	B	2	Dam
52	AYA-5	Construction dam and System of Irrigation Chaqllani-Pucapampa	III	B	2	Dam
53	AYA-6	Irrigation Papatapruna - Ccochalla	II	B	1	-
54	AYA-9	Impr. And Const. System Irrigation Putacca Ccatun Pampa	I	M	1	Protection Wood Titankas – Proposal GR
55	AYA-12	Const. Dam and system of irrigation Chito-Sachabamca y Quishuarcancha, Chiara	III	B	2	Dam
56	AYA-13	Const. Canal and dam Tintayccocha-Acoro	III	M	2	Dam、Birds feeding zone（Observation）
			7			
		TOTAL	56			

Note): ·Type I indicates Subprojects considered as minimum risk of negative environmental impact; Type II indicates Subprojects considered as moderate risk of negative environmental impact; Type III indicates Subprojects considered as high risk of negative environmental impact.
·In sensibility , "A "indicates high impact; "M" indicates moderate impact; "B" indicates low impact.
·In study level, 1 indicates "DIA", study 2 indicates "EIA-sd", and study 3 indicates "EIA-d".

Source: Study Team

3.13 Selection of Alternative

Alternative 1

The Program consists on the construction of irrigation facilities for 38,732 ha and 1,120 ha under the technical irrigation, benefiting to 24,849 families, distributed in 50 micro watershed, in 56 districts and in 9 departments, and strengthening the organizations inside the micro watershed regarding the appropriate use and the preservation of the water resource, so that they can plan and to manage the water resource at micro watershed level through the conformation of irrigation committees, technical irrigation and committees of Management of Micro watershed.

The component of the Program is;

a) Irrigation Infrastructure

b) Technical Irrigation

c) Strengthening of Water Resources Management at Micro watershed Level

ALTERNATIVE 2

The Program consists on the construction of irrigation facilities for 38,732 ha, benefiting to 24,849 families, distributed in 50 micro watershed, in 56 districts and in 9 departments, and strengthening the organizations inside the micro watershed regarding the appropriate use and the preservation of the water resource, so that they can plan and to manage the water resource at micro watershed level through the conformation of irrigation committees, technical irrigation and committees of Management of Micro watershed.

The components of the alternative are:

a) Irrigation Infrastructure

b) Strengthening of Water Resources Management at Micro watershed Level

Deference between the Alternatives 1& 2 is as follows;

- The Alternative 2 shows cost of S/. 225,407,000 less than the Alternative 1 of S/. 243,108,000.
- The Alternative 2 no consider the Component Technical Irrigation, but, in the Alternative 1 consider it supporting the increase of agricultural production through the improved use of water resources.
- The Alternative 2 shows the rate of return of 29.0% that is smaller to the alternative 1 of 29.4%. Not being significant this difference, is certain the necessity to diffuse the tecnical irrigation in Sierra that incorporates the alternative 1, given the shortage of the irrigation water and the necessity to improve the productivity.
- The alternative 2 present a Current Net Value of S/. 155,574,000 which is inferior to that of the alternative 1 of 169,414,000, being considered eligible in this aspect the alternative 1
- The alternative 2 present a Benefit/Cost ratio of 1.75, being smaller than the alternative 1 that presents a B/C ratio of 1.76, indicating that the eligibility of the alternative 1.

Conclusion

The alternative 1 shows an economic viability and superior technical aspect to the

alternative 2 for what is considered acceptable the alternative 1 for the program.

3.13.1 Indicators of Alternatives

Main Indicator of the Program is;

Indicators of the Alternatives

Item	Unit	Alternative 1	Alternative 2
N° of Subprojects		56	56
N° of Departments at the Program Area		9	9
N° of Districts at the Program Area		56	56
N° of Subprojects "Irrigation Infrastructure"		56	56
N° of Subprojects "Technical Irrigation"		56	0
N° of Microwatersheds to be strengthened	Watersheds	50	50
Cost of the Program	S/.x 10^3	243,108	225,407
Cost of Conglomerate A (Irrigation Infrastructure)	S/.x 10^3	185,474	185,474
Improved Area	Ha	18,103	38,732
Incorporated Area	Ha	20,629	0
Total Benefited Area	Ha	38,732	38,732
Beneficiary Families	Fam.	24,849	24,849
Cost of the Program per ha	S/./ha	S/. 6,277 /ha	S/. 5,849 /ha
Harvest Area (Component A)	Ha	55,141 ha	55,141 ha
Annual Increase of the Gross Value of Production (Component A)	S/.x 10^3	143,789	143,789
Annual Increase of the Production Cost (Component A)	S/.x 10^3	78,247	78,247
Net Value of Production (Component A)	S/.x 10^3	65,542	65,542
Harvest Area (Component B)	Ha	1,923	-
Annual Increase of the Gross Value of Production (Component B)	S/.x 10^3	11,337	-
Annual Increase of the Production Cost (Component B)	S/.x 10^3	6,308	-
Net Value of Production (Component B)	S/.x 10^3	5,029	-
B/C at Private Price		1.76	1.75
IRR_{10} at Private Price		29.4	29.0%
NPV_{10} at Private Price	S/.x 10^3	169,414	155,574
B/C at Social Price		2.05	2.03
IRR_{10} at Social Price l		36.6	36.1%
NPV_{10} at Social Price	S/.x 10^3	200,887	184,957

3.13.2 Selection of Alternatives

Considering the differences among the alternatives 1 and 2, it is recommended to select the Alternative 1. The justification of selection are as followings:

- The Alternative 1 present bigger economical indicators that determines a better profitability of the program.
- The Alternative 1 presents a bigger technical viability for the increment of the agricultural production and an appropriate management of the water resources.

3.14 Implementation of the Program, Organization and Managements

3.14.1 Program Implementation Plan

(1) Necessary Actions

The Program has as central objective the "Increase of Agriculture Production for Families in Situation of Poverty and Extreme Poverty, located at the Program Area". So, the institutional schemes– programs, subprojects and involved entities– should be oriented toward this purpose.

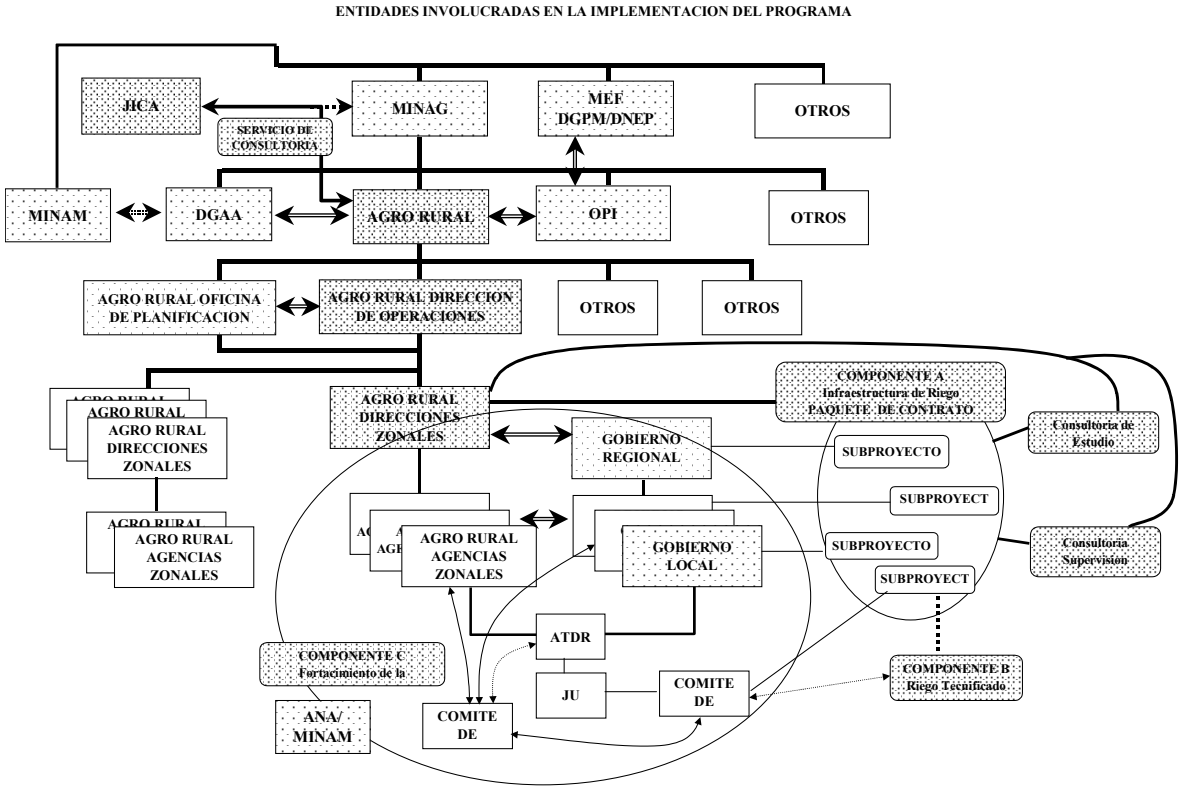
The Activities considered in the program are the following:

Component	Activities
Program	▪ Conduct the necessary processes for the Program Implementation ▪ Preparation of the necessary documents ▪ Preparation of Detailed Design
Component A Irrigation Infrastructure	▪ Improvement of the Existing Irrigation System and Incorporation of Irrigation at Dry Cultivation Land - Rehabilitation of Canal (Lining) - Construction of concrete Canal - Construction of intake - Construction of dam ▪ Construction of lateral Canal ▪ Training for the maintenance of canals and water distribution
Component B Technical Irrigation	▪ Implementation of the Technical Irrigation Module ▪ Competitive Grant ▪ Formation of Groups of Beneficiaries for Technical Irrigation ▪ Technical Assistance for the Use of Technical Irrigation
Component C: Conservation of the Watershed	▪ Elaboration of Studies for the Microwatershed collecting area management. ▪ Organizational Strengthening of the farmers' communities, the Irrigation Committees and the Microwatershed Water Management.

The Program will be implemented considering the preliminary list of projects, except for when one has enough arguments for the substitution, in accordance with the established substitution approaches criteria.

(2) Concerned Institutions

The Program is to be implemented with the participation of different institutions. The inter-relation among the institutions is shown in the following graphic:



The responsibilities and actions of each institution are the following:

For the Program

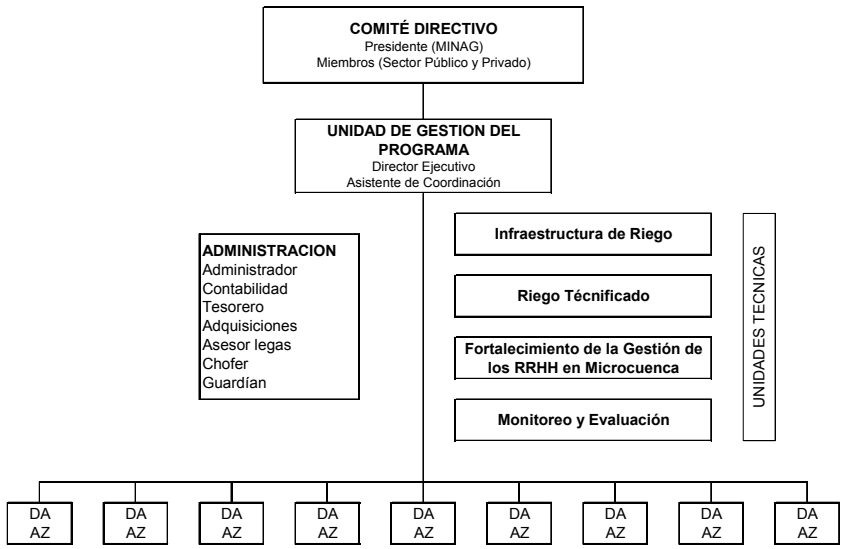
Institution	Responsibility
JICA	▪ Cooperation and Financial Institution of the Japanese Government is financing the program for the elaboration of the Pre feasibility and Feasibility of the Program, through Nippon Koei Consultants. It is the financial entity of the Program
MEF/DNEP	▪ Entity of the Central Government who will give opinion about the Program before proceeding to negotiate the loan with JICA
MEF/DGPM	▪ Entity of the Central Government who approves the Program and assigns the resources of the public treasure in the General Budget of the Republic, for its development
MINAM	▪ Superior Organism to whom the sectors inform about the actions to assure the prevention of the environment and natural resources degradation and to reverse the negative process affecting them.
MINAG	▪ Organism of the Central Government, directs agricultural activities and will approve the contents of the study at pre-investment and investment level of the program for MEF's submittal, requesting the external financing negotiation
OPI (MINAG)	▪ Office of Programming and Investment of the MINAG. It is the highest technical organ of SNIP in the sector. It declares the feasibility of PIP or Programs of Investment with financial sources different from the indebtedness operations.
ANA	▪ Entity of the MINAG. It exercises administrative jurisdiction of water resources. Local Authorities of Water who issue the certificate of water availability depend on it.
AGRO RURAL	▪ Institution of MINAG in charge of formulating some Pre-Investment studies and review and inclusion of profiles submitted by Local Governments in the Program. It is the executor of subprojects considered in each component of the Program. Also it is the Consultant's counterpart in the elaboration of studies 1.
Planning Office	▪ Manage the formulation and financial support for the studies and the implementation of the Program. ▪ To establish the Program Implementation Committee
Direction of Operations	▪ Manage the implementation of the Program through the Zonal Directions and the Zonal Agencies.
Zonal Direction	▪ Conduct the follow up at the Zonal Agencies for the efficient implementation of the Program.
Zonal Agencies	▪ Follow up the Communities, Users and the Committees of Management in the Program implementation at the respective scopes.
Regional Governments	▪ Financial support for actions of awareness raising and technical assistance, as part of the organizational strengthening. ▪ Motivate farmers communities of the high part of the microwatershed, in coordination with local Governments, to apply the knowledge of water reload techniques, learned during the training. ▪ Maintain a horizontal relationship with the Zonal Directions of AGRO RURAL to coordinate the implementation of the Operative Plan at level of Agrarian Agency and Zonal Agencies
ATDR (today ALA)	▪ Formalize the Irrigation Committees as well as support the administration of the Watershed Management Committee. ▪ Support the Irrigation Committees and Commissions in all aspects related to organization and planning. ▪ Solve conflicts about water in the scope of its intervention.
Local Governments	▪ Coordinate with the Regional Government to apply a coherent policy about management and administration of the microwatershed. ▪ Coordinate with the Irrigation Committees and the Watershed Management Committee the implementation of their annual operative plans. ▪ Support the Committees in the formulation of the Strategic Development Plans as well as the Operative Plans. ▪ Support the Management Committee with financing as well as in the search of subprojects of irrigations and watershed water reload improvement. ▪ Coordinate with the zonal agencies of AGRORURAL for the implementation of operative plans of the Committees.
Board of Users	▪ Watch over the organizational strengthening of the Irrigation Committees. ▪ Coordinate with the Committee of Watershed Management to manage activities and actions related to the watershed water reload.
	▪ To be organized for a good management in the use of irrigation water, mainly taking part in a Commission or Board of Users of the Watershed and paying for the

Committee of Irrigation Users	tariffs for the good maintenance of the Irrigation Infrastructure. ▪ Coordinate with the local Government, Committee of Watershed Management and the Zonal Agency of AGRORURAL for the execution of water reload practices.
Committee of the Watershed Management	▪ Coordinate with the Local and Regional Government, with the Zonal Agency of AGRORURAL and the Communities for the implementation of water reload practices in the watershed. ▪ Actively participate in meetings and events executed by the local and regional Governments in issues related to water management and administration. ▪ Formulate subprojects for watershed water reload as well as the construction or maintenance of the Irrigation Infrastructure and negotiate the financing.

(3) AGRORURAL

The main office of AGRO RURAL will be in charge of the Program implementation.

Experts who will have the mission of coordinating the entire process of the Program implementation and evaluation, measuring the goals and the effects, will constitute the technical team of the Program.



Department offices of AGRO RURAL are in charge of the tender processes, selection of contractors, works supervision, verification of payments requests. Applications for contract approval, request of payments and others toward JICA will be conducted by the Main office of AGRO RURAL. Also, they are in charge of contracting and supervising the Program Consultant.

1) Departmental Offices of AGRO RURAL

The executing entity of the present Program is AGRORURAL

AGRORURAL, through the "DIRECTION OF OPERATIONS" is responsible for the implementation of the Program through the departmental offices and will be in charge of the following functions:

1. Tender and supervision of Studies and Planning
2. Preparation of the Tender Process for works (Packages)／Tender of Works and Contract
3. Works Supervision and payment administration according to the works progress.

(a) Tender and supervision of Studies and Planning

Due to the short time available for the implementation of the subprojects, the studies should carried out in a determined period, through contracting of local consultants. One or two packages have been

prepared for each department and each package has 2 to 9 subprojects, so in order to implement the program in the shortest time it is necessary to implement several subprojects at the same time. For this reason, as it is complicated to make a pre-qualification evaluation separately for each department, a short list of companies will be prepared according to only one criterion for all departments, the proposals are evaluated and the Consultant will be selected. The Terms of Reference (ToR) and selection criteria are to be elaborated by the Supervising Consultant of the Program. The departmental offices of Agro Rural will establish an evaluation committee that will be in charge of the strict selection. The contents of the studies and the design of each subproject will be in general lines as follows:

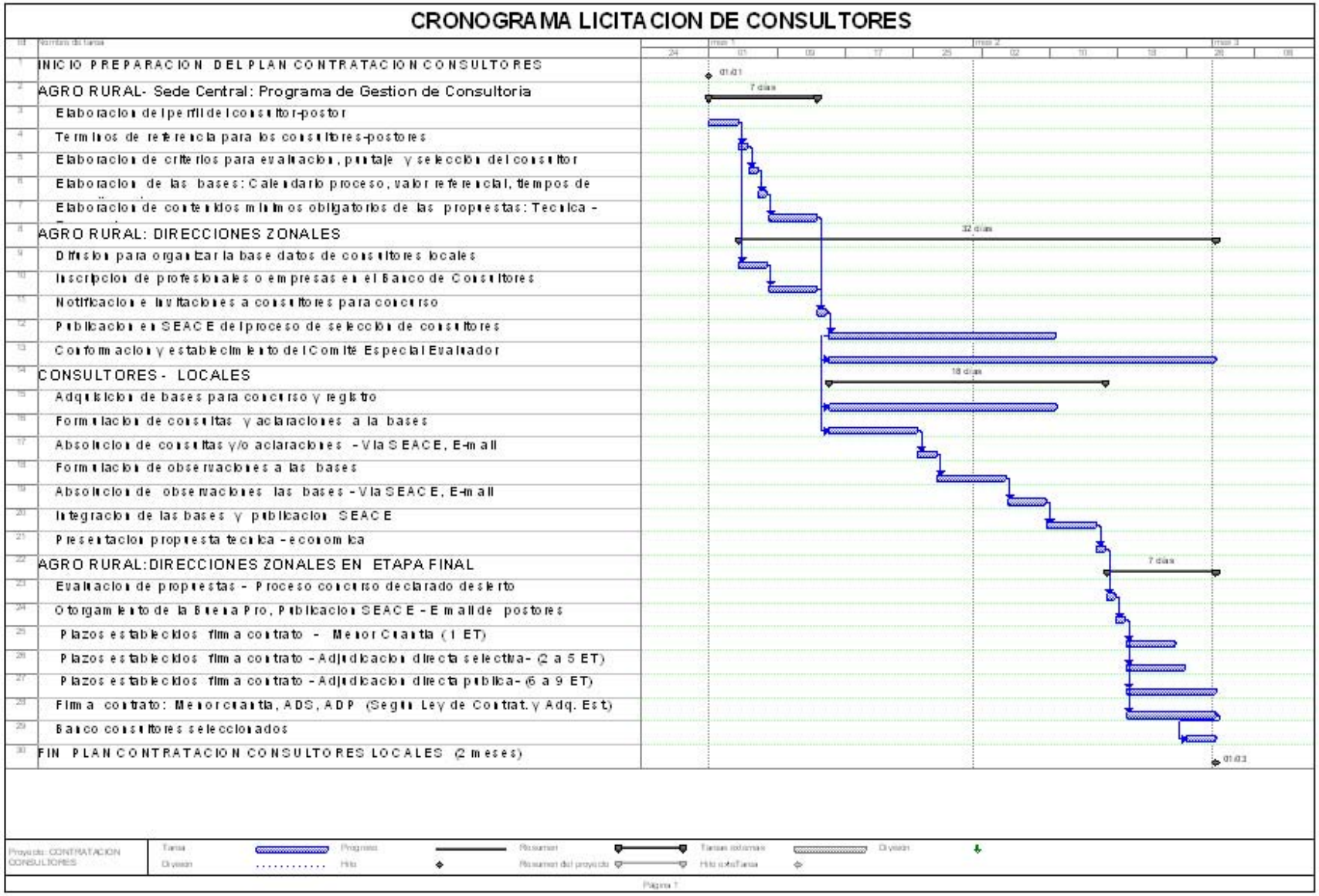
a. Measurement, Geological and geotechnical studies (If necessary)

b. Implementation Plan – Plan of Drawings

c. Quantity and cost of the construction works

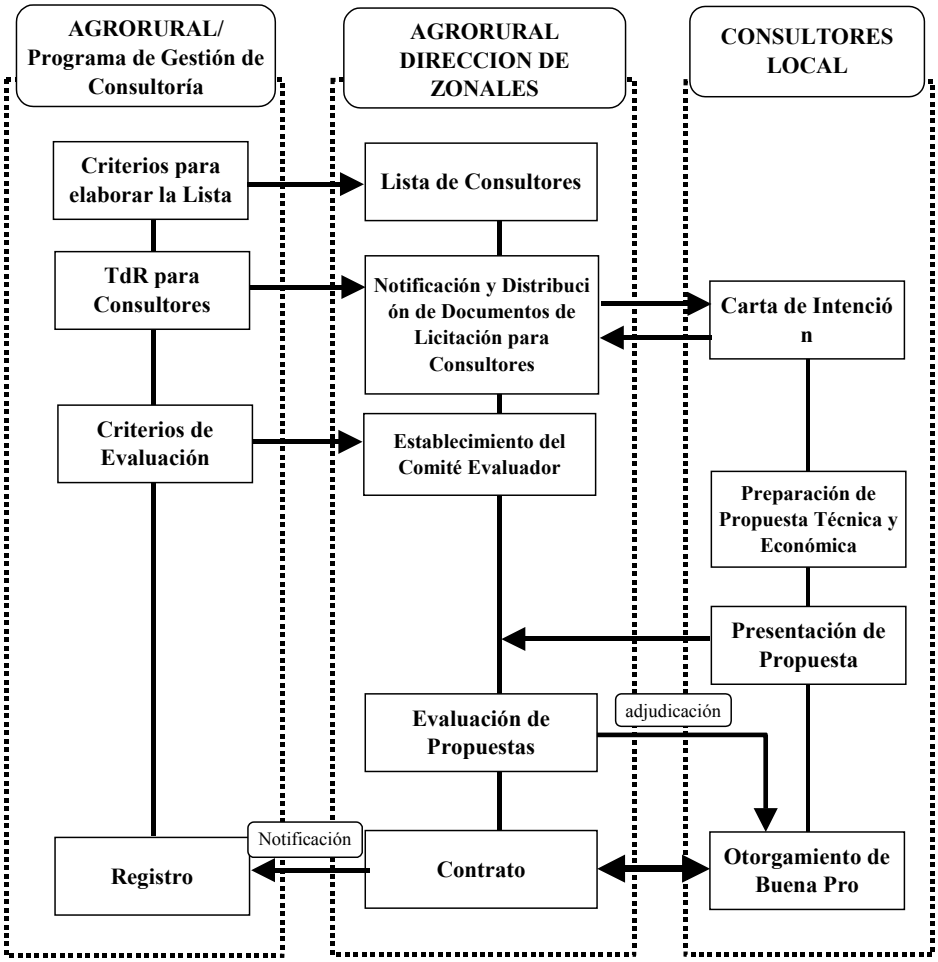
d. Special specifications of the works

e. Report of Environmental Study


CRONOGRAMA LICITACION DE CONSULTORES
Nombre de tarea
INICIO PREPARACION DEL PLAN CONTRATACION CONSULTORES
AGRO RURAL- Sede Central: Programa de Gestion de Consultoria
Elaboracion del perfil del consultor-postor
Terminos de referencia para los consultores-postores
Elaboracion de criterios para evaluacion, puntaje y seleccion del consultor
Elaboracion de las bases: Calendario proceso, valor referencial, tiempos de
Elaboracion de contenidos minimos obligatorios de las propuestas: Tecnica -
AGRO RURAL: DIRECCIONES ZONALES
Difusion para organizar la base datos de consultores locales
Inscripcion de profesionales o empresas en el Banco de Consultores
Notificacion e invitaciones a consultores para concurso
Publicacion en SEACE del proceso de seleccion de consultores
Conformacion y establecimiento del Comité Especial Evaluador
CONSULTORES - LOCALES
Adquisicion de bases para concurso y registro
Formulacion de consultas y aclaraciones a la bases
Absolucion de consultas y/o aclaraciones - Via SEACE, E-mail
Formulacion de observaciones a las bases
Absolucion de observaciones las bases - Via SEACE, E-mail
Integracion de las bases y publicacion SEACE
Presentacion propuesta tecnica - economica
AGRO RURAL:DIRECCIONES ZONALES EN ETAPA FINAL
Evaluacion de propuestas - Proceso concurso declarado desierto
Otorgamiento de la Buena Pro, Publicacion SEACE - E mail de postores
Plazos establecidos firma contrato - Menor Cuantia (1 ET)
Plazos establecidos firma contrato - Adjudicacion directa selectiva- (2 a 5 ET)
Plazos establecidos firma contrato - Adjudicacion directa publica- (6 a 9 ET)
Firma contrato: Menor cuantia, ADS, ADP (Segun Ley de Contrat. y Adq. Est.)
Banco consultores seleccionados
FIN PLAN CONTRATACION CONSULTORES LOCALES (2 meses)
mes 1
mes 2
mes 3
24
01
09
17
25
02
10
18
26
08
01-01
7 días
32 días
18 días
7 días
01-03
Proyecto: CONTRATACION CONSULTORES
Tarea
Progreso
Resumen
Tareas externas
Division
Division
Hito
Resumen del proyecto
Hito externo
Página 1

Tender Process for the local consultant is shown in the figure below;

Flujo y etapas para la selección de Consultoría local



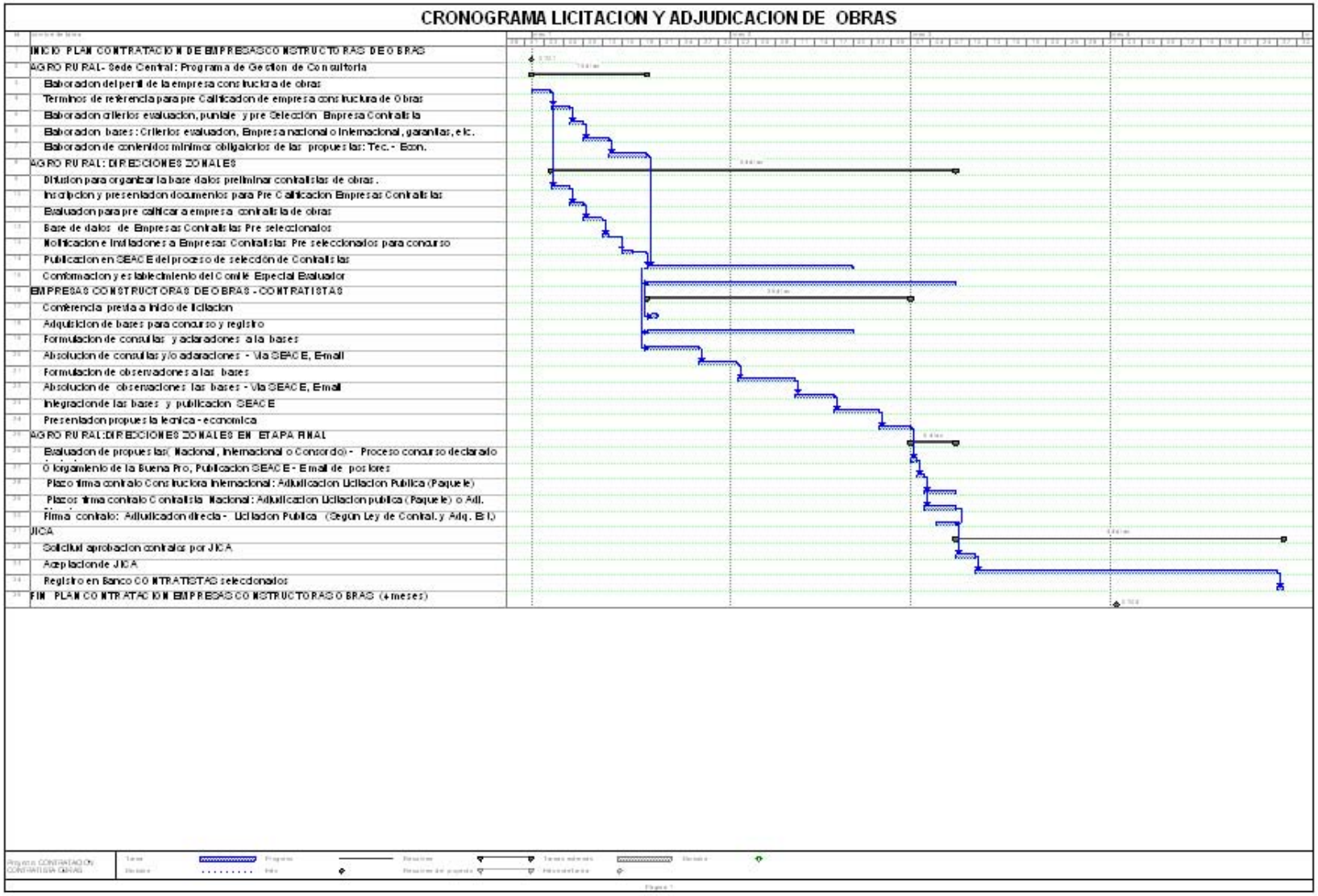
(b) Preparation of the Tender Process of Works by Packages/Tender of Works, Selection and Contract

The Supervising Consultant of the Program is in charge of preparing and redacting the necessary tender documents of works by packages. The system will be the system of competitive bid and the documents of pre-qualification and evaluation criteria will also be prepared.

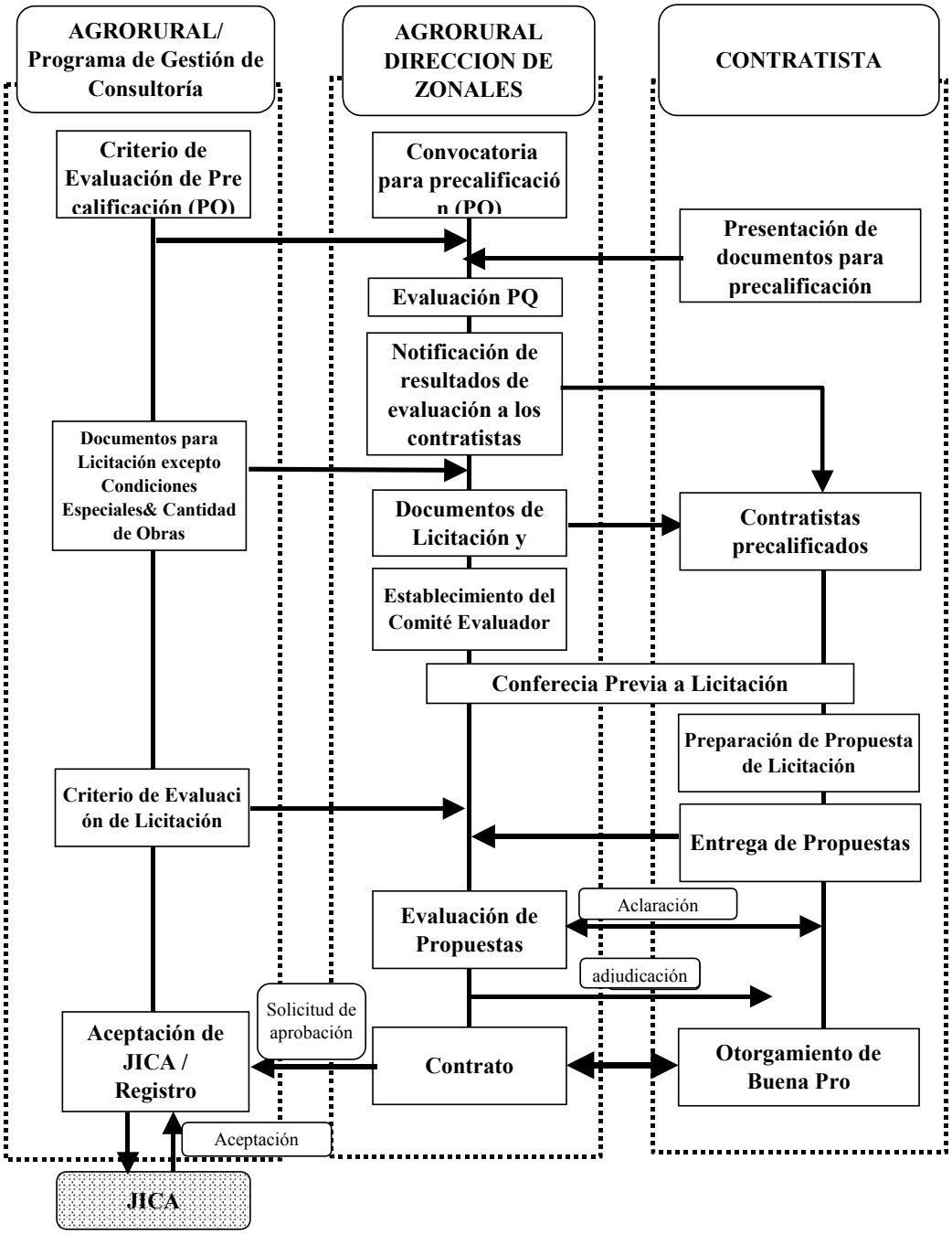
a. Tender documents, general and special conditions of contract, general and technical specifications.

b. Evaluation Criteria for the Tender

The call for pre-qualification, evaluation of pre-qualified, tender and evaluation will be made by the evaluation committees selected by the departmental offices of Agro Rural under the advisement of the supervising consultant of the Program.


CRONOGRAMA LICITACION Y ADJUDICACION DE OBRAS
INICIO PLAN CONTRATACION DE EMPRESAS CONSTRUCTORAS DE OBRAS
AGRO RURAL- Sede Central: Programa de Gestion de Consultoria
Elaboracion del perfil de la empresa constructora de obras
Terminos de referencia para pre Calificacion de empresa constructura de Obras
Elaboracion criterios evaluacion, puntaje y pre Selección Empresa Contratista
Elaboracion bases: Criterios evaluacion, Empresa nacional o Internacional, garantias, etc.
Elaboracion de contenidos minimos obligatorios de las propuestas: Tec. - Econ.
AGRO RURAL: DIRECCIONES ZONALES
Difusion para organizar la base datos preliminar contratistas de obras.
Inscripcion y presentacion documentos para Pre Calificacion Empresas Contratistas
Evaluacion para pre calificar a empresa contratista de obras
Base de datos de Empresas Contratistas Pre seleccionados
Notificacion e Invitaciones a Empresas Contratistas Pre seleccionados para concurso
Publicacion en SEACE del proceso de selección de Contratistas
Conformacion y establecimiento del Comité Especial Evaluador
EMPRESAS CONSTRUCTORAS DE OBRAS - CONTRATISTAS
Conferencia previa a Inicio de licitacion
Adquisicion de bases para concurso y registro
Formulacion de consultas y aclaraciones a la bases
Absolucion de consultas y/o adaraciones - Via SEACE, Email
Formulacion de observaciones a las bases
Absolucion de observaciones las bases - Via SEACE, Email
Integracion de las bases y publicacion SEACE
Presentacion propuestas tecnica - economica
AGRO RURAL: DIRECCIONES ZONALES EN ETAPA FINAL
Evaluacion de propuestas(Nacional, Internacional o Consorcio) - Proceso concurso declarado
Otorgamiento de la Buena Pro, Publicacion SEACE - Email de postores
Plazo firma contrato Constructora Internacional: Adjudicacion Licitacion Publica (Paquete)
Plazos firma contrato Contratista Nacional: Adjudicacion Licitacion publica (Paquete) o Adj.
Firma contrato: Adjudicacion directa - Licitacion Publica (Segun Ley de Contrat. y Adq. BID)
JICA
Solicitud aprobacion contratos por JICA
Aceptacion de JICA
Registro en Banco CONTRATISTAS seleccionados
FIN PLAN CONTRATACION EMPRESAS CONSTRUCTORAS OBRAS (4meses)

Flujo y etapas para trámite de adjudicación de Obras



(c) Supervision of Works and administration of payment according to the works progress.

Due to the limitation of personnel at the departmental offices of Agro Rural, the supervision of works and the payment according to the progress of works will be in charge of the local consultant contracted by the Department. The Supervising consultant of the Program will be in charge of preparing the manual of works supervision; however, in case the department or the subproject use some unique or special technique that is not be subject to it, the department should indicate the specifications. The local consultant will receive the support of the Supervising Consultant of the Program through the person in charge assigned by the department.

3.14.2 Consultant of the Program

AGRO RURAL will contract the Consultant of the Program that will globally administer the Program.

The Consultant of the Program will be contracted through international call for tender.

The responsibilities of the Program's Consultant are the following:

(a) Component A

a. Prepare the Pre-qualification documents and the evaluation criteria for the Pre qualification of the Works contracts.

b. Prepare the tender documents (draft) and elaborate the evaluation criteria for the Works contract tender.

c. Advise the departmental offices in contracting local Consultants

d. Provide technological support for the departmental offices of Agro Rural in the Supervision of Local Consultants (Design Costs)

e. Orientation to the local consultant in special technical aspects such as water balance, geology and others.

f. Advise in the works contract tender process.

g. Prepare the manual for the Works construction and supervision.

h. Training the local Consultant and persons in charge of the departmental offices in Works Supervision.

i. Technological support to the departmental offices of AGRORURAL in the Supervision of Environmental Impact Studies by a Local Consultant.

j. Periodical supervision and Technical Orientation of the Works administration.

k. Provide support to the departmental offices of AGRORURAL in the works progress and request of payment for the same.

l. Conduct trainings and prepare the necessary material for the entity in charge of conforming and/or reinforcing the entities in charge of the Irrigation System administration.

m. Provide advisement in the elaboration of construction designs of lateral canals and others.

n. Supervision of construction works of lateral canals and others.

o. Evaluation and Monitoring of the Project's benefits, Studies of Base Guidelines and Monitoring

p. Monitoring of environmental impact during the works.

(b) Component B

a. Prepare the prequalification documents and the evaluation criteria for the pre-qualification of contracts for equipment acquisition and/or works execution for the Technical Irrigation system

b. Prepare the tender documents (draft) and elaboration of evaluation criteria of contracts for equipment acquisition and/or works execution of the Technical Irrigation system

c. Provide technological support to the departmental offices of AGRORURAL for Local Consultants Supervision (Equipment, Design, Costs)

d. Advise the departmental offices in the process of Technical Irrigation works reception, referring to hydraulic good functioning tests, contracting of irrigation uniformity coefficients, application of penalties by CUR.

e. Elaboration of training manuals for users to familiarize them with the Technical

Irrigation systems, manuals for operation and maintenance, manuals for formulation of irrigation and fertirrigation, manuals for gauging the pressurized irrigation system.

f. Training the persons in charge of entities related to the implementation of Technical Irrigation.

g. Assistance to the entities related to the implementation of Technical Irrigation in the pertinent procedures.

h. Training the persons in charge of supervising the implementation works of Technical Irrigation (Critical points and pressures)

i. Conduct training and prepare the necessary materials for the committee of Technical Irrigation in charge of the operation and maintenance of the pressurized irrigation system.

j. Provide advisement, training and courses in the elaboration of the designs for irrigation systems by sprinklers, in the formulation of irrigation and fertigation schedules.

k. Supervision of hydraulic infrastructure works in the main, secondary and mobile lateral lines.

l. Supervision of civil works annex to the pressurized irrigation system.

m. Evaluation and Monitoring of the Project's benefits, studies of base lines, follow-up and monitoring

(c) Component C

a. Recollection of documents concerning watershed conservation plans. Update of the GIS Data base.

b. Elaboration of an example of Action Plan for the Project of Watersheds Conservation.

c. Training the persons in charge of the Project Microwatersheds management in Agro Rural

d. Assistance in the conformation of the Commission for the microwatershed water resources management.

e. Elaboration of the necessary material for the institutional strengthening for Watershed conservation/ Coordination with the Commission for the Watershed Conservation.

f. Training the members of the Commission for the Watershed Conservation.

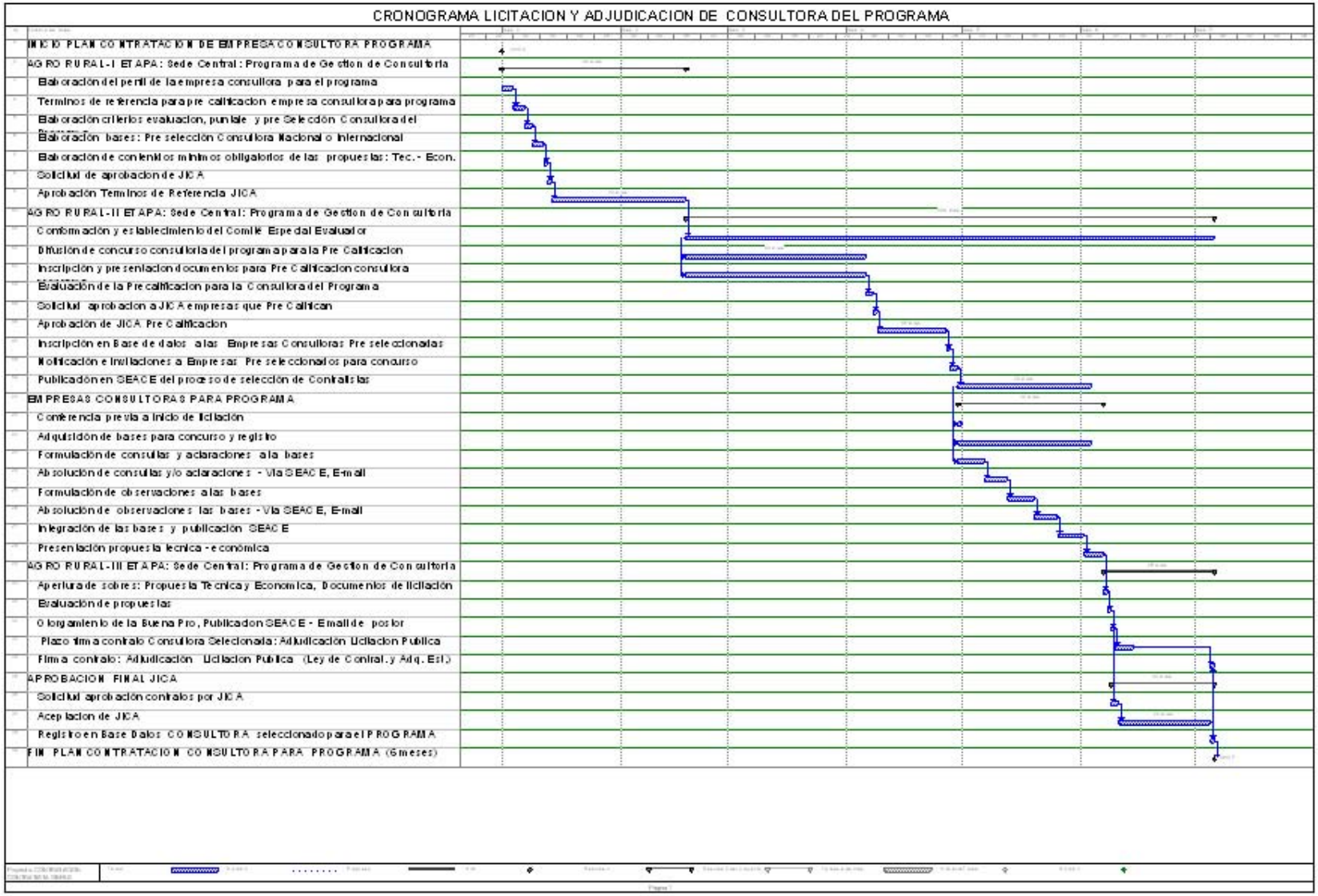
g. Assistance for the identification of new irrigation subprojects.

(d) Related Services and others

a. Proposal of a cultivation plan proper for each subproject.

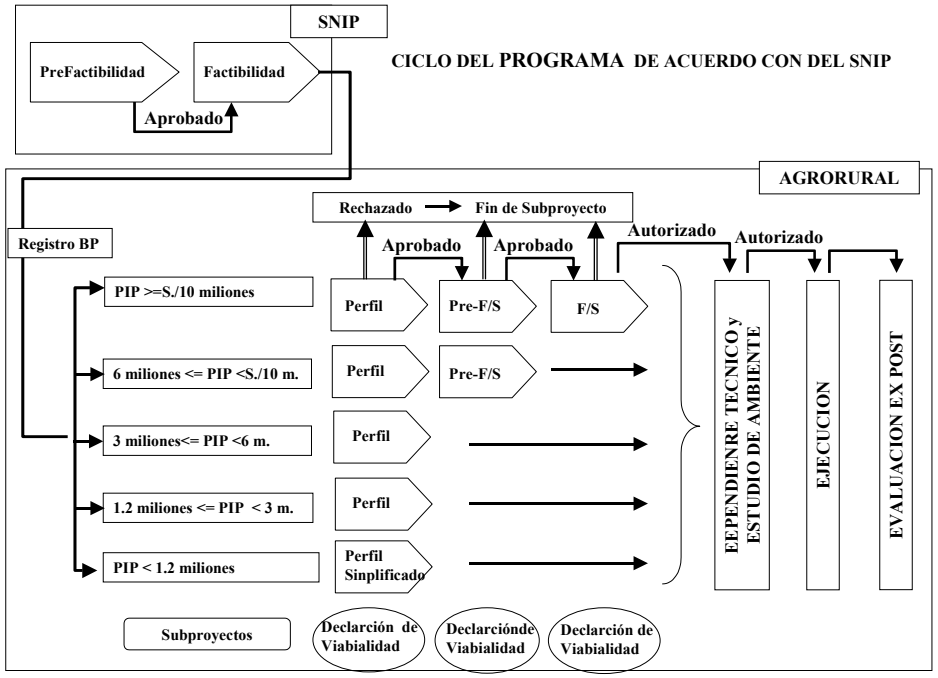
b. Proposal of proper cultivation products with the implementation of Technical Irrigation for each subproject.

c. Collaboration with the agriculture supporting entities in each department.


CRONOGRAMA LICITACION Y ADJUDICACION DE CONSULTORA DEL PROGRAMA
INICIO PLAN CONTRATACION DE EMPRESA CONSULTORA PROGRAMA
AGRO RURAL-I ETAPA: Sede Central: Programa de Gestion de Consultoria
Elaboración del perfil de la empresa consultora para el programa
Terminos de referencia para pre calificacion empresa consultora para programa
Elaboración criterios evaluacion, puntaje y pre Selección Consultora del
Elaboración bases: Pre selección Consultora Nacional o Internacional
Elaboración de contenidos minimos obligatorios de las propuestas: Tec.- Econ.
Solicitud de aprobacion de JICA
Aprobación Terminos de Referencia JICA
AGRO RURAL-II ETAPA: Sede Central: Programa de Gestion de Consultoria
Conformación y establecimiento del Comité Especial Evaluador
Difusión de concurso consultoria del programa para la Pre Calificacion
Inscripción y presentacion documentos para Pre Calificacion consultora
Evaluación de la Precalificacion para la Consultora del Programa
Solicitud aprobacion a JICA empresas que Pre Califican
Aprobación de JICA Pre Calificacion
Inscripción en Base de datos a las Empresas Consultoras Pre seleccionadas
Notificación e invitaciones a Empresas Pre seleccionadas para concurso
Publicación en SEACE del proceso de selección de Contratistas
EMPRESAS CONSULTORAS PARA PROGRAMA
Conferencia previa a inicio de licitación
Adquisición de bases para concurso y registro
Formulación de consultas y aclaraciones a la bases
Absolución de consultas y/o aclaraciones - Via SEACE, E-mail
Formulación de observaciones a las bases
Absolución de observaciones las bases - Via SEACE, E-mail
Integración de las bases y publicación SEACE
Presentación propuesta tecnica - económica
AGRO RURAL-III ETAPA: Sede Central: Programa de Gestion de Consultoria
Apertura de sobres: Propuesta Tecnica y Economica, Documentos de licitación
Evaluación de propuestas
Otorgamiento de la Buena Pro, Publicacion SEACE - Email de postor
Plazo firma contrato Consultora Seleccionada: Adjudicación Licitacion Publica
Firma contrato: Adjudicación Licitacion Publica (Ley de Contrat. y Adq. Est.)
APROBACION FINAL JICA
Solicitud aprobación contratos por JICA
Aceptacion de JICA
Registro en Base Datos CONSULTORA seleccionado para el PROGRAMA
FIN PLAN CONTRATACION CONSULTORA PARA PROGRAMA (6 meses)

3.14.3 Strategy of the Implementation

In the Program, the Implementation of Component A is fundamental for the implementation of other components. Considering the characteristics of Component A "Conglomerate of Irrigation Infrastructure", the Subprojects to be implemented will be conducted according to the SNIP regulation, indicated in the following figure;



The Sub-Projects integrated in the projects will be declared viable according to the norms of SNIP and according to the agreements between with OPI Agriculture and with DGPM of the Ministry Economy and Finances.

To be able to implement the projects that were approved, it will be necessary to have their respective Profile. In that process it is possible that it is necessary to replace some projects. Due to the short time of implementation of the Program or being implemented to already be, the new projects that are presented will have a good advance level. Leaving of this premise, the new projects to be presented will fulfill the selection approaches that are shown in the following table.

The Table 3.14.1 shows the approaches to consider new projects, for substitution, either for reasons of geography, social or of risk among other that show up in the process of the implementation.

Table 3.14.-1 Selection Criteria for New Subproject to be Incorporated

Criteria					Present Situation of the Subproject		
Conditions	Item		Explanation		Present Situation		Result
Social Conditions	I-1	Poverty Zone	Located at one of the 9 departments of the Program		Name of the Department	to be filled	
	I-2	By request of the city	The right of use of water can be obtained through a request from the committee of irrigation or farmers association.		Solicitant	to be filled	
					Situation of water use rights	to be filled	
Technical Conditions	II-1	Clear technical base	Study at Perfil level.		Perfil or Registration Form finished		
	II-2	Availability of water resources	Without dam	Maximum demand can be the 50% of the minimum flow by watershed	Maximum demand can be the 50% of the minimum flow by watershed		
			With dam	1. Detailed analysis of the supply and the watershed	Fulfill the condition at the left	to be filled	
				2. Calculation of water balance	Fulfill the condition at the left	to be filled	
Economic Conditions	III-1	Amount of Investment	Less than S./ 6,000,000.00		Amount of Investment	to be filled	
	III-2	Internal Rate of Return (IRR)	Perfil indicates that private IRR is higher than 10% and social IRR is higher than 14%		Private IRR (%)	to be filled	
					Social IRR (%)	to be filled	

Selection Criteria:
- ○ Approved
- □ Approval is on hold till some data are provided or because it is actually in course of procedure
- × Not approved

Departments : Amazonas, Cajamarca, Piura, La Libertad, Ancash, Huanuco, Junín, Huancavelica and Ayacucho

3.14.4 Implementation of the Works

The Program will be implemented through Central AGRORURAL office and supervised by the zonal agencies, in coordination with the local and regional Governments. The responsibilities of each part are the following;

Table 3.14.-2 System of Program Implementation

WORKS			AGRO RURAL		REGIONAL/ LOCAL GOVERNMENT	CONSULTANTS MANAGEMENT	LOCAL CONSULTANT	CONTRACTOR	BENEFICIARIES
Component		Detail	CENTRAL	DEPART-MENT					
Component A									
	Conglomerate Irrigation Infrastructure	Pre-qualification	○			●			
		Qualification		●		○		▲	
		Management	○	●		○			
		Study (DD and Environment)		○		▲	●		
		Supervision		○		▲	●		
		Works						●	
		Training		○	▲	▲		●	
	Lateral Canal Works	Management		▲	○	●			
		Supervision		○	▲				
		Work			○	▲			●
Component B									
	Conglomerate Technical Irrigation	Study (DD and Environment)		○		▲	●		
		Workshop		●		○			
		Tender		●		○			
		Supervision		●	○				
		Training		●	○				
		Works		○	▲			●	▲
Component C									
	Study	Watershed Environment	○	○	▲	●			▲
		Inventory		○	▲	●			▲
		Action Plan		○	▲	●			▲
	Strengthening		○			●			
Others									
	Proposal of the proper cultivation products				○	●			▲
	Collaboration with entities of agriculture support				○	●			▲
Request of disbursement to JICA			●	○		▲	▲	▲	

● : Entity in charge

○ : Supervising entity / supporting entity

▲ : Related entities

3.15 Matrix of the Program Logical Framework

Logical Framework of the Program

Summary of the project	Objectively verifiable indicator	Sources of verification	External conditions
Superior Objective Increase agricultural production of families located at the less developed areas of the sierra	Cultivation area and volume of production at the irrigation area	Record of cultivation area, statistic records	
Objective of the Program Improve the availability, conservation and supply of water resources to favor the increase of agriculture production of families located at the less developed area of the sierra.	Irrigation Area (24,800 farmer families, 38,700 of land under irrigation) Water availability (38,700ha of land under irrigation) Activities of Conservation (50 microwatersheds)	Monitoring report (Number of executed works, Conservation areas)	Availability of participation by the community and Regional/Local Government Technical assistance by the local Government
Results ・ Increase agriculture production by increase of irrigation area ・ Incorporation of Technical irrigation ・ Sustainable development to assure natural resources self-managed by farmers	・ 56 Subprojects (Improvement of Irrigation Area 18,103ha and Incorporation of Irrigation area 20,629ha) ・ Number of Technical Irrigation of 56 modules ・ Studies and Promotion of 50 Microwatershed Management Committees	・ Monitoring report ・ Number of beneficiaries ・ Number of committees conformed ・ Implemented works ・ Number of Irrigation Users Board conformed	Motivation of Farmers Organizations and other agents Efficient Maintenance Start of watershed conservation activities
Activities **Component A:** ・ Improve the de Irrigation System ・ Construction of Irrigation Infrastructures ・ Training, Operation and Maintenance of the Irrigation System.	・ Improvement and construction of Canals for 56 subprojects ・ Improvement and construction of lateral canals for 38,700 ha. ・ Investment budget for component A is S/. 157 million ・ Bids and contract. ・ Detailed Design (56 projects) ・ Environmental Study (56 projects) ・ Formation of Irrigation Committees	・ Monitoring report ・ Evaluation reports ・ Minutes of reception of work and contracts liquidation. ・ Expenses by activities ・ Supervision Reports ・ Contract ・ Detailed Design Report ・ Environmental Study Report	Timely availability of financial resources Good permanent administration of financial resources by the Board of Users Good supervision Predisposition of users to be formalized Predisposition of regional, local entities and users to participate in workshops, seminars, forums and public hearings
Component B: ・ Installation of Technical Irrigation Modules ・ Training in the Use of Irrigation ・ Training, Operation and Maintenance of Technical Irrigation.	・ Number of Technical Irrigation modules is 56 subprojects. ・ Investment budget for the component B is S/. 14.6 million. ・ Formation of Irrgation Comittees(S/. 6 million)	・ Supervision Reports ・ Records of the Executing Unit, the Board of Users and AGRO RURAL.	
Component C: **Activities:** - - Elaboration of Studies for the Microwatershed collecting area management. - - Organizational Strengthening of Farmers Community and the Committees of Irrigation and of the Microwatershed Management.	Number of; ・ Characterization studies. ・ IPRH's, DES-P. ・ Events of awareness raising and motivation, radio Spots, press releases, training and technical assistance. ・ Committees of Irrigation, Management of conformed Microwatersheds.	・ Study with ecological and economic zoning ・ Study of inventory and action plan of water resources. ・ Study of diagnosis and action plan ・ Final report, Monitoring and follow up report.	Financial availability for the execution of the studies. Farmers' communities disposed to accept awareness raising and motivation. Predisposition of organizations to be reinforced. Financial support from local and regional Governments
Component D: Implementation Management	・ Tender and contracting ・ Detailed Design (56 subprojects) ・ Environmental Study (56 subprojects) ・ Management of component A, B and C ・ Budgetary control	・ Contracts ・ Detailed Design Reports ・ Environmental Reports ・ Monthly Report of Program Management ・ Budgetary Balance	

3.16 Baseline for the Impact Evaluation

Considering the objective of the Program "Structure the base of Irrigation Infrastructure and reinforce institutional capacities for the management, administration and conservation of water in the microwatersheds and contribute to increase the agriculture production of families in situation of poverty and extreme poverty in the Sierra area", the base line for the impact evaluation is established;

Expected Results of the Program

Component	Field	Expected Qualitative Benefits
Program	Economic	• Improvement of income by trading Production surplus • Increase job opportunities for greater regional economic activity • Increase income of agricultural unit
	Labor Force	• Reduction of migration for job searching • Increase job opportunities
	Human Capital	• Learning of new agricultural technologies • Improvement of Schooling
	Access to Natural Resources	• Better use of Natural Resources (Water and Soil) • Introduction of innovative agriculture practices and improvement of agricultural practices
	Social Capital	• Creation of leadership in the community by actions of the program • Existence of organizations within the community • Reinforce the organization • Possibilities to create industries related to agricultural activity
	Physical Capital	• Availability of Irrigation Infrastructure • Availability of services • Access and distance to markets of products and jobs • Quality of the physical biological quality surroundings of the community
	Institutional Capital	• Access to the credit system • Access to technology transfer • Access to legal support
Component A		
Improvement of irrigation system	Agroeconomic	• Reduction of costs in number of small repairs making a complete repair • Increase reliability in water supply
Construction of new irrigation system	Socio environmental	• Revitalization of the region and increase of mutual cooperation through the creation of irrigation committees.
Improvement of agriculture production through the implementation of the irrigation system	Reduction of poverty/ consideration toward the less favored	• Reduction of expenses in health, by the stabilization of food provision for families • Improvement in the population health by the stabilization of food provision • Better education by improvement of family income • Water resource for daily use reduce domestic labor
Component B		•
Introduction of state of art technology	Agroeconomic	• Improvement of family economy by increase of production /Improvement at social level by the participation in the market • Awareness of the farmer by training in the introduction of irrigation systems with state of art technology. • Increase in cultivation area by improvement of water use
	Socio environmental	• Reduction in disputes over water through the efficient use of the resource
Component C		•
Participation of population in the Institutional Strengthening	Environment	• Awareness of beneficiaries concerning environment conservation. • Acknowledgement of necessary actions for environment conservation

3.16.1 Application and Effect Indicators of the Program

(1) Application Indicator

Provisional indicators of functioning have been established as indicators of this Program's results- It should be taken into account that the reference is from the fifth year of the Program implementation.

(1) Indicator of Application Impact

Provisional indicators of effectiveness have been established as indicators of goals' achievements proposed by the Program. It should be taken into account that the reference is from the fifth year of the Program implementation.

Program Effectiveness Indicators

Typical Project	Effect							
	Potato Yielding (ton/ha)		Yellow corn yielding (ton/ha)		Wheat yielding (ton/ha)		Poverty rate 2007 (%)	
	Present	After 5 years	Present	After 5 years	Present	After 5 years	Present	After 5 years
Cont. Canal El Rejo	1.53	13.32	1.05	1.50	0.35	1.23	89.6	30.0
Rehabi. El Huayo	5.44	13.32	1.20	1.50	0.86	1.23	88.6	30.0
Improv. Canal Chantaco	2.87	14.31	0.61	1.00	0.78	1.11	100.0	30.0
Const. Canal Sol Naciento	4.63	11.55	0.58	1.41	0.64	1.03	96.3	30.0
Canal abd Dam Tintay Ccocha	9.17	18.59	0.88	1.25	1.01	1.44	93.9	30.0

(2) Methodology

In order to generate information on the progress, achievements, effects and impacts of the Program intervention application the following surveys are proposed to be carried out;

1. Socio economic survey of farmers benefited with the subproject of irrigation in the Sierra (for 5 typical projects)
2. Analysis of the surveys
3. Measurement of impacts

Subjects to be surveyed are the following;

- Geographic location of the Study Area
- Data about the Producer and the Agricultural Units
- Present Land Use, type of land hold and property
- Agricultural Production (Agriculture activity, destination of production, name of products, elaborated products, expenses in agricultural activities, livestock activities, preference of producers, expenses in livestock activities, etc.)
- Irrigation (Water source, main problems, etc.)
- Composition of the producer households and access roads
- Credit
- Aspects related to the social participation and organization
- Technical assistance and agricultural training

CHAPTER 4
CONCLUSION

Chapter 4 CONCLUSIONS

a) The program has as objective to irrigate 38,732 ha and to benefit 24,849 families located in the less development areas in 9 departments of the country

b) The Program is located at far away zones of the Andes Highland Sierra, far from the District Capitals. Predominant agricultural practices are of subsistence with low productivity; production is only for family self consumption. Job opportunities outside the agriculture sector are scarce, at large distance and temporal. Main income sources are in the agriculture sector, being in average S/. 100.00 to S/. 150.00 per month. It should be mentioned that the average expenses in the district at the Program area is S/. 270.00 per capita. Majority of the beneficiaries are in situation of extreme poverty.

c) The economy in the Program area strongly depends on agricultural activities. However, most of farmers do not produce enough food for consumption due to the limited resources of land and water. Predominant agricultural practices are cultivation in dry land at strong slopes. To alleviate poverty in the rural zone, it is necessary to improve land productivity where farmers presently work.

d) In terms of rainfall distribution, the period that farmers can works in agriculture is limited, cultivation usually in November and harvest in April. Besides there are some extended periods with no rain, causing losses in production. For these reasons, the introduction of irrigation systems is necessary to stabilize the agriculture economy of producers.

e) To improve self-consumption situation it is necessary to improve agricultural production through the increase in cultivated area besides improving productivity by the introduction of irrigation systems. However, available water resources are used in the precarious existing irrigation systems. To extend irrigation area it is necessary to improve conditions of irrigation efficiency.

f) Statistics show a greater rigidity to reduce rural poverty. In consequence, the State takes after this problem to focus for solutions for this area. Recovery and extension of the installed capacity to improve Andean agriculture production should be attended through small and medium irrigation infrastructure, where poverty is deeper and less accessible to Programs of assistance aid.

g) The proposed Program has 56 candidates for Subprojects of small and medium irrigation infrastructure (Component A), a set of technical irrigation modules (Component B) and studies to conduct actions related to watershed conservation (Component C). Also, the Program intends to improve living conditions of farmers in highland Andes, it is estimated that there is much demand for the Program to be implemented.

h) Component A “Conglomerate of Irrigation Infrastructure” is applied to construct and rehabilitate the irrigation system to increase production.

i) Component B “Technical Irrigation” is applied to construct technical irrigation modules in order to disseminate irrigation technology by sprinklers at the Andean zone to benefit a larger number of producers, maximizing the use of water resources and increasing productivity.

j) Component C is developed to build the foundation for water resources conservation and management at microwatersheds through studies to identify the necessary actions of watershed conservation and management to empower communities in order to keep the source of their income: “Water”.

k) Component D is directed to conduct all administrative procedures to implement Components A, B and C of the Program. The Program is integrated by 4 components, Components A and B have been structured as conglomerates, including works.

l) The number and group of proposed subprojects for each alternative are the following:

Contents of the Program Alternatives

Item		Alternative 1	Alternative 2
A	Conglomerate "Irrigation Infrastructure "		
	Type 1: Subprojects (more than 10 million) only canal Subprojects	2	2
	Type 2-A: Subprojects (6 to 10 million) only Canal Subprojects	1	1
	Type 2-B: Subprojects (6 to 10 million) with canal and dam Subprojects	2	2
	Type 3-A: Subprojects (3 to 6 million) only Canal Subprojects	10	10
	Type 3-B: Subprojects (3 to 6 million) with canal and dam Subprojects	5	5
	Type 4-A: Subproject (1.2 to 3 million) only Canal Subprojects	21	21
	Type 4-B: Subproject (1.2 to 3 million) with canal and dam Subprojects	4	4
	Type 5: Subprojects (less than 1.2 million) only canal Subprojects	11	11
	Total Subprojects	56	56
B	Conglomerate "Technical irrigation"		
	Irrigation Works Technical irrigation Module	56	-
	Training Module	56	-
C	Project "Institutional Strengthening for Microwatershed Water Resources Management"		
	Study Microwatershed	50	50
	Promotion of Watershed Committee Microwatershed	50	50
	Total		
D	Program Management		
	Administration and National Supervision Unit	1	1
	TOTAL Program	1	1

Note: Conglomerates A and B include Technical Training

m) Total Investment of the Program as Alternative 1 is S/. 243.1 million.

(Unit: Mil S./)

COMPONENTS / ITEMS	BASE COST	TOTAL COST	
		IGV (19%)	TOTAL
	a	b=a x 0.19	C=a+b
1. Construction and Acquisition	200,287	38,054	238,341
Component A; Irrigation Infrastructure	160,715	30,536	191,251
Component B; Technical irrigation	12,271	2,331	14,602
Component C; Institutional Strengthening	16,341	3,105	19,446
Component D; Program Management	39,572	7,518	47,090
2. Price Staggering	4,006	761	4,767
GRAN TOTAL (S./)	204,293	38,815	243,108
GRAN TOTAL (US$)	64,243	12,206	76,449

Exchange Rate: 1.0 US$ = S./ 3.18 (End of March 2009 Central Bank of Peru)

n) Total Investment of the Program as Alternative 1 is S/. 243.1 million.

(Unit: Mil S./)

COMPONENTS / ITEMS	BASE COST	TOTAL COST	
		IGV (19%)	TOTAL
	a	b=a x 0.19	C=a+b
1. Construction and Acquisition	173,143	32,898	206,041
Component A; Irrigation Infrastructure	155,860	29,614	185,474
Component B; Technical irrigation	-	-	-
Component C; Institutional Strengthening	17,283	3,284	20,567
Component D; Program Management	12,560	2,386	14,946
2. Price Staggering	3,714	706	4,420
GRAN TOTAL (S./)	189,417	35,990	225,407
GRAN TOTAL (US$)	59,565	11,318	70,883

o) The Program will allow to increase cultivation areas and the productivity, achieving the

following benefits:

Ítem	Alternative 1		Alternative 2	
	Without Project	With Project	Without Project	With Project
Cultivation Area (Component A)	27,529 ha	55,141 ha	27,529 ha	55,141 ha
Cultivation Area (Component B)		1,922 ha		-

p) The results of the evaluation of each Component are the following;

Item	A Private Prices			A Social Prices		
	B/C	IRR_{10}	NPV_{10} (mil S./)	B/C	IRR_{10}	NPV_{10} (mil S./)
(Alternative 1) Program	1.76	29.4%	169,414	2.05	36.6%	200,887
Component A	1.87	31.9%	168,243	2.16	38.3 %	191,254
Component B	1.38	18.1%	6,414	1.63	22.3 %	9,020
(Alternative 2) Program	1.75	29.0%	155,574	2.03	36.1%	184,957
Component A	1.87	31.9%	168,243	2.16	38.3%	191,254
Component B						

q) The results of the evaluation show that the Program, the Components and subprojects are favorable, presenting a favorable IRR and B/C.

r) Main indicators for each alternative are;

Indicators of Alternatives

Item	Unit	Alternative 1	Alternative 2
N° of Subprojects		56	56
N° of Departments at the Program Area		9	9
N° of Districts at the Program Area		56	56
N° of Subprojects "Irrigation Infrastructure"		56	56
N° of Subprojects "Technical Irrigation"		56	0
N° of Micro-watersheds to be reinforced	Watershed	50	50
Cost of the Program	S/.x 10^3	243,108	225,407
Cost of Conglomerate A (Irrigation Infrastructure)	S/.x 10^3	185,474	185,474
Improved Area	Ha	37,612	38,732
Incorporated Area	Ha	1,120	0
Total Benefited Area	Ha	38,732	38,732
Benefited Families	Fam.	24,849	24,849
Cost of the Program by ha	S/./ha	S/. 6,277 /ha	S/. 5,849 /ha
Harvest Area (Component A)	Ha	55,141 ha	55,141 ha
Annual Increase of Production Gross Value (Component A)	S/.x 10^3	143,789	143,789
Annual Increase of Production Cost (Component A)	S/.x 10^3	78,247	78,247
Net Value of Production (Component A)	S/.x 10^3	65,542	65,542
Harvest Area (Component B)	Ha	1,923	-
Annual Increase of Production Gross Value (Component B)	S/.x 10^3	11,337	-
Annual Increase of Production Cost (Component B)	S/.x 10^3	6,308	-
Net Value of Production (Component B)	S/.x 10^3	5,029	-
B/C at Private Prices		1.76	1.75
IRR_{10} at Private Prices		29.4	29.0%
NPV at Private Prices	S/.x 10^3	169,414	155,574
B/C at Social Prices		2.05	2.03
IRR_{10} at Social Prices		36.6	36.1%
NPV_{10} at Social Prices l	S/.x 10^3	200,887	184,957

s) Considering the characteristics of each alternative, it is recommended to select Alternative 1. Justification for it are 1) proposed subprojects in the Program of Alternative 1 are in the SNIP framework, and 2) Alternative 1 shows high technical reliability in the preparation of studies and also in water resources caption.

t) The Program of irrigation systems management has been developed in the design stage in the same way as it will be developed in the execution stage, that is, jointly between the

State entities that regulate the administration of water resources and those in charge of operation and self-management of the systems (Irrigation Committees, Commissions and Boards of Users).

u) Willingness to pay for the use of water by direct beneficiaries is clearly manifested in the results of the "Socio-economic Survey for Beneficiary Farmers" of the subprojects, that was conducted in the Program intervention area; however, it is necessary to promote awareness-raising and motivation tasks at users' level and at the direction level, to promote and/or reinforce said willingness to pay, the same that can be covered partially with the farmer's community labor force contribution.

v) It is considered that the present Program has economic and social feasibility. Beneficiary producers have a great expectation to participate in the Irrigation Projects, contributing to its sustainability.