IRRIGATION PRICING AND MANAGEMENT

ANNEX 1

Peru

IRRIGATION PRICING AND MANAGEMENT

ANNEX 1

Peru

Submitted to: Ms. Joan Atherton
Social Science Analyst
U.S. Agency for
International
Development
Office of Policy
Development and Program
Review
Bureau of Program and
Policy Coordination

Submitted by: Ian D. Carruthers
N.S. Peabody, III
A.A. Bishop
A.D. LeBaron
Rekha Mehra
Ramchand Oad
Dean Peterson
Dennis H. Wood

DEVRES, INC.
2426 Ontario Road, N.W.
Washington, D.C. 20009
(202) 797-9610
Cable: DEVRES
Telex: 440184

Contract No.: OTR-0091-C-00-4466-00

September 30, 1985

IRRIGATION PRICING AND MANAGEMENT

TABLE OF CONTENTS

ANNEX 1

Peru

N. S. Peabody III, Team Leader
and Social/Institutional
Specialist
A. A. Bishop, Irrigation Engineer

ACRONYMS AND ABBREVIATIONS

CEDEP	Centro Estudios para el Dessarollo y la Participation
DEPTI	Dirección Ejecutivo Proyecto Especial Tinajones
DGASI	Dirreción General de Aguas, Suelas e Irrigaciones
EMTECO	Empresa Técnica de Conservación Chancay-Lambayeque
GDP	Gross Domestic Product
IDB	Inter-American Development Bank
INADE	Instituto Nacional de Desarrollo
INAF	Instituto Nacional de Ampliación de la Frontera Agricola
O and M	Operations and Maintenance
PEPMI	Proyecto Especial Pequeñas y Medianas Irrigaciones
Plan MERIS I	Plan de Mejoramiento de Riego en la Sierra (I-American supported)
Plan MERIS II	Plan de Mejoramiento de Riego en la Sierra (II-German supported)
Plan REHATIC	World Bank supported agricultural project
SENAPA	Office administering water supply to city of Tacna
USAID	United States Agency for International Development

CURRENCY EQUIVALENTS

US$ 1.00 (22 March 1985) = S/ (Peruvian Soles) 8,250

WEIGHTS AND MEASURES

1 hectare (ha)	=	10,000 m^2
	=	2.471 acres
100 hectares (ha)	=	1 km^2
1 kilogram (kg)	=	2.204 pounds
1 metric ton (MT)	=	1,000 kg
	=	2,204 pounds
1 kilometer (km)	=	0.621 miles
1 square kilomter (km^2)	=	100 ha
1 millimeter (mm)	=	0.04 inch
1 cubic meter (m^3)	=	1,000 liters
1 liter (l)	=	1.066 quarts
1 liter per second (l/s)	=	1.066 quarts per second

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PEOPLE INTERVIEWED

Lima

Mr. Pablo Venistes Castro
Director, Tarifas
Dirección General Aguas Suelos y Irriaciones (DGASI)
Instituto Nacional de Ampliación de la Frontera Agricola (INAF)

Ing. Onorato Puaa
Director, Distritos de Irrigacion
INAF

Mr. Leonardo Armas Nuñes
Director General
Proyecto Especial Pequeñas y Medianas Irrigaciones (PEPMI)
INAF

Ing. Hugo A. Galvez Paredes
Director Adjunto
PEPMI

Ing. Luis Haro
Director, Plan de Mejoramiento de Riego en la Sierra II
(Plan MERIS-II)
PEPMI

Mr. David Bathrick
Chief, Agriculture
USAID

Mr. Ray Waldron
Project Officer, Agriculture
USAID

Dr. Fred Mann
Director, Agricultural Policy and Analysis
USAID

Mr. Robert Burke
USAID

Ing. Vito Aliaga
Grupo de Analisis de Politica Agricola (GAPA)

Ir. Manuel Castillo
GAPA

Tinajones

Ing. Milton Luna Sosa
Director Regional
Dirección Aguas y Suelos

Ing. Leonardo Romero Matos
Director Ejecutivo
Proyecto Especial Tinajones (DEPTI)
Instituto Nacional de Desarrollo

Ing. Edmundo Illoa
Subdirector
DEPTI

Ing. Luis Moreno
Administrator Tecnico
Cancay-Lambayeque Irrigation District

Director
Empresa Técnica de Conservacíon Chancy-Lambayeque (EMTECO)

Tacna

Ing. Angel A. Eguiluz
Director Regional
Dirección Aguas y Suelos

Ing. Luis E. Navarrette Rejas
Director Regional
Dirección de Aguas

Mr. Victor Hugo Gutiérrez G.
President, Comisión de Regantes
Subsector de Riego Uchusuma
Uchusuma Irrigation District

Cuzco (Plan MERIS II)

Ing. Americo Caseres
Director Regional
Dirección de Aguas

Ir. Jesus Melga Mejo
Administrator Tecnica

Ir. Agrón Jorge León
Subdirector, sarrollo Agriculo
Plan MERIS II

Mr. Rudolf K. Fernsebner
Chief Technical Advisor
Plan MERIS II

Mr. Johann Berg
Economic Advisor
Plan MERIS II

Engineer, social worker, farmers
Sacca Irrigation System
Plan MERIS II

Water User Group Chairman, Mayor, Plan MERIS II Agricultural Extension Officer
Cusipata Irrigation System

Devr

ANNEX 1

Peru

A. Background

1. Economic Background

a. Macroeconomic conditions and policy

The Peruvian economy has grown only slowly over the past fifteen years. (See Table 1-1.) During the 1970s per capita Gross Domestic Product (GDP) grew at an annual rate of less than one half of 1 percent. While government services, mining and power grew substantially during this decade, agriculture stagnated and manufacturing declined in the second half of the decade.

During 1979 to 1981, the economy grew at a rate of about 4 percent per year in real terms, or a per capita real growth rate of slightly over 1 percent per year. This improvement was short-lived, and following stagnation in 1982, the economy suffered a severe depression in 1983/84--caused in part by natural calamities, unsustainable public deficits, extremely weak export markets, high foreign debt service and a shortage of external credits to help finance investment.

The droughts, floods and landslides of 1983 disrupted the lives of over 1.3 million persons and caused economic losses estimated at over $1 billion. In 1983, GDP plunged 11 percent, export earnings decreased $400 million, inflation exceeded 125 percent, tax revenues declined by more than 20 percent, and the public budget deficit reached nearly 12 percent of GDP.

In 1984 climatic conditions reverted to normal and some recovery occurred in commerce, agriculture and, in particular in Fisheries. Overall real growth in GDP in 1984 was about 4 percent higher than in 1983. However, output of goods and services was still below the level reached in 1981/82, and manufacturing, construction, utilities and government expenditures remained depressed.

After years of expansion of the state's role, efforts were undertaken by the Morales administration, starting in 1978/79 to stabilize the economy including devaluation of the sol, reduction of the public deficit and measures to liberalize trade. Following the reinstitution of democratic government in 1980, the Belaunde administration undertook sectoral reforms designed to address structural and institutional weaknesses. By 1984, nearly all subsidies were removed from foodstuffs, petroleum and utilities and the prices of these items were brought close to world levels. The Belaunde administration continued the process of liberalizing trade by eliminating anti-export tariffs and regulations and by price and fiscal policies designed to help make industry and agriculture more

Table 1-1: Gross Domestic Product by Sectoral Origin
(Producer Prices in M of Sols 1973)

Year	Agriculture	Fishing	Mining	Manufacturing	Other	Totala	Import Duties	Total
1970	51,701	7,673	24,930	87,238	170,771	342,313	10,283	352,596
1971	52,759	6,670	24,798	93,214	131,822	359,263	11,073	370,336
1972	51,490	3,549	26,693	93,862	191,878	367,472	9,029	376,501
1973	51,687	2,571	26,924	99,524	202,457	383,163	9,396	342,559
1974	53,582	3,591	27,927	110,401	219,468	414,969	6,964	421,933
1975	53,564	3,186	25,243	114,959	234,745	431,697	9,376	441,073
1976	54,372	3,754	26,762	119,566	239,261	443,715	6,272	449,738
1977	54,302	3,278	32,909	114,469	239,973	444,931	4,807	449,738
1978	53,478	4,141	36,033	110,026	238,571	442,249	5,221	447,470
1979c	55,575	4,640	39,324	114,697	246,097	460,333	5,606	465,939
1980c	52,339	4,538	39,477	121,275	259,086	476,715	7,133	483,848
1981c	58,643	4,309	38,245	121,031	271,621	493,849	8,814	502,663
1982d	60,330	3,960	40,750	118,010	273,982	497,032	7,419	504,451
1983d	54,524	2,554	37,612	99,128	250,173	443,991	5,655	449,646

[a]Producer prices

[b]At market prices

[c]Preliminary

[d]Estimates

Source: The World Bank, Country Economic Memorandum for Peru, (Washington, D.C.: The World Bank, November 1984)

efficient and labor intensive, and more competitive and export-oriented.

In 1985 the Administration made further price adjustments of basic commodities and foodstuffs, and utilities and succeeded in reducing the deficit on public account. However, the country continues to experience high rates of inflation, unemployment and underemployment and widespread poverty. The economic problems faced by the country are severely compounded by its large external debt and debt service, and by weak export markets.

Total foreign debt amounted to about $13.5 billion at the beginning of 1984 equivalent to about three quarters of 1983's GDP. Service on the foreign debt amounted to about 30 percent of export earnings in 1983 and unless restructured will grow as a percentage of export earnings and GDP. The debt service is such that nearly half of domestic savings in 1983/84 were mobilized by the government and went to cover the debt service, thus severely limiting use of savings for financing domestic investments and development.

Export markets are weak. The outlook for increasing foreign exchange earnings from traditional exports is considered limited. At the end of 1984, export prices for minerals--which make up two-thirds of total exports--were, with the exception of silver and petroleum, the lowest (in real terms) since before the 1930s. (Export prices for coffee and sugar were also low.) Moreover, World Bank analysts project only a modest increase in world market prices for metals: the Bank's consolidated metal and minerals real price index is expected to remain at its 1984 level through 1986 and then increase at only 3 percent per year through 1990. Bank analysts also project only limited prospects for increased volume of exports of minerals.[1]

Following recent elections, a new administration under Alan Garcia assumed office in July 1985. A major challenge for the new administration and its overseas partners will be to achieve a coherent program for fiscal, monetary and balance of payment stabilization to set the basis for accelerated investments in the economy and longer term growth.

Prospects for longer term growth in the next decade are considered to be very dependent on improving productivity in the use of resources in agriculture and other sectors of the economy. It is unlikely that the economy will be able to grow by exporting minerals, as noted above, and protecting its industry and agriculture, or by an expansion of government services which was a major growth factor in the 1970s and early 1980s.[2]

---

[1]The World Bank, Country Economic Memorandum for Peru (Washington, DC: The World Bank, November 1984) p. 23.

[2]Ibid, p. 22.

The scope for improving productivity and stimulating exports of nontraditional agricultural and industrial products is considerable. The fact that agriculture and industry are characterized by relatively low levels of efficiency and labor productivity means that well designed efforts to increase productivity from existing low bases could result in very appreciable gains, at least in the early years of a productivity effort. Within agriculture, the increase of farm land under irrigation from projects now in execution (Table 1-2) as well as opportunities for increased efficiencies in irrigated farming offer significant opportunities for expanding production and marketing, increasing farm income and generating jobs.

b. The rural and agricultural sector

Natural resources in Peru are limited, at least by comparison to its neighbors in Latin America. The country has a total area of 128.5 million ha of which only 2.9 percent, or about 3.7 million ha are cultivable and about 22 million ha are natural pastureland (17 percent). The main opportunities for additional land with soils suitable for cultivation are found on the well watered lower eastern slopes of the Andes (requiring expensive development of access routes and basic infrastructure) and in the coastal zone (requiring substantial investments in irrigation). Overall, about 0.34 hectares of land per person is cropped.

There are three principal and very different agroecological zones: the coast, the Andean Highland zone or Sierra, and the Forest zone or Selva, east of the Andes mountains. The Sierra zone supports over half of Peru's rural population. Much of the Sierra has poor soils; most of the holdings are based on low to primitive production technology carried out on minifundia where low yields, poverty and recourse to off-farm employment is the norm.

About 50 percent of the total population of Peru (19.1 million people as of mid-1984) live in the coastal zone. Coastal agriculture is limited to irrigated river valleys. This zone is more prosperous, productivity is higher and farmers are technically more advanced and have more access to credit and support services than in other areas. It has ideal growing conditions and produces 40 percent of the country's gross value of crop production. It also accounts for the main agricultural exports, sugar and cotton.

Only about 10 percent of the population live in the Forest zone. Most farming there is concentrated in four river valleys in the Ceja de Selva with tea, coffee, and fruit the main crops. Despite poor soil quality, the Forest zone is gaining economic importance with oil exploration and the construction of two trans Andean highway projects which are expected to promote agricultural development in the zone.

Table 1-2: Land Added and Improved by Irrigation Projects
(ha)

	New Areas	Improved Areas	Reclaimed by drainage	Total Area
Built between 1906 and 1983	183,523	338,231	4,375	526,129
In execution				
Large projects	249,000	368,000	0	617,000
Small projects	22,013	53,922	14,456	90,414
Total	454,536	760,153	18,831	1,223,543

Source: Roger Sanchez Velez, "Resumen del Informe de Peru." Document prepared for Seminario Latinoamericano de Irrigacion, (Santiago, Chile: 1983).

Overall, agriculture provides employment for about 38 percent of the labor force and contributes about 13 percent of the GDP. Peruvian agriculture today does not produce enough to meet domestic requirements for consumption or provide for possible exports. The situation has been brought about by rapid increases in the total and urban population of the country and by the poor performance of the agricultural sector as a whole. Poor performance of the sector in the 1970s is attributable to the impact of a sweeping land reform and excessive Government regulation instituted following the military takeover in 1968[3], aggravated by consecutive years of drought, 1978 through 1981, and by the abnormal growing conditions of 1983.

Per capita agricultural output has declined as shown in Table 1-3. As a result, Peru has become dependent on food and feed imports including wheat, corn, rice, soybeans, grain sorghum, milk products, vegetable oils and beef. Peru has even had to import sugar, a traditional export.

This situation of declining per capita output clearly requires policies and programs to support improved use of land and water resources. Moreover, these policies must take into account the fact that improvements in agriculture are essential to the welfare of poor, the majority of whom are found in the Serra zone. A favorable factor is an apparent decline in fertility and population growth apparently in recent years.[4] Another is the increasing integration of Peru's rural poor into the rest of the economy as indicated by a recent study.[5]

---

[3]Under the Ararian Land Reform Law of June 1969, 11.6 million ha of land (representing 48 percent of land in agricultural units) in 16,500 farms was expropriated. By 1981/82, 8.9 million ha of this land had been distributed to 389,000 families with the balance remaining under state control pending adjudication, state afforestation or other tax incentives for agricultural investments and re-opened agricultural marketing to the private sector.

[4]According to the World Bank's Country Economic Memorandum for Peru (page 20), 1981 census data indicate a decline in the population growth rate to about 2.2 percent, a level earlier expected to be attained only by 1990s. However, this trend has still to be confirmed.

[5]Adolfo Figeroa, Capitalist Development and the Peasant Economy in Peru, 1984.

Table 1-3: Per Capita Agricultural Output

Period	Farm Output Index	Population Index	Per Capita Farm Output Index
1970-73	100	100	100
1974-77	104	111.7	93
1978-81	106	124.2	85
1982	116	132.7	87

Source: Derived from Tables 1.1 and 2.1, World Bank, Country Economic Memorandum for Peru," (Washington, DC: The World Bank, November, 1984)

2. Irrigation development in Peru

Peru has vast amounts of hilly desert on the coast, rough peaks in the Andes and lush jungle in the Amazon. Only 2.34 percent of the surface, 3,021,600 ha, is farmed. (See Table 1-4.) Of this, 706,400 ha in the Pacific coastal valleys are totally dependent on irrigation year round. These highly productive valleys, 53 in all, appear from the air to be thin lines of green running from the Andes to the west. Sometimes they fan out into broad fields on the Pacific slopes. In many cases, the flat lands near the ocean have been damaged by salinity and high water tables with an estimated 20 percent to 35 percent of the irrigated land having these problems.

Most of the land that is farmed is in the Sierra or highlands, and of this about one-fourth is irrigated. Most of the irrigation in the Sierra is supplementary, i.e., it assists the germination of the main rainy season crop grown from October to April. Some irrigation is also used to grow a second crop in the dry season--June to November.

Supplemental irrigation is also used in the Selva, or forest zone, or, more properly, in the foothills between the Andes and the jungle. Both the highlands and the jungle have an abundance of water. The Atlantic Ocean side of the Andes accounts for 74.5 percent of the surface area of Peru and has 97.8 percent of the water. The Lake Titicaca basin receives 0.5 percent of the water and represents 3.8 percent of the land area. That leaves the Pacific slopes with 21.7 percent of the land and only 1.7 percent of the water. Water which naturally flows to the Pacific is now being supplemented slightly by water brought through tunnels from the Atlantic side. Electricity production is the main motivation for these tunnels.

Irrigation projects in Peru often involve long canals of large size. Table 1-2 shows the number of hectares added between 1906 and 1983; the number of hectares to be added by projects now in construction actually exceeds the number already built in this country. Some of these are extremely expensive projects per hectare irrigated.

B. National Irrigation Administration and Policy

1. Organization of irrigation administration

The agricultural sector is served by the Ministry of Agriculture and by semi-autonomous public agencies set up to administer special loans. The Instituto Nacional de Desarrollo (INADE), one such organization which reports directly to the Prime Minister, oversaw the Tinajones Project (DEPTI) which was financed mainly by a German loan. INAF, the Instituto Nacional de Ampliación de La Frontera Agricola, is another decentralized organization and is the one that administers Plan REHATIC (World Bank), Plan MERIS I (American), Plan MERIS II (German) and Linea Global IDB (Inter-American Development Bank) loans. These decentralized agencies are reported to have better salary scales and

Table 1-4: Distribution of Farm Land According to Region and Irrigation Status
(ha)

	Coastal	Sierra Zone	Forest Zone	Total
Not Irrigated	0	1,276,200	497,600	1,773,800
Irrigated	706,400	434,800	106,600	1,247,800
Total	706,400	1,711,000	604,200	3,021,600

Source: Roger Sanchez Velez, "Resumen del Informe de Peru." Document prepared for Seminario Latinoamericano de Irrigacion, (Santiago, Chile: 1983).

esprit de corps than does the Ministry of Agriculture. The loan projects have something specific to do, and someone specific to whom they must report--the foreign lender.

a. Organizational structure of ministries and agencies

Figure 1-1 shows a list of the "organic structure" of the Ministry of Agriculture. The figure is deceptive, however, because action is now supposed to take place at the regional or departmental level in the direcciónes regionales. The list puts these direcciónes regionales in fifth place, below the "Central Line" agencies which includes the Dirección General de Aguas, Suelos e Irrigaciones (DGASI). In fact, the line agencies have very little executive authority. DGASI, for example, mainly espouses norms and tries to aggregate regional data. The "Alta Dirección" actually has very little chance of making a dirección regional carry out a suggestion of the DGASI and vice versa.

Figure 1-2 lists the main direcciónes (departments) within the GASI. They are relics from the past when the military government, with its 1969 Ley General de Aguas (General Water Law) attempted to run all the irrigation systems and crop plans from Lima. The Dirección de Tarifas has never been able to enforce the collection of water fees or even make all the regions report what they are collecting. It does have some things it can do, however, such as helping irrigation districts determine how to save money for engineering studies and emergencies. It can also help to resolve the complex problems which arise when two irrigation districts decide to join their water supplies.

Figure 1-3 shows the complex list of offices in each dirección regional (regional agricultural office). Most of the central line agencies are repeated at this level, including the Dirección de Aguas y Suelos. Most valleys also have an oficina agraria which should be an agricultural extension office. Under that office is the Administración Tecnica of each irrigation district. Therefore, there are at least two levels between the government appointed Administrator of water in an irrigation district and the Ministry of Agriculture: the oficina agraria and the dirección regional. The line from the Dirección de Tarifas in Lima to the Junta de Usuarios, who actually sets the water fees, is circuitous--up through the DGASI to the Minister and then down through Departmental and Valley Agricultural Offices to the Technical Administrator and finally to the junta. The Technical Administrator collects the tarifa, the mandatory fee, and passes, most of it to the junta; the junta collects any others.

b. Responsibilities and functioning of irrigation agencies

Figure 1-4 shows an idealized concept of a Technical Administrator's Office in an irrigation district. Figure 1-5 describes the structure we observed in Chancay, which is similar to that in Tacna. In these two cases, the juntas seem to get along well with the

La estructura orgánica del Ministerio de Agricultura es la siguiente:

a) Alta Dirección

-- Despacho Ministerial

-- Vice-Ministro

b) Organo de Control

-- Inspectoría General

c) Organos de Apoyo

-- Oficina General de Administración

-- Oficina de Catastro Rural

-- Oficina Sectorial de Estadística

-- Oficina General de Comunidades y Relaciones Públicas

-- Oficina General de Igeniería

d) Organos de Linea Centrales

-- Direccíon General de Agua, Suelos e Irrigaciones

-- Direccíon General de Agricultura y Ganadería

-- Direccíon General de Agroindustria y Comercialización

-- Dirección General Forestal y de Fauna

-- Dirección General de Reforma Agraria y Acentamiento Rural

e) Organos de Linea Desconcentrados

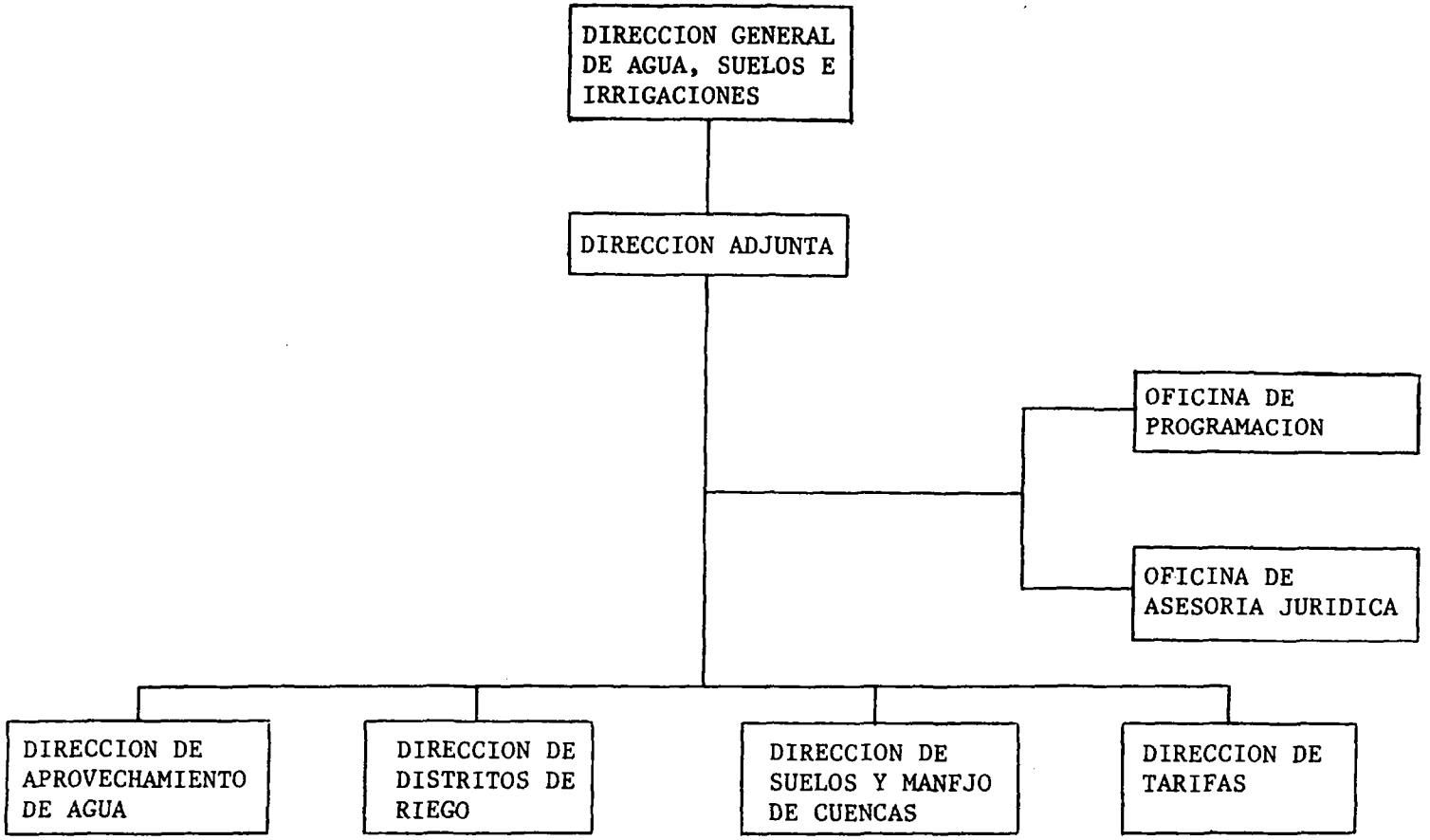
-- Dirección Regionales

f) Organos de Coordinación

-- Comité Central de Coordinación

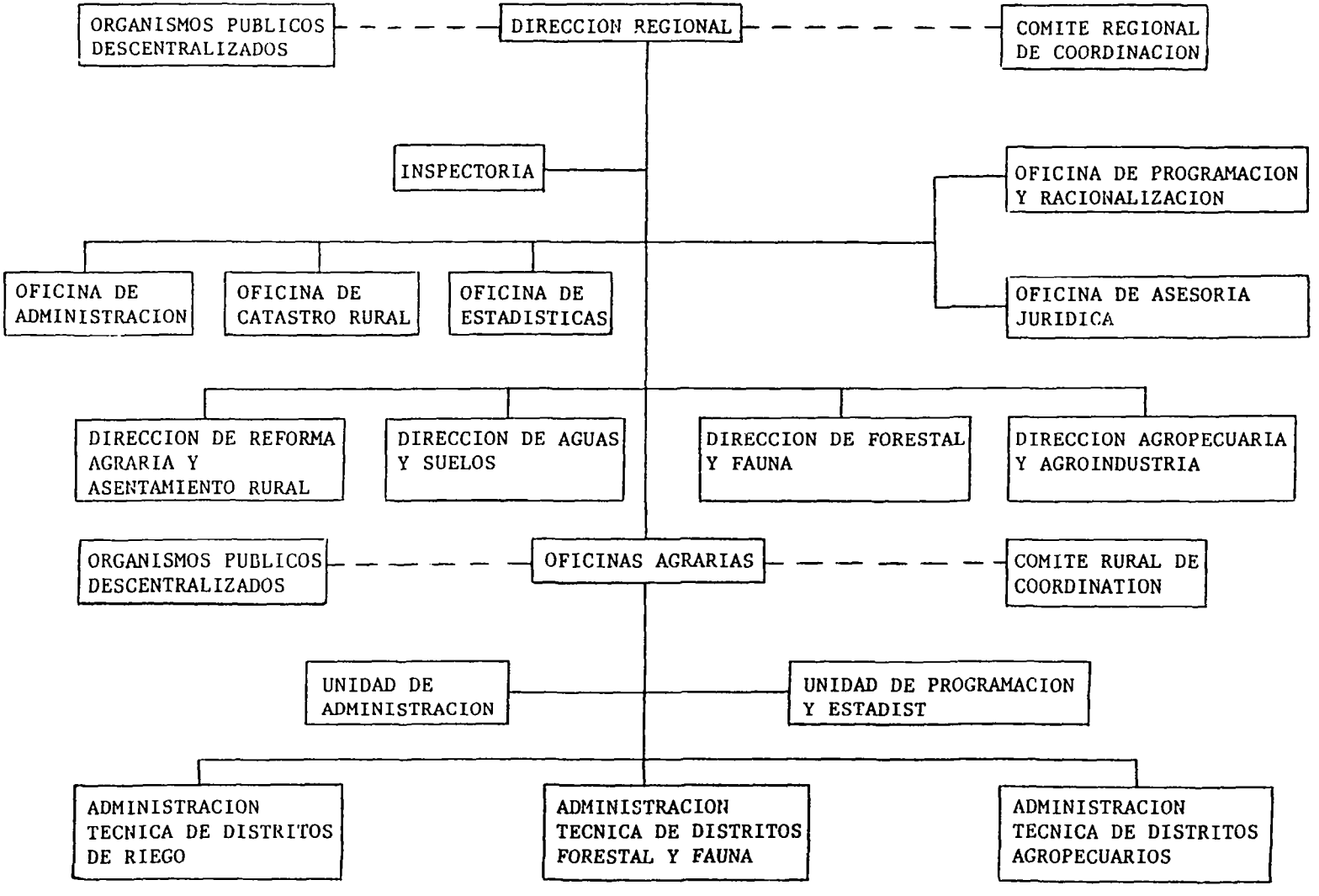
IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-1: Main Agencies Within the Peruvian Ministry of Agriculture



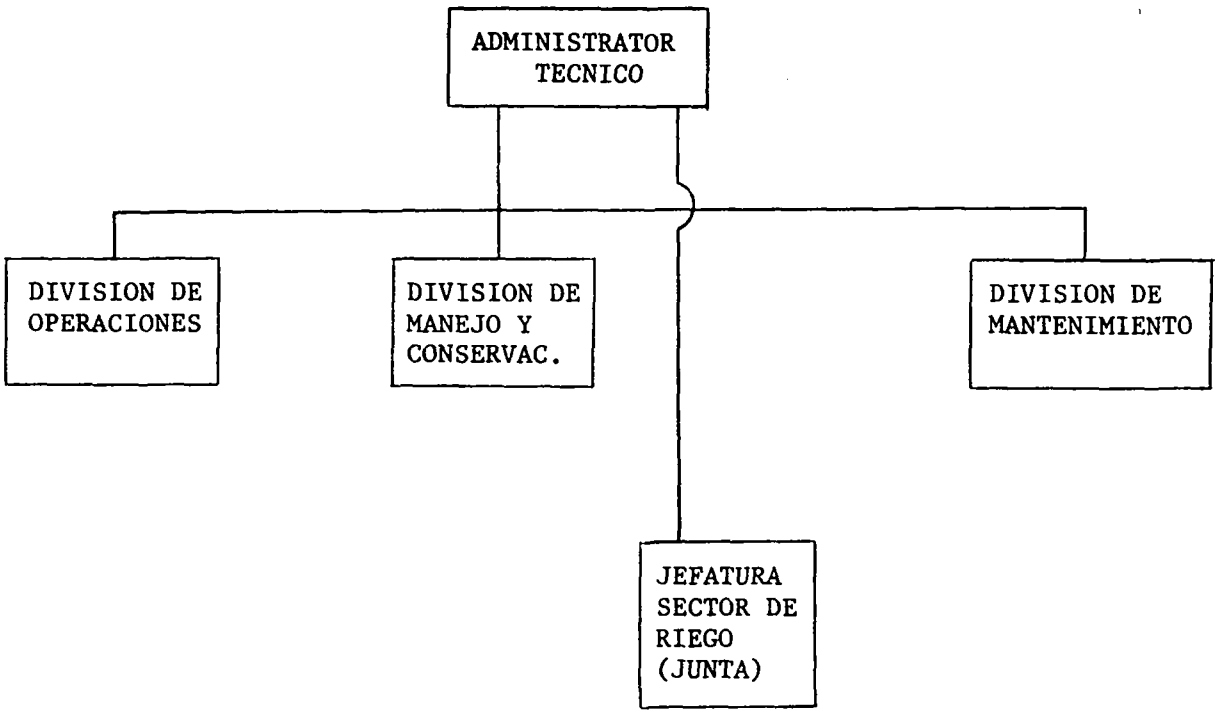
IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-2: Departments within the DGASI



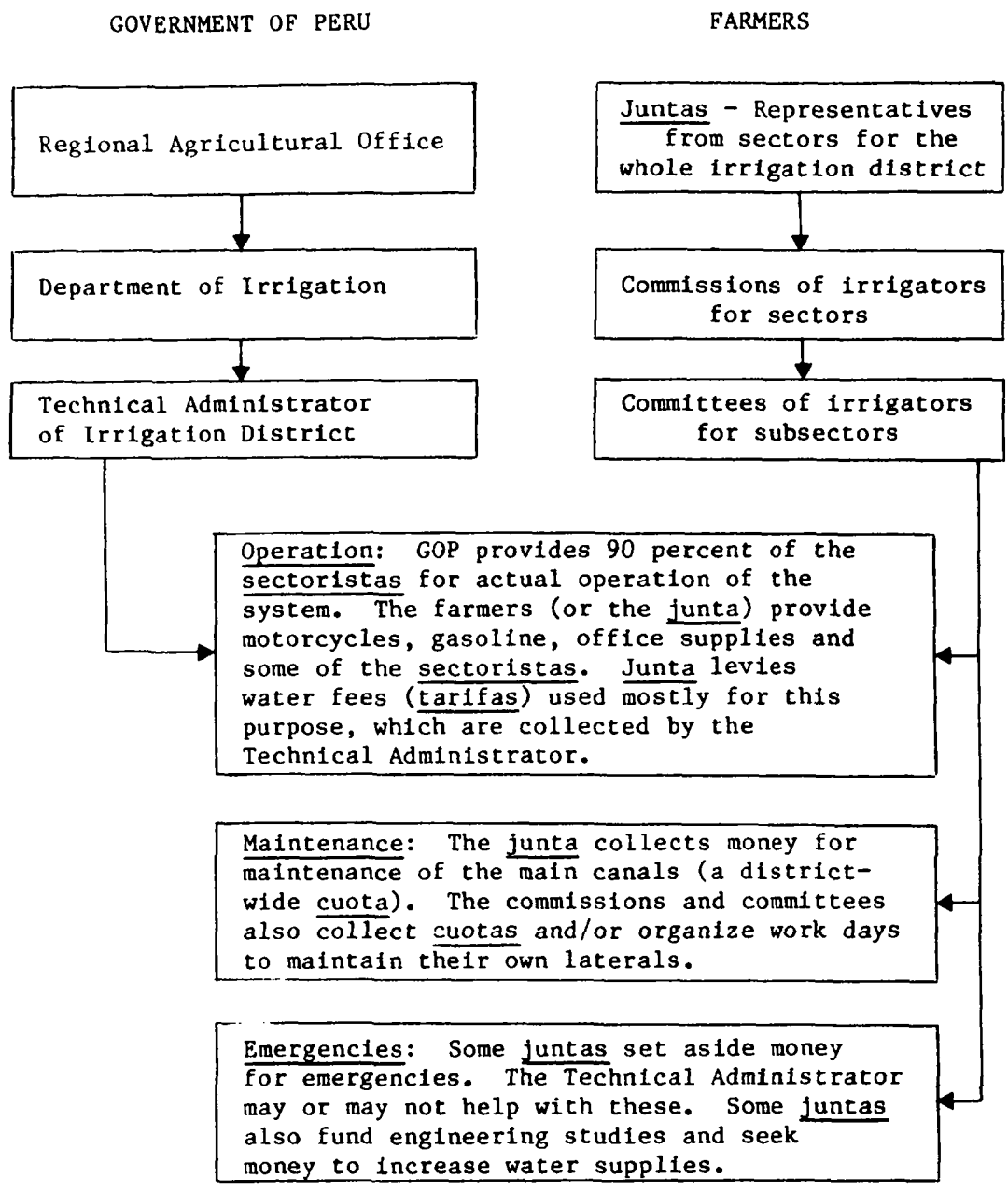
IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-3: Organogram of the Regional Directorates and Agrarian Offices



IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-4: Idealized Concept of the Technical Administration of a "Typical" Irrigation District



IRRIGATION PRICING AND MANAGEMENT: PERU

Figure 1-5: Rough Descripiton of the Actual Operation and Maintenance Coastal Irrigation System in Peru

Technical Administrator, who functions as an executive officer. The junta is primarily a legislative group. The Administrator and the junta pool their resources in order to accomplish the basic task of distributing limited supplies of water to the farms. The Administrator helps plan and supervise maintenance, even though the farmers through the junta provide money for that function.

It is said that in other valleys cooperation between the juntas and the Technical Administrators is poor, and that farmers actually operate some systems because the Technical Administrators are not able to do so. The Sarria study[6] says that money from the central government for the operation of the irrigation districts fell in real terms, between 1981 and 1983, and that tariff money collected from the users of the irrigations systems fell in absolute terms.

2. Irrigation policies

a. Policy framework for irrigation development

Peru's irrigation policies are in a state of transition. For about ten years, 1968 to 1978, there was an experiment with centralization and technocracy. The 1969 Ley General de Aguas proclaimed that all the water belonged to the people and that the government was to decide how to best use it, but this system never really worked. During the past seven years, 1978 to 1985, there has been a timid move toward less centralized government and delegating more power to the regions. The government gave less and less money to the irrigation districts and in places where water was really valuable (or where irrigation systems were complex and breaks in canals were serious) the farmers, through their juntas, have been compelled to fill in the gap--i.e., they provided some money and leadership and tried to collaborate with the Technical Administrators.

It is hard to know whether this process of regionalization will be continued, whether new power actually will be given to the sugar cooperatives, and whether a strong central government will emerge. It is possible that all three things will happen: the sugar coops will get more definite water rights, a "strong" central government will reduce the size of the government; and the taxation powers of both the local governments and the juntas will be increased.

The basic tenets of the present water law are:

- There are no private water rights and transfer of assumed rights is illegal;

---

[6]Sarria, Carlos R. Analysis de los Mechanismos Institutionales y Economicos Para Optimizar el Uso de Agua Agricola (Lima, Peru: Grupo de Analisis de Policitica Agraria (GAPA), 1984).

- o Water is to be used in the social interest and only with permission from the government. (The government establishes priorities: human use, industry, animals, permanent crops, and animal crops taking into account social needs.); and

- o The line of judicial appeal is administrative to the Technical Administrator, then to the DGASI, and then to the courts. (In practice, the Technical Administrators first refer individual appeals for more water back to their juntas because the juntas help the Administrator decide on the rules for water allocations and crop preferences.)

b. Functioning of current policies on water rights, irrigation charges and maintenance

In practice, the farmers have a lot to say about their water rights. Where water rights are extremely valuable, as in Tacna, traditional arrangements have not been modified. Where and when water is not valuable, people simply ignore the dictates of the Ley General de Aguas and use it as they see fit.

Current interpretations of the water law require the juntas to set their own tarifas and cuotas and to keep the money in the irrigation districts.

Our impression is that during the past several years farmer participation in irrigation management is more evident. It appears that current policies are reasonably effective even though many aspects of the water law are ignored.

The basic problem with the concept that all the water belongs to the state and the state will decide how to make rational use of it is that the state is unable to use markets to help implement that notion.

For example, the government says water should be allocated according to a plan de cultivo y riego, which requires farmers to request permission to plant certain crops and modify their plans according to directives issued by a District Coordinating Committee. In a water-short valley such as La Leche[7], the Coordinating Committee give preference to the permanent crops, allocating 14,379 cubic meter per hectare per year for sugar cane, for example. That leaves an expected 4,219 cubic meter per hectare per year for the annual crops based on the total area available--not that seeded. There is no regulating reservoir and the farmers only know that their share of a tiny amount of water will come, primarily between December and June with most of it in March, April and May. The farmers must submit a plan for the crops they want to plant, but it is merely a formality.

---

[7]Ibid., pp. 102-104

After receiving requests, the Administrator goes through another formality of cutting back requests, but there is no follow-up to determine whether an individual farmer actually plants the amounts he says he will plant or whether or not he adjusts his acreage according to the Technical Administrator's directive.

In Chancay de Lambayeque, the Technical Administrator, claims to allocate water according to the plan de cultivo y riejo. However, the functioning system seems to be a slight modification of the old system of water rights with a few annual adjustments. In Tacna, where water is very valuable farmers are allocated water in time units according to landholding size, irrespective of crop.

3. Official perceptions at the national level

Officials at the national level seem to minimize the extent to which the farmers are running their own irrigation systems; however, those associated with autonomous projects are perhaps more cognizant of this than those in the Ministry of Agriculture. At the national level in Lima one needs to distinguish clearly between the perception of the officials, which is usually sharp, and the "official line" which is often unworkable. The "official line" is that plans de cultivo y riego work, that support for technical administration is adequate and that the government manages the water for the welfare of all.

C. Irrigation Projects

1. Chancay de Lambayeque

a. Background

The area constitutes one of the oldest irrigated valleys of Peru, having been irrigated since Inca times. The old system included the area presently in sugar cane which was expanded during the colonial period. A considerable part of the area included in the 1968 expansion was irrigated from the La Leche River.

The Chancay de Lambayeque project is different from most of the coastal irrigation projects of Peru in that some regulation of the highly fluctuating water supplies is made possible by the Tinajones Reservoir. This reservoir with a capacity of 320 million cubic meters (MCM) was completed in 1968 along with its feeder canal diverting water from the Rio Chancay and the discharge canal supplying water back to the river for irrigation. The project was in the planning stage for 30 years (1928 to 1958) and ten years in construction (1958 to 1968) to its present state. Phase II including diversion tunnels tapping the east slope of the Andes is yet to be built. Prior to 1968 the area was served by a number of canals diverting directly from the river and its tributaries and the irrigation was "run of the river", subject to the high streamflow variation and periods of drought and excess.

(1) Description

The project consists of the old canal systems diverting water from Rio Chancay and lesser streams including Rio Lambaysque and Rio Rique serving some 70,000 ha. Superimposed upon this old system is the new project to provide storage and supplemental water to the existing area and develop new lands bring the total area to approximately 100,000 ha. Main features of the project include the "off stream" Tinajones Reservoir, 320 MCM; the reservoir feeder canal, 70 cubic meter per second with its diversion dam, Bocatoma Roca Rumi; the supply canal back to the river, 70 cubic meter per second; along with new diversions and new lined canals linking the new system with the old.

The advantage of off-stream storage, besides being available where it is, is that the sediment can be removed and left in the river and thus not deplete the reservoir capacity as much as if it were on the main channel. On the other hand, if the flow in the river exceeds the capacity of the feeder canal any excess will be bypassed even though the reservoir is not full and the additional water could be used. Since its completion in 1968, the reservoir has filled only five times.

An integral part of the planned project is yet to be constructed, namely Phase II, consisting of trans diversions from the higher watersheds to bring water to the Pacific side of the Andes. Diversion dams, canals and nearly 15 miles of tunnels are being planned. Water for the new lands is expected to come mainly from these waters now draining to the Atlantic.

(2) Agriculture in the project area

The main crops are sugar cane and rice. In the past, cotton and beans were much more important than today. Table 1-5 reflects the large fluctuations in rice production, which have continued in 1984-85 and a small reduction in sugar cane harvests. About half of the coops formed by agrarian reform in the late 1960s have chosen to subdivide themselves into individual parcels of land. The average size farm is small--two to three hectares--and the number of hectares on the sugar coops is about the same--2.6 per member.[8]

Alfalfa and milk production are also important. In 1983, the valley produced 4,771 MT of milk and 1,051 MT of cattle meat. They also produced 4,719 T of chicken meat and 869 T of eggs.[9]

---

[8]Centro de Estudios para el Dessarollo y la Participation (CEDEP). Diagnostico-Economico de la Actividad Agropecuaria del Valle de Chancay-Lambaque (Lima, Peru: CEDEP, 1984) p.1.

[9]Ibid., Cuadro (Table) No. C-IV-8.

Table 1-5: Principle Crops Harvested in the Valley as a Whole and by Cooperatives in Chancay Lambayeque, 1978 and 1983
(ha)

Crop	Valley		Cooperatives	
	1978	1983	1978	1983
Rice	16,636	31,298	3,327	4,168
Sugar	19,441	15,888	15,911	13,043
Cotton	2,392	1,217	677	101
Corn	1,776	1,584	192	25

Source: Centro de Estudios para el Desarrollo y la Participacion (CEDEP), *Diagonostico Tecnico-Economico de la Actividad Agropecuaria del Valle de Chancay-Lambayaque* (Lima, Peru: CEDEP, 1984), Cuadro (Table) No. C-IV-3.

b. Project management and administration

(1) Roles and responsibilities

The administrative structure of the Tinajones Project corresponds to the official pattern described in Sections A.2.a and A.2.b above, in virtually all aspects. The Development Corporation, DEPTI, executes activities which utilize foreign funds: studies, construction and major rehabilitation and repair. The Technical Administrator of the Chancay-Lambayeque District is responsible for system operation and the junta de usuarios has recently assumed responsibility for maintenance. Operational policies are set by a District Coordinating Committee, which consists of representatives of the users, DEPTI, the Agricultural Bank, the Ministry of Agriculture, and other non-agricultural water users. The office of the Technical Administrator, located in Lambayeque, has three divisions: operations, maintenance, and management and conservation. Suboffices are located in each of the five Sectors, which correspond to the area served by a major lateral. For operational purposes, Sectors are divided into subsectors, or sublateral units.

The farmers are organized in a parallel structure. In some turn-out units, they have formed comites de regantes (Irrigator committees). Otherwise, there are comisiones de regantes (Irrigator commissions) on the subsector level, and a system-wide Junta de Usuarios, which includes representatives of individual comisiones.

The Technical Administrator and his staff establish cropping parameters, maintain records of cropping and water delivery, set delivery schedules, distribute water to the farm turnout, and advise the junta and comisiones on maintenance needs. The junta assumes responsibility down through the laterals; the comisiones are responsible for smaller units.

(2) Operation

As indicated above, the Tinajones Reservoir allows some control over the flow of water through the system. Nonetheless, the prevailing situation is that of water shortage during critical periods, even in good years. The project was designed to increase the available water supply by storing excess flow and by diverting other mountain rivers, to regularize the supply on the existing 68,000 ha command area, and eventually to expand the command area to 100,000 ha. However, the command area has already been expanded to approximately 90,000 ha without an increase in the water supply, thus water allocation remains a chronic problem.

Water is allocated through a detailed process which attempts to reconcile technical limitations and farmer preferences. Near the end of the calendar year, farmers are required to submit a cropping plan to the office of the Technical Administrator. These data are aggregated

by crop and estimated water requirements are prepared, using standard water requirement coefficients for each crop. At about the same time, the hydrology unit of the Directorate of Water and Soils in Lima submits an annual water availability projection, based on river flow, rainfall patterns, and the status of the Tinajones Reservoir. The Coordination Committee meets to review both sets of data and establishes a crop adjustment formula which is then to be applied to the requests of each farmer. Sugar cane, fruit and other permanent crops are given first priority in water allocation, and no adjustments are made. Normally, other grains and vegetables are also left untouched, but rice allottments are adjusted almost every year.

Uniformly, technicians and administrators contend that the system cannot support more than 25,000 ha of rice production, even in good years. Consequently, each year a formula is developed which theoretically reduces the total cropped area to that amount or even less, if the water supply is inadequate. In final allocations, the amount of rice permitted on large units (over 10 ha) is reduced disproportionately more than small units. Individual cropping plans are then approved after the formula is applied and the final product becomes the annual Plan de Cultivo y Riego. Farmers whose allotments have been reduced are supposed to substitute crops, but there is no follow-up to determine whether or not this is done in practice.[10]

The process does not always follow the above pattern. In 1984-85, for example, the Coordination Committee attempted to impose a ceiling of 25,000 ha of rice cultivation, but farmers protested to political figures, who intervened to raise the ceiling to 40,000 ha, despite the contrary advice of technicians. As rainfall was less than anticipated, the reservoir was depleted faster than planned and water was already deficient by the time of the team's visit in late March. Consequently, farmers had abandoned some of their paddies, and the Technical Administrator was about to request the Coordinating Committee to cut water supplies altogether in the low priority areas of the system.

Once the Plan has been established, water is delivered by rotation. Generally, rice paddies receive water every eight days at a rate of two hours per hectare, and other crops receive water every two weeks. When supplies are low, the frequency is reduced and/or the duration of the turn is shortened. Normally, rotation occurs within each lateral. However, during the team's visit, a new procedure was introduced on the new canal which brought water to one lateral at a time and reduced deliveries to one hour per hectare. At one field site, the sectorista (water master) estimated the stream flow to be 140 liters per second, which translates into a gross application of 50.4 mm, or about 2 inches.

---

[10]Recharte, Jorge, "Ethnography of Irrigations in Peru with Special Reference to the Coast," 1983, (typewritten), pp. 25-26.

The day before his turn, each farmer must go to the suboffice of the Technical Administrator to request water. His request is added to his annual irrigation card, and a time is fixed for water delivery. The turnout gates are opened and closed by a sectorista in the presence of the farmer. If a farmer fails to appear when his turn is scheduled, he misses the turn and must wait for the following rotation.

(3) Maintenance

Until 1983-84, DEPTI took care of the maintenance of the main canal, laterals, and drains. The oficina agraria formally assumed maintenance responsibility in 1981; however, as the office had no operating budget, DEPTI and the oficina agraria collaborated with the junta de usuarios to establish EMTECO, a non-profit maintenance company under the control of the junta. DEPTI provided basic staff and the oficina agraria transferred to EMTECO the machinery which DEPTI had acquired with German funding. EMTECO started operations in 1984, working on an uncertain budget from the collection of delinquent tariffs and quotas, concentrating its efforts primarily on maintenance of major drains. For the 1984-85 season, EMTECO prepared a complete work plan and a budget which included funds to purchase new heavy machinery. As of the end of March, EMTECO was about to ask the junta to provide a budget of S/ 4 billion (approximately $500,000), three times as great as that of the previous year.

It is too early to say how successful EMTECO will be. It has started with a strong institutional base, but it remains to be seen whether the junta will actually be able to perform the managerial role anticipated, and whether the technicians currently managing EMTECO will function well under the control of the junta. If this does succeed, the arrangement may be duplicated in other coastal systems.

The comisiones are responsible for repairs and maintenance below the laterals. The staff of the Technical Administrator prepares an annual maintenance program for each subsector, complete with cost (labor), and submits it to the comision. The comision, in turn, reviews the program, decides on an appropriate assessment, and assigns mobilization and supervision responsibilities to apuntadores, who oversee the work.

c. Farmer participation

The Tinajones Project is characterized by a high level of formalized, officially integrated participation of water user organizations. The organizations were created by fiat, but they have clear roles in the operation of the system, they have unique responsibilities, and they have control over the resources they generate. Moreover, their roles and responsibilities have increased in importance over time, and their resources have also grown. This discussion will proceed from the bottom of the hierarchy to the top.

Some subsectors have comites de regantes, which are formed at the small turnout level. However, they are not common, and there is no indication that the system functions better in subsectors where they exist. This question bears further exploration.

Comisiones are apparently well established in each subsector of the system, and their role is legitimized by farmers and technicians alike. Farmers in each subsector elect a slate of candidates for the executive committee of the comision, which carries out the routine functions of the comision. Each farmer and each cooperative has a single vote in the election, and each slate is apparently composed of a cross-section of farmers, large and small. Members of the Committee can serve two two-year terms before being retired for at least one term. Officials contend that small farmers are well represented on the Committees because they represent the majority of the farmers, and because large farmers do not have the time to devote to such activity. This bears further exploration, but it is clear that the leadership is not an elite clique.

Each Committee elects one of its members to represent it in the junta de usuarios, which also serves a two-year term. Although members of the junta have always assumed administrative, as well as regulatory responsibilities, they have been known to maintain close ties to their constituents. Until now, they do not represent an independent leadership group, nor are they identified with officials. However, the creation of EMTECO may change the situation. Members of the junta will be required to demonstrate higher levels of managerial and technical competence as the overall responsibilities of the junta increase in magnitude and complexity. In consequence, a cadre of semi-professional managers may emerge to lead both the comisiones and the junta.

There is little evidence to suggest that farmers have had a substantial role in the development of the Tinajones Project, except for the study funded by the junta in 1982. However, the user groups do have a primary role in setting tariff and quota rates and, most recently, they have assumed responsibility for the whole maintenance operation. These tasks were thrust upon the groups, rather than sought by them, thus they have been supported by the administration, rather than opposed. Until now, the junta has had a passive role in cost recovery, but it can be expected to take a more active role in the future.

Farmers have shown the ability to mobilize political support to change the plan de cultivo y riego, and thus modify water allocations. In the short run, this has had the detrimental impact of depleting reservoir supplies and threatening significant crop shortfalls. At the moment, chronic water shortages are handled essentially by administrative fiat, with very little collaborative involvement of the farmers or their representatives, which leaves the system vulnerable to political interference. In the longer run, however, if the current crisis is managed properly, a satisfactory resolution of the apparent conflict between farmers and technicians may lead to a more widespread

and sophisticated understanding of the technical limitations of the system, more precise and equitable cropping allocations, improvements in water delivery efficiency, and the mobilization of development resources, both internal and external, to complete the system as planned. The present expansion of the maintenance role of the junta provides a good opportunity to involve farmers in other aspects of system operation which greatly affect their livelihoods.

Conflicts are resolved administratively; user groups have no apparent formal or informal role in conflict resolution. Water theft is the most common source of conflict. Infractions are reported to the Technical Administrator, who fines perpetrators from S/ 10,000 to S/ 30,000. Although most fines are appealed to Lima, they apparently are seldom overturned.

In short, farmer participation in the Tinajones Project is rather like a bureaucratic extension of the irrigation administration. Farmer organizations represent their constituents in aspects of the system in which they have been granted authority; increasingly, they assume responsibility for functions which previously were performed by administrators and technicians. There are few signs that the authority or responsibilities of the users groups have increased as the result of their own initiatives. Rather, farmers participate in response to the initiatives of officials. Although there are some underlying problems, the arrangement works fairly smoothly.

d. Cost recovery

Farmers in the Tinajones Project are subject to four types of water charges: a tariff, which is collected by the Technical Administrator; the quota and the development assessment, which are collected by the junta; and a special quota, collected by the comisiones. Each charge is assessed, collected and utilized differently, but all charges are decided by the farmers themselves or their representatives; none is set by an external authority. In total, the charges constitute a small fraction of the cost of production. Although the special quotas are recovered regularly, the record of other charges has not been as successful, primarily because of weaknesses in the collection and enforcement procedures.

(1) Tariff

The water tariff, the only charge mandated by law, is levied on the basis of the volume of water delivered, multiplying standard crop coefficients by the area planted in a particular crop. The rate levied per cubic meter of water is decided by the junta, but cannot exceed five percent of the cost of production. The tariff is levied for crops included in the plan de cultivo y riego, which covers the major annual agricultural season; second crops are not subject to the tariff. In 1982 and 1983, the tariff in Tinajones was set at 1 Sol per cubic meter, or Soles 14,000 per hectare of rice and Soles 6,800 per hectare of maize

($1.70 and $0.82, respectively, as of 22 March 1985). The rates were not adjusted to account for the great inflation over the 1982/1983 period, thus the impact of the tariff declined significantly. In April 1985, the rate is to be set retroactively for 1984. Although it was assumed that the 1984 rate would be increased, officials were unable to predict the outcome of the discussion.

The Technical Administrator collects the tariff and is supposed to give part of it to the junta for operation and maintenance (75 percent), and send part to Lima for "amortization" (10 percent) and the "canon" (10 percent), a water right tax.[11] In practice, very little of the tariff goes to Lima. Approximately 10 percent of the tariff is retained in an emergency fund, in lieu of the amortization and canon payments. The remainder is allocated to the junta, but most of these funds ultimately are transferred to the Technical Administrator to be used for vehicles, fuel, and salaries of some sectoristas, in addition to other routine administrative costs of the office. According to EMTECO, only about 15 percent of the tariff collection is used for maintenance.

To enforce its authority to collect the tariff, the Technical Administrator and is given the power to impose fines for late payments or to cut off the water supplies of delinquent farmers. However, collection rates have been low, however, primarily because of reluctance to enforce sanctions. Since the creation of EMTECO, which coincided with the disappearance of maintenance budgets from Lima, the junta has begun to encourage farmers to pay current and past tariffs. The effort has achieved some degree of success, apparently without resorting to sanctions.

Two small systems located nearby Tinajones have more successful collection records. In both of the systems (La Lache and Motupe) the tariff is based on water volume, calculated as in Tinajones. The tariff has been lower in each of the systems, but that does not account for the differences in collection rates. Rather, farmers are required to pay the tariff in advance of each turn. Consequently, although water supplies in the systems are uncertain, and highly variable, farmers pay their tariffs. Officials say that the procedure was not instituted in Tinajones because that system is much larger and thus frequent collection would present great administrative problems. Although this may be the case, it does indicate that collection, not payment, is the problem in Tinajones.

---

[11]Bazo, Jose Louis, "Sondeo Descriptivo Sobre Irrigacion en el Peru" (Lima, Peru: 1982.) (Mimeographed), pp. 20-23.

(2) Quota

The quota is an optional water charge levied by the junta for maintenance. It appears to be levied in systems with major civil works, rather than in smaller systems like La Leche and Motupe. The quota is paid directly to the junta, which maintains complete control over the funds. However, as the tariff and quota are generally levied and paid together, collection rates for the two are similar.

Traditionally, the quota and tariff are set at the same rate and based on the same volumetric surrogate system, (which means that a rice farmer was assessed a quota of Soles 14,000 per hectare in 1982 and 1983; the 1984 rate will also be set in April, 1985). The relationship between the tariff and the quota may change. The Regional Director predicts that the junta will be asked to approve rates of Soles 2.80 per cubic meter for the tariff and the quota; however, EMTECO seems to think that farmers will resist an increase in the tariff, thus it may recommend a slight increase in the tariff (to Soles 1.25 per cubic meter) and a larger increase in the quota (to Soles 3.00 per cubic meter).

The quota is the principal source of funding for EMTECO, which claims to pass some of the funds to the comisiones. It was not clear, however, whether these are direct payments to the comisiones, or payments in kind in the form of maintenance services rendered. Nonetheless, it is clear, that quota funds remain in the system.

(3) Development assessment

Tinajones and a few other major coastal irrigation systems have been given the authority to collect fees to be utilized for future system development. Strictly speaking, the junta is supposed to levy a charge and transfer the funds to DEPTI, which will commission studies, or award construction contracts, as relevant. Funds were collected under this law only once, in 1982. At that time, DEPTI commissioned a German consulting firm to prepare a plan for tapping additional water sources in the mountains, at a cost of 300 million soles. Rather than transfer the funds to DEPTI, however, the junta retained financial control over the project. No development funds have been collected since 1982 because of the poor harvests and floods which have plagued the system. Once the situation improves, it is expected that this will be continued, and that the junta will again retain control over the funds that are collected.

(4) Special quotas

The special quota is levied by comisiones for the repair and maintenance of sublaterals and minor drains. The Technical Administrator recommends a work program, which is ratified or modified by the comision, which then sets the quota. Farmers are assessed according to the size of their landholdings, at a fixed rate per hectare, and payments are made in cash or kind. The amount varies

according to the comision, but was generally about Soles 8,000 per hectare in 1984, which was equal to two days of work. Farmers who labored in excess of their requirement are paid for the work with funds collected from other farmers, generally the larger landowners. In addition, people are also mobilized to contribute labor and/or funds for emergencies, sometimes on a more localized basis. All of the special quota funds are used within the subsector, and collection seems not to be a problem.

2. Tacna

a. Background

(1) Description

Irrigation systems of the Tacna area are typical of most of the coastal irrigation systems of Peru. Diversions of the steep mountain stream are accomplished with concrete structures and lined canals. Sediment is a major problem requiring sluiceways at the diversion structure. Even so, sediment still gets into the canal and causes problems. Parshall measuring flumes are installed at the main canal intake and at each lateral turnout. Laterals, like the main canal, are lined with rubble masonry. Water is delivered to individual users on a rotation basis with irrigation being practiced on a 24-hour basis. The basic water allocation is 20 minutes per hectare each 7-1/2 days with a stream of 120 liters per second. This translates into a gross water applications of only 14.4 millimeters every 7-1/2 days and explains why so much land is idle. Basic water requirements of growing crops range from 2 mm per day to as much as 10 mm per day. At one point, we heard that the basic water allocation was 33 minutes per hectare with a flow of 350 liters per second. On a 7-1/2 day rotation basis, this translates to 9.24 minutes per day which agrees quite closely with the general "rule of thumb", 1 liters per second hectare or 8.64 mm per day. This latter figure of 33 minutes per hectare with 350 liters per second is undoubtedly the goal whereas the 20 minutes per hectare and 120 liters per second is the actual.

At Tacna, the team also visited La Yarada, an area of some 5000 hectares supplied entirely by wells and irrigated using both sprinkler and surface application. The wells were equipped with electric powered deep well pumps fielding directly in to the distribution system for surface application. Booster pumps at the well supply the pressure required for the sprinklers. Here the water is available on demand and power and operating costs are paid directly by the farmers. Pumps are operated and controlled by the farmers.

(2) Agriculture in the project area

In Tacna, there is only enough water to irrigate about 2500 hectares[12], and nearly every farm has dry land that is not used. There were 4,471 hectares in the farms served in 1975. The farms in the valley proper had an average size of 3.95 hectare in 1975.[13] Small farms produce alfalfa, fruits, chile peppers, potatoes, vegetables, olives, corn, and even wheat. Two or more crops per year are common. A typical allocation of water in Tacna is 20 minutes per cultivated hectare every 7-1/2 days with an average flow of 120 liters per second, which works out to 7,008 cubic meters per hectare per year. Although water rights are not actually sold, officials in Tacna estimate that a water flow equal to one-half of the water allocation above typically might be worth S/ 15 million (or US$ 1,807.23). If this allocation's value is amortized over 20 years, its average annual value would be US$ 90.36 or US $0.02 per cubic meter. This relatively high value illustrates that excess water would be worth selling in Tacna.

b. Project management

(1) Roles and responsibilities

Similar to Tinajones, the Tacna System is managed by a Technical Administrator. He has a staff of 23, 14 of whom are sectoristas. Administrative units and roles are similar to those described above. Compared to Tinajones, however, the Tacna System is easier to manage, and both formal and informal relations between officials and farmers are better than in Tinajones.

Water users in Tacna are organized into three comisiones and a junta. The comisiones were established in 1973, formalizing the traditional irrigation groups which already existed. The comisiones are each based on a major unit of the system, thus they are operationally discrete. Farmers elect members of the comision, which then elects a representative to serve on the junta. Compared to Tinajones, the comisiones in Tacna are active, cohesive groups which manifest their strength in many informal interactions with irrigation officials and which contribute much voluntary labor to maintain and improve the system.

---

[12]Leindo Gil, Nancy. "Marco Historico-Economico del Aprovechamiento del Agua el el Agricultural del Valle Viejo de Tacna." M.A. Thesis (Lima, Peru: Universidad Particular Ricardo Palma, 1976), p. 9.

[13]Ibid, p. 9.

(2) Operation

Water is chronically short in Tacna and the land under irrigation has essentially decreased over the last decade. An annual plan de cultivo y riego is prepared in Tacna, but it has no bearing on water distribution. Water is allocated on the basis of land area, irrespective of the crop grown.

Water charge rates are supposed to be set at the beginning of an irrigation year and levied at the end. To establish individual payments, the total annual flow is divided by the number of delivery "minutes" in the system, and each farmer is billed according to his time allottment.

The rotation is systematic, based on traditional arrangements, but the water flow is reduced during periods of water shortage. The rotation sequence and time allotments are so well known that the system almost works by itself. Indeed, sectoristas open and close gates during their eight-hour daytime shift, and farmers themselves manage the system during the night.

(3) Maintenance

Theoretically, the junta is responsible for the maintenance of major canals and laterals, as in Tinajones, as well as the pumps located in the highlands. In practice, however, the Tacna system benefits from a special maintenance project, funded through the oficina agraria. Farmers and their organizations contribute to maintenance, but the bulk of the maintenance budget is provided externally. Comisiones organize and execute maintenance below the laterals. As virtually all of the channels are lined, such responsibilities are minimal, however.

(4) Urban water use

In addition to irrigation, the Caplina and Uchusuma Canals also supply drinking water to the city of Tacna. The urban supply has increased over the last decade as the population has doubled. The urban water supply is administered by SENAPA, which negotiates an annual water fee with the junta. Farmers do not object in principle to this use, but there are many complaints that too much of the urban water use is unregulated, and thus wasted, doubly depriving farmers of their needed supplies.

The urban water is not totally lost to agriculture. Discharge water from the Tacna water treatment plant has been diverted to a 200 ha settlement project area near the airport. Farmers are permitted to use the "treated" water only for above-the-ground crops, no root crops or low vegetables. Local people contend that the water is so rich in nutrients that farmers receive good yields with minimal inputs. This is not surprising; on more than one occasion during its brief visit to Tacna, the team saw mounds of detergent suds billowing

from drop structures on the canals leading to the settlement area. However, even though the water is ultimately used for agriculture, this fact is little consolation to long-term residents, the farmers, who have lost part of their traditional water supplies.

c. Farmer participation

Farmers are actively involved in the Tacna system, both formally and informally. Their participation is less bureaucratic than that of farmers in Tinajones, and less systematic, but more pervasive on an everyday operational level. Farmers, their representatives, and officials seem to maintain a close collaborative relationship, rather than the strict division of labor which is evolving in Tinajones. Nonetheless, there are limits to farmer participation in Tacna which should be overcome.

User groups have not participated officially in questions of system design, but they are likely to do so in the future, at their own initiative. Two circumstances have prompted farmers to take an active interest in future developments of the system. First, urban consumption steadily decreases the supply of irrigation water available, and threatens the very survival of agriculture in the Valley. Farmers know that they will continue to lose the battle unless new water supplies are tapped. Second, they have already experienced the burden of short-term, energy-intensive responses to their need for more water. When the diesel pumps were installed high up on the Uchusuma Canal, the water supply increased and became more regular. However, the fuel costs, maintenance requirements and logistical problems associated with the diesel pumps have been so great, and so continual, that farmers now question the benefits they derive. Although there is no move to eliminate the pumps, the user groups will surely object to any further developments which place huge recurrent cost burdens on them.

Farmers participate informally in many maintenance operations beyond those required of comisiones. However, the junta in Tacna has not assumed formal responsibility for maintenance, nor is it likely to do so as long as external funds are available. If required, the junta could probably become an implementation agency, but it cannot be expected to seek out such responsibilities as long as the Technical Administrator has the funds and manpower needed for such work. Nonetheless, it is clear that the junta participates in discussions to set maintenance priorities and schedule work.

For the most part, the junta has played a passive role in cost recovery. It sets tariff and quota rates and leaves collection to the Technical Administrator, primarily because the funds are ultimately managed by officials, not by the junta. Consequently, recovery rates have been low. As in Tinajones, however, such low rates reflect collection problems, not payment problems. For example, once the Chairman of the Uchusuma Comision decided to take an active interest in recovering outstanding charges, most delinquent farmers complied

long before sanctions would be imposed. The system would benefit financially and administratively if other Chairmen would also undertake such a campaign.

Water theft, the most common problem in the system, occurs principally at night during the months of short water supply--September, October and November. If caught, farmers are sanctioned by the comisiones, which also resolve other conflicts. Overall, traditional social control patterns prevail over bureaucratic ones, thus the Technical Administrator rarely is called upon to assume a juridical role, as in Tinajones.

d. Cost recovery

Farmers in Tacna pay three types of water charges--the tariff, a quota, and a special quota. In addition, they informally contribute much labor to assist the staff of the Technical Administrator in carrying out both routine and emergency repair and maintenance works. Finally, the junta is paid by SENAPA for the water diverted to the city of Tacna. Nonetheless, because of the high cost of operating the pumps in the highlands, Tacna farmers ultimately assume a smaller proportion of the total operation and maintenance costs of their system than their peers in Tinajones. Despite the lower charges, and despite the greater solidarity among users, recovery rates in Tacna are no better than in Tinajones, primarily because of lax collection procedures.

(1) Tariff

In 1984, the tariff in Tacna was 0.40 Soles per cubic meter. The proposed 1985 tariff, to be decided in early April, was 8.60 Soles per cubic meter, a 50 percent increase. Ten percent of the tariff is sent to Lima for "amortization," and nothing is sent for the water canon. The remainder is allocated to the junta, and much of it ultimately returns to the Technical Administrator to cover fuel, vehicles, office expenses, and the salaries of two sectoristas.

(2) Quota

The quota, also decided and levied by the junta, is used exclusively for maintenance, through the Technical Administrator's office. The quota was 1.50 Soles per cubic meter in 1984, and was expected to be increased to 1.80 Soles per cubic meter for 1985. The Chairman of the Uchusuma Comision expressed the need to raise the quota to 8.00 Soles per cubic meter, but doubted that such an increase would be approved by the farmers.

(3) Special quota

The comisiones assess an annual special quota for the maintenance of minor canals. The amount of the special quota varies from one year to the next, but it is always minimal. It is calculated in Sol, in an amount equal to a number of labor-day equivalents, generally on the order of one day per 20-minute irrigation turn. As in Tinajones, this special quota is honored by farmers. Cash payments are used to reimburse farmers who work more days than required.

(4) Urban water charges

The city of Tacna is the largest single consumer of water from the canals, and its share increases annually. In 1984, SENAPA obtained 1.80 liters per second from the Uchusuma Canal and 0.60 liters per second from the Caplina Canal. The two Uchusuma Comisiones received a total of S/ 11 million for their share of the water in 1984, which they added to the maintenance fund.

e. Summary

Tacna is an interesting system because it contains a healthy mixture of tradition and new technology. The water supply is inadequate, but the system runs smoothly because farmers are experienced in managing irrigation water, individually and collectively, and they know the value of the water, as it is linked to their very survival. The irrigation administration and the official water user structure are institutional facades covering a basically sound traditional system of relationships and controls. Water delivery is dependable and equitable and it is said farmers "lend" water to one another at times. The system is threatened by competing water use demands, increasing fragmentation of landholdings and the cash requirements of higher standards of living. There are signs that farmers and officials are trying to find ways to obtain additional water.

Cost recovery for O and M is feasible in Tacna, in terms of the farmers' ability to pay, but farmers will not easily agree to substantial increases in the tariff and quota. Currently, Tacna still has access to maintenance funds, thus water collection has not been emphasized systematically by either the junta or the Technical Administrator, nor has the junta been given responsibility for maintenance. One comision has launched a campaign to collect water charges, but the team understands that this is not a general trend.

Tacna has a high level of farmer participation in O and M, both formal and informal. Although this undoubtedly reduces overall system costs, the participation has not affected direct cost recovery. As in Tinajones, cost recovery deficiencies seem to relate to the collection side, rather than the payment side. That is, very little effort is made to collect the funds, the level of collection only partially

affects the O and M budget, and sanctions really are not imposed for non-payment. Consequently, farmers have little incentive to pay, and many do not. As in Tinajones, water application efficiency is not likely to improve if the cost of water increases. Farmers use water efficiently when it is scarce, and they are not known to over-water when it is abundant. Until now, water price has nothing to do with this practice and it is unlikely to affect it unless a number of basic physical characteristics of the system are changed.

3. Plan MERIS II

a. Background

(1) Description

Plan MERIS (Plan de Mejoramiento de Reigo en la Sierra) provides for small scale irrigation projects with the general objective of improving the quality of life for the farmers of the mountain areas through increased production under irrigation.

Plan MERIS II projects in the Cusco area have been funded by the German government along with technical support to design and initiate the operation of the projects. Eleven such projects are now in various stages of completion, two of which were visited by the team, Cusipata and Salcca. At Cusipata, the team only talked with farmers at project headquarters, at Salcca a trip was made to the diversion structures and along the canal and distribution system. Both systems are located in the high mountain valleys above Cuzco at elevations upwards of 11,000 feet.

Both projects divert directly from the river. Unlike the coastal irrigation projects, these systems have ample water in the river, thus the operational plan anticipates only daytime irrigation with release of water back to the river at night. This requires more capacity in the conveyance system but provides some insurance against erosion damage and poor distribution associated with nighttime irrigation.

The Salcca system includes the diversion and sluiceway structure and 28 km of main canal with a rubble masonry lining. The diversion gate is below the river bed and a diversion weir is not required. There are approximately 14 km of laterals serving 1200 ha with 600+ farm families. This project is an enlargement of an old project which served some 350 families. The process of integrating the old and new system is apparently still underway.

The Cusipata project is similar in design with a diversion higher than the one serving the old project to make possible an increase of approximately 30 percent in the area served. This project includes approximately 11 km of main canals and 11 km of laterals serving a total area of 476 ha with 679 families.

(2) Agriculture in the project area

Most of the farms are small, some less than 1/3 ha, the terrain is rugged and the altitude above 10,000 feet. These farms exist as a source of security for the families and especially for the women. Traditionally, they only produce one crop per year in the rainy season--October to April. The crops are mainly for consumption--corn, beans, potatoes and quinoa. If complementary irrigation is available, they use it twice; once in June to sprout seeds and a second time in October, before planting, to guarantee germination. A German agricultural economist estimates that it would take at least 1.8 ha to feed a family of six and provide enough marketable surplus to exist. Yet the average size is much smaller than this and subdivision is continuing.

These little valleys near Cuzco are not major crop exporting areas. The main export crops are alpaca wool, which comes from higher elevations (12,000 to 14,000 feet) with less irrigation, and coffee which is produced at much lower elevations in the high jungle. Many of the men work outside of the valleys for six months of the year. They return for celebrations and sometimes to help with planting and harvests.

The main emphasis in the individual irrigation projects is on growing a second crop and maintaining home gardens during the period May to October. The projects as much as double the existing gravity fed command areas and they are designed to allow double cropping in the whole area served. The concept may have merit as far as home gardens are concerned, although this will not automatically result in improvements in the nutritional status of people in the project area. However, the idea of using the second crop to increase family incomes directly is very problematic. Local demand inelasticities and the absence of viable marketing channels may cause farm incomes to fall, rather than rise, if second cropping becomes prevalent. Nonetheless, incomes may increase indirectly if the second crop enables more people to remain in the project area to produce handicrafts, knit sweaters and other products that can be exported from the region. Plan MERIS is apparently considering honoring requests to install small hydro-electric systems which could supply electric power for small mills and sewing machines. However, this aspect of the program has not been well developed to date.

b. Project management

(1) Roles and responsibilities

The Plan MERIS II projects are both more complex and simpler than the irrigation systems described above. They are more complex because, theoretically at least, they involve a number of different agencies at different stages in the planning, implementation and operation of the individual systems. However, they are institutionally simpler than the other projects because only one

agency really is actively involved in the program, Plan MERIS II itself. Much of the cooperation and collaboration implicit in the project design, including that of the farmers, has yet to materialize.[14]

With the assistance of a team of six expatriate advisors, Plan MERIS II staff design, construct and repair the irrigation channels and plan and implement an agricultural development program. Initially, the design work was contracted to private firms, but the experience was not satisfactory and the Plan has since developed the in-house capability to undertake the work. Virtually all other types of expertise that might be needed for the program, from agricultural extension to social work, are included in the Plan office or are made available through the technical assistance budget, without reference to other line agencies. This does not mean, however, that staffing levels are necessarily commensurate with the amount of work to be done, or the extent of the area to be covered.

It is hoped that the regional irrigation and agriculture offices will assume responsibility for their respective programs when Plan MERIS II concludes, but this may not happen. There is little substantive communication between Plan MERIS II and the other offices at present, and it is doubtful that the offices will be given the manpower or financial resources needed to continue the programs once the Plan office is dismantled. This prospect very much worries Plan staff.

In effect, the Plan MERIS II administration is a self-contained, virtually autonomous authority which has its own funds and staff to carry out its mandate in the villages. In addition, it has resources to mobilize for investment in supplementary social infrastructures, such as health posts and pre-schools, that frequently are used as bargaining chips in negotiations with villagers. However, many of the ancillary programs--extension, nutrition, education, health, and so on--are ad hoc activities without adequate planning or staff either to guarantee that the desired impact will be achieved or to ensure continuity.

Once construction is completed, the Plan calls on farmers to establish water user organizations, generally consisting of Comites de Regantes on the lateral level, and a system-level comision. The Plan provides tomeros, ditch tenders, who are responsible for water scheduling and distribution, and pays their salaries. After a threeyear operational shake-down period, Plan Meris II intends to withdraw, leaving the systems entirely in the hands of the water users.

---

[14]Many of the problems in this project are similar to those of Plan Meris I. See Wilkinson, John L.; McKeon, C., Meyer, R.; Nunberg, B., Weil, C., and Martinez, H. Peru: Improved Water and Land Use in the Sierra. AID Project Impact Evaluation No. 54 (Washington, DC: US Agency for International Development (AID), 1984).

Dav

(2) Operation

Cusipata can be seen as an example of how simply the Plan MERIS II systems operate. The system provides supplemental irrigation during the rainy season, normally once or twice for a crop. When he needs water, a farmer approaches the tomero early in the morning to request a place on the day's schedule. The tomero sets the schedule, which generally allows five or six hours per hectare, and then opens and closes the gates. Crops are irrigated more frequently during the dry season, but only about 50 farmers crop during the dry season, so the demand system is still easy to operate.

Overall, the system operates essentially as it did before being upgraded by Plan MERIS II, with five principal exceptions. First, the command area has increased, but the previous distribution pattern has been maintained. Second, in the old command area, four farmers can get water at the same time, rather than one at a time. Third, more people irrigate during the dry season--about fifty, rather than four. Fourth, there are three salaried tomeros, paid by the Plan, rather than one tomero position which rotates among farmers in the system. Finally, in most aspects of system operation, farmers and their representatives are subject to the influence of Plan staff, rather than independent.

(3) Maintenance

Once construction is completed, Plan MERIS II takes care of major maintenance for a period of approximately three years. This has been essential, because most of the first systems encountered substantial maintenance costs at the outset, which farmers would not have been able to afford to undertake themselves. Plan officials say that current and future projects are to be designed to minimize recurrent maintenance costs, even though that means higher per hectare construction costs.

The comisiones are responsible for minor maintenance. Such work is recommended by Plan staff or farmers themselves and organized by the comisiones. A number of different activities have been undertaken quite successfully in Cusipata. Farmers are already familiar with the kinds of work required, thus they need no special encouragement or training to set the process in motion, once an organizational mechanism is established.

c. Farmer participation

Farmer participation is an exceedingly important issue which Plan MERIS II has just begun to face seriously. Until recently, the Plan has discouraged participation, seeing it as a threat, rather than a benefit. In their zeal to implement the projects, Plan staff took pains to avoid giving farmers or local leaders any opportunities to provide input into decisions affecting the projects, because they feared they would meet opposition, not support. In practice, they did

encounter much opposition, but it is not clear whether the opposition resulted from the recalcitrance of farmers, or was a reaction to the heavy-handed approach of Plan staff. The Plan has modified its approach lately, but only after wasting much time and money.

It is indicative of the Plan approach that the local language Quechua, is used as a medium for defusing opposition, not for initiating communication, despite that fact that many Plan staff speak the language. This bias may be inevitable, given the origins of the project (Lima) and the presence of the expatriate advisor cadre. Nonetheless, it is a source of discontent among Plan staff and certainly limits the impact of the project.[15]

In early stages of Plan MERIS II, farmers in many villages opposed the Plan's proposal for their villages. Sometimes the farmers believed that the proposals were not feasible; sometimes they feared they would be forced to pay for all the water they would receive; sometimes they said they did not need the proposed project because they already had irrigation water. Whatever the reason, opposition was common. In most cases, Plan staff ultimately convinced people to accept the systems, often by promising additional facilities, and then proceeded with construction. In at least one case (Chectuyoc) construction started and concluded despite local opposition, and farmers have never really used the system. Now that the Plan has successfully completed some systems, however, additional villages have approached project staff seeking assistance.

Initially, project designs were not discussed with farmers. Technical staff alone reviewed the designs and attempted to implement them. Farmers were expected only to give their consent to a project as a whole. In the field, Plan staff found that some farmers challenged specific design elements, such as the placing of laterals and sublaterals, and even the number of laterals in the system. Often, staff discovered that the challenges were reasonable. Subsequently, Plan staff started to review detailed designs with farmers and adopted many of the suggestions they received, including the placement of diversion structures.

One basic element of the Plan MERIS II approach was to use local laborers for construction. This was expected to upgrade local skills and to provide employment opportunities. In practice, local project managers decided who can work. In some projects, the manager used local farmers as laborers; in others, outside laborers were brought in to do the work. In all cases, laborers were paid slightly more than

---

[15]Jack Keller, et al., Peru: Irrigation Development Options and Investment Strategies for the 1980s, USAID Water Management Synthesis II Project, Report No. 14 (Logan, Utah: Utah State University, 1984), Annex IV, by Percy Aitken, pp. 86-87.

the prevailing daily wages, and beneficiaries were not expected to work without pay. This strategy probably served to dissuade farmers from thinking of the systems as their own.

Despite the fact that the traditional irrigation systems each had some sort of water user institutional structure, Plan MERIS II staff chose to ignore the existing structure and, at the conclusion of construction, attempted to create their own water user committees and comisiones. Had they tried to use existing group structures instead of establishing their own, and had they tried to start the associations at the beginning of a project instead of the end, undoubtedly Plan staff would have found farmers to be much more receptive and cooperative. The Plan has recently modified its approach to follow this suggested plan of operation.

Prior to Plan MERIS II, each of the systems was operated and maintained entirely by the farmers. Since the Plan, however, farmers have lost many of their responsibilities, and much of their authority. Ultimately, the plan may want to relinquish the authority and responsibilities it usurped, and the farmers may not be willing to accept them again.

Comites and comisiones have full authority to levy and collect the quota. The charge is low and should stay low until the economic viability of the irrigation investments are firmly established, and until the agriculture development program has had an impact. In order to speed up the process, the Plan has recently started to introduce the agriculture program before construction, rather than wait until afterwards.

The principal area of conflict in Plan MERIS II systems is the question of the allocation of water between old and new parts of the systems. This sort of conflict is inevitable, but it is probably exacerbated by two factors: disparate traditions in old and new parts of the system; and the strategy of forming groups at a late stage in system development. That is, farmers in the old command areas have long experience in working together in irrigation, but those in the new areas do not. It is difficult for a comision to handle conflicts between comites until the comision itself is well established and until the comites individually develop some sort of legitimacy. This will take time. Secondly, the Plan strategy of forming groups only after construction makes it even more difficult for the new groups to establish themselves. Consequently, Plan staff undoubtedly are called upon to resolve conflicts which the comisiones themselves should handle.

d. Cost Recovery

Like other PEPMI projects, Plan MERIS II makes no attempt to recover investment, shake-down or operating costs from farmers. The comisiones levy an annual quota, but not a tariff. In Cusipata, the quota for 1984 was S/ 500 per topo, or about

S/ 1,500 per hectare. The comision recommended an increase to S/ 3,000 per hectare for 1985, but the proposal was voted down by the farmers. Until dry season cropping becomes more prevalent, and is shown to be remunerative, it is not realistic to expect the quota to be increased enough to cover the full cost of maintenance.

In Cusipata, and presumably in the other systems, the quota is used for at least two purposes. First, it covers the cost of establishing the comision itself, including such things as furniture and office supplies. Second, it is used to buy food and drinks (chaquipa) for farmers who participate in maintenance activities, as well as to pay them a minimal honorarium.

e. Summary

Until the Plan MERIS II projects are shown to bring substantial economic benefits to the farmers, it is not feasible to expect the full cost of operation and maintenance to be recovered. By the same token, however, the plan should discontinue policies which unnecessarily raise recurrent costs, like paying salaries of tomeros, instead of utilizing the traditional tomero appointment and payment procedure.

Because of the many problems encountered in its earlier attempts to impose its projects on the villagers, Plan MERIS II has begun to encourage farmers to participate in various aspects of project planning, design and operation. If Plan staff take this approach seriously and adopt such measures as communicating in Quechua at the outset, instead of doing so only as a way of defusing opposition, there is hope that the Plan will ultimately have a beneficial impact, and that the Plan will be able to withdraw and leave the systems completely in the hands of the farmers.

For too long, however, the Plan has used an approach which is inconsistent with its long term goals. The only way for the Plan to succeed is to construct improved irrigation systems, to help farmers establish farming systems which can make good use of the irrigation water, and to withdraw. Plan MERIS II still needs to demonstrate that its agricultural recommendations are viable, but at least it seems to have learned the lesson that it cannot help farmers become more competent and independent by imposing its will upon them.

D. Summary and Conclusions: Study Issues

1. To what extent is cost recovery through direct and indirect charges a feasible goal in irrigation systems?

If the discussion is limited to recurrent (O and M) cost recovery, our evidence supports the conclusion that cost recovery is a feasible goal, in general. Although individual farmers vary considerably in their ability to pay water charges, even within systems, the water charges are so low in each of the systems that this factor does not appear to affect payment rates.

Cost recovery has been low in most of the systems we visited, but the low recovery rates indicate inconsistent policies within the various irrigation authorities, rather than problems with farmers. In Peru, it is clear that responsible agencies have not been serious about collecting fees, and have made few efforts, if any, to apply sanctions for non-payment. In many cases, it is not physically possible for authorities to cut irrigation water supplies for delinquent farmers. Where this is possible, however, it is rarely done. In two small systems near Chiclayo, farmers must pay for water in advance, and they do. In the other systems, water fees are assessed annually, sometimes long after the conclusion of the irrigation season, and payment rates are low unless officers of the users' association take a special interest in the collection process.

In general, irrigation staff believe that farmers should pay O and M costs, but they seem to be reluctant to enforce collection, either because they do not want to give farmers reason to question the quality of their service, or because they identify specific conditions which seem to limit the ability of farmers to pay, such as floods, droughts, or combinations. That is, they think farmers ought to pay, but are not sure that they can afford to do so. Consequently, they do not enforce collection and they never really find out whether or not their perceptions are accurate. Moreover, until recently maintenance budgets were unrelated to collection rates, thus there was little institutional incentive to enforce collection provisions.

Rice farmers in Tinajones and fruit producers in Tacna clearly can afford to pay irrigation assessments, and it is likely that assessment levels and payment rates will rise as it becomes clearer that the fees are essential and that they are all used locally to operate and maintain the systems. In the Plan Meris II systems, farmers can probably pay the fees that are currently assessed, especially because most of the funds are recycled within the system in the form of payments to people who participate in maintenance activities. However, there is some question about the ability of farmers to pay the overhead operating costs currently borne by the Project.

The situation is not as clear regarding the recovery of sunk costs, major emergencies, and investment in future developments. A small amount of the tariff is supposed to be transferred to Lima for "amortization" of previous investments. The amount is insignificant and officials feel that farmers resent the transfer, thus they increasingly ignore this provision. This decision reflects a reasonable assessment of the farmers' desirability to pay such sunk costs, especially in Tacna and Tinajones, where water supplies are still too limited to provide dependable service.

Major emergencies, such as the 1983 flood damage in Tinajones, and shakedown costs, such as those in Plan MERIS II, are still covered by external funds. It is not likely that these costs could be borne by the water users, especially in the Plan MERIS II systems.

There is some indication that farmers may be able, and willing, to assume some of the costs of future system developments, especially if the investments ultimately guarantee regular, adequate water supplies. However, this applies only in some systems, and on an irregular basis. In Tinajones, the junta has already paid for one technical study and may make other such investments in good years, but not in poor years. This means that it is difficult, if not impossible, to establish the sort of long-term plan which is needed for major investments. Consequently, water users should be included more actively in the development process, but it is unrealistic to expect them to assume major investment burdens until after they already start to benefit from the investments.

2. Do increased farmer participation and control contribute to improved cost recovery?

In Peru, a hierarchical structure of water user associations is mandated by law, and implemented in most coastal systems, to a greater or lesser degree. The situation in the Sierra is much more mixed. In Tinajones, the role of the associations has grown as the government maintenance budgets were cut. In this case, participation and control followed a withdrawal of government subsidies. Now, the water user groups control maintenance entirely, through a not-for-profit company which was formed with personnel and equipment transferred from the local development corporation. It is likely that the role and authority of the associations will increase in the future.

In Tacna, farmers pay a much smaller part of the O and M budget, but they have institutional authority similar to that of the associations in Tinajones. The associations own the building in which the irrigation authority is located, they pay salaries of some sectoristas (as in Tinajones) and are trying to participate in discussions about future system developments. Nonetheless, because the maintenance budget in Tacna has not been entirely cut, there is no discernible relationship between participation and control and cost recovery.

In Plan MERIS II systems, cost recovery is now limited entirely to activities of the comisiones and participation has essentially been discouraged. It remains to be seen whether or not the farmers will eventually be given control over their systems; whether or not they will accept responsibility if it is given to them; and whether or not cost recovery will be related to either of the above. Recent changes in the Plan's operational approach may improve the prospects of achieving a smooth transition from Plan control to local control.

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

a. Reliable water supply

The team expected to find evidence of a relationship between cost recovery and the reliability of water supply, but found none in the systems visited. Indeed, two of the small systems near Tinajones with irregular supplies require advance payments, indicating a possible inverse relationship between reliability and cost recovery. For the most part, the systems we saw in Peru had reasonably reliable, but not adequate, water supplies. Instead, the team identified a clear link between the reliability of water charge collection and cost recovery.

b. Adequate water supply

As above, the tariff levels were too low, and collection patterns too irregular to indicate a relationship between cost recovery and the adequacy of water supply. Once tariffs increase, some linkages may become apparent, but the data available and the experience so far do not support such conclusions.

c. Water delivery and measurement technology

This possible relationship also was not discovered in our cases. In none of the systems we visited can water be measured at the farm turnout level. In Tinajones, measurement is possible on the main laterals, but not below. Consequently, in no system is it possible to do more than estimate the amount of water which may reach a farmer, and even in those cases, there is no indication that measurement and cost recovery are related.

4. Are increased water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

a. Are increased water charges a necessary and sufficient condition for improved O and M?

In coastal systems in Peru, increased water charges are necessary for improved O and M, and they may be sufficient, if the funds are used in the system in which they are collected. In the Sierras, the answer is not so clear.

Government maintenance budgets have been cut or eliminated altogether, depending on the system. Systems are supposed to be maintained by funds generated locally at levels set by the farmers themselves. This arrangement has been questioned by at least one international donor agency, presumably because it gives too much power to consumer groups and precludes using donor funds for such purposes.

The team believes that the existing strategy is correct, although it needs to be supported by a significant effort to involve water users more directly in the operation of individual systems, as is happening already in Tinajones.

Farmers themselves set the tariffs and quotas; officials can recommend fee levels, but they cannot impose them. Thus before water charges can be increased, as required, to cover maintenance costs, the authorities must convince farmers of the necessity. Even in Tinajones, this is expected to be difficult.

Other things being equal, increased budgets are likely to result in improvements in O and M, although the benefits may be unevenly distributed. The impact of higher charges can be increased if farmers are involved more actively in the operation of the system itself, in determining maintenance priorities, in identifying needed structural changes, and in setting rotation and rationing programs. This is easier to say than to do, because effective participation requires adequate preparation and understanding of technical and organizational questions, which means that both officials and water users have to do their homework.

Tinajones exemplifies many of the areas in which water users can and should participate in system operation, but it also illustrates some of the limitations of this approach. For example, water allocation in Tinajones is based on the plan de cultivo y riego, which attempts to reconcile farmers' cropping preferences with projected water availability. For many reasons, farmers want to grow rice, but the total water supply is generally short of the amount required to honor all cropping requests. This year, the supply is much less than predicted at the time the Plan was adopted. Nonetheless, farmers used political influence to get authorities to approve rice allottments which far exceed even the projected water supply. Now farmers and officials alike are in a bind.

The situation in Tinajones illustrates three points. First, farmers do not necessarily accept official water estimates. That is, they question the technical decisions of officials. Second, farmers may not really understand the technical limitations of the system, thus they are not prepared to make responsible decisions. In other words, an essential educational role of the officials has not been successfully carried out. Finally, it shows how vulnerable such an arrangement is to political manipulation. Again, poor information and limited credibility contribute to this vulnerability.

b. To what extent does efficiency of water use vary with the cost of water?

Our cases turned up no situations conducive to linking water prices and application efficiency. In none of the systems is water cost related to water use in such a way as to encourage farmers to use less water than they have available. There are any number of instances in which application efficiency is affected by water scarcity, but not by charges.

5. Do institutional arrangements whereby farmers participate in and control irrigation systems improve O and M?

The record of communal systems is obvious: participation and O and M levels are essentially isomorphic. The Plan MERIS II systems around Cuzco were self-sufficient before the Plan imposed itself, for instance. The record is not so clear in systems which are constructed or managed by irrigation authorities, primarily because participation is generally restricted, if it is even encouraged. Our cases offer evidence to support the relationship between participation and control and O and M, although our conclusions are based on projection, rather than accumulated experience.

In Tinajones and Tacna, user associations are assuming increased responsibilities for decisions affecting the maintenance, operation and expansion of the system. The institutionalization process is still in its initial stages, but there is ample reason to be optimistic about the future. In any case, the financial situation of the government is such that there is no alternative; if users do not participate in critical decisions, and thereby mobilize maintenance funds locally, there will be no funds at all.

In Plan MERIS II, one sees the consequences of external attempts to impose irrigation "development" without encouraging participation. In some instances, Plan staff have had to re-design systems to overcome faults which farmers quickly identified; in other instances, farmers still refuse to utilize the systems. Apparently the approach will be modified in future systems, based on lessons learned to date, but the question remains as to the future role of farmers vis-a-vis their systems.

E. LIST OF REFERENCES

Bazo, José Louis. "Sondeo Descriptivo Sobre Irrigacion en el Peru." Lima, Peru, 1982. (Mimeographed.)

Centro de Estudios para el Desarrollo y la Participacion (CEDEP). Diagnostico Technico-Economico de la Actividad Agropecuaria del Valle de Chancay-Lambaque. Lima, Peru: CEDEP, 1984.

Direccion General de Agua Suelos e Irrigaciones (DGASI). Estudio de Tarifas de Agua Proyecto Tinajones. Lima, Peru: DGASI, 1982.

Keller, Jack; Smith, B.; Aitken, P.; LeBaron, A.; Meyer, R.; Walter, M.; and Wolf, J. Peru: Irrigation Development Options and Investment Strategies for the 1980s. USAID Water Management Synthesis II Project, Report No. 14. Logan, Utah: Utah State University, 1984.

Leindo Gil, Nancy. "Marco Historico-Economico del Aprovechamiento del Agua el la Agricultura del Valle Viejo de Tacna." M.A. Thesis, Lima, Peru: Universidad Particular Ricardo Palma, 1976.

Recharte, Jorge. "Ethnography of Irrigations in Peru with Special Reference to the Coast," 1983. (Typewritten)

Sanchez Velez, Roger. "Resumen del Informe de Peru." Document prepared for VII Seminario Latinoamericano de Irrigacion, Santiago, Chile, 1983.

Sarria, Carlos R. Analisis de los Mecanismos Institucionales y Economicos Para Optimizar el Uso de Agua Agricola. Lima, Peru: Grupo de Analisis de Politica Agraria (GAPA), 1984.

Wilkinson, John L.; McKeon, C.; Meyer, R.; Nunberg, B.; Weil, C.; and Martinez, H. Peru: Improved Water and Land Use in the Sierra. AID Project Impact Evaluation No. 54. Washington, D.C.: US Agency for International Development (AID), 1984.

The World Bank. Country Economic Memorandum for Peru. Washington, D.C.: The World Bank, November, 1984.