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STAFF APPRAISAL REPORT

YEMEN ARAB REPUBLIC

EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

DECEMBER 20, 1988

Country Department III
Europe Middle East and North Africa Region
Agriculture Operations Division

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CURRENCY EQUIVALENTS AT APPRAISAL

US\$ 1.00	=	Yemeni Rials (YR1s) 9.75
YR1 1.00	=	US\$ 0.102564
YR1s 1.0 million	=	US\$ 102,564

(As of November 1988)

WEIGHTS AND MEASURES

1 millimeter (mm)	=	0.039 inches
1 meter (m)	=	3.28 feet
1 square meter (m ²)	=	10.76 square feet
1 kilometer (km)	=	0.62 miles
1 hectare (ha)	=	10,000 square meters (2.47 acres)
1 metric ton (ton)	=	2,205 pounds
1 liter (l)	=	0.264 gallons
1 l/s	=	One liter per second
1 m ³ /s	=	One cubic meter per second
1 Mm ³	=	One million cubic meters

PRINCIPAL ABBREVIATIONS AND ACRONYMS USED

ADF	=	Abu Dhabi Fund
AMSL	=	Above Mean Sea Level
ARA	=	Agricultural Research Authority
CACB	=	Cooperative and Agricultural Credit Bank
CLCCD	=	Confederation of Local Councils for Cooperative Development
CPO	=	Central Planning Organization
ERADA	=	Eastern Region Agricultural Development Authority
ERADP	=	Eastern Region Agricultural Development Project
ERR	=	Economic Rate of Return
FAO/CP	=	Food and Agriculture Organization/World Bank Cooperative Program
ICB	=	International Competitive Bidding
IDA	=	International Development Association
LCB	=	Local Competitive Bidding
LCCD	=	Local Councils for Cooperative Development
MAF	=	Ministry of Agriculture and Fisheries
NORADP	=	Northern Regional Agricultural Development Project
O&M	=	Operation and Maintenance
M&E	=	Monitoring and Evaluation
PCR	=	Project Completion Report
PDRY	=	People's Democratic Republic of Yemen
PPF	=	Project Preparation Facility
SA	=	Kingdom of Saudi Arabia
SFYP	=	Second Five-Year Plan
SMS	=	Subject Matter Specialist
SRADP	=	Southern Regional Agricultural Development Project
SSHARDA	=	Sana'a, Saadah, Hajjah Regional Development Authority
SURDP	=	Southern Uplands Rural Development Project
SURDU	=	Southern Uplands Rural Development Unit
TDA	=	Tihama Development Authority
TFYP	=	Third Five-Year Plan (1987-1991)
UNDP	=	United Nations Development Program
YAMCO	=	Yemen Agricultural Marketing Company
YAR	=	Yemen Arab Republic

GOVERNMENT OF YEMEN ARAB REPUBLIC

FISCAL YEAR

January 1 - December 31

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Project was prepared by FAO/CP in November 1987, appraised by IDA in March/April 1988, and postappraised by IDA in September 1988. This report is based on the findings of the appraisal mission to the Yemen Arab Republic consisting of Messrs. Hikmat G. Nasr, Senior Agriculturalist (Leader); Youssef Fuleihan, Economist; Luis Moscoso, Irrigation Engineer; D. Masterton, Agriculture and Livestock Specialist (Consultant); Fouad Khoury, Sociologist (Consultant); and O. J. Rescher, Dam Specialist (Consultant).

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YEMEN ARAB REPUBLIC

EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

STAFF APPRAISAL REF RT

CREDIT AND PROJECT SUMMARY

Borrower	:	Government of Yemen Arab Republic.
Amount	:	SDRs 11.0 million (US\$15.0 million equivalent).
Terms	:	Standard IDA with 40 Years Maturity.
Beneficiaries	:	Inhabitants of the Eastern Region of YAR.
Implementing Agency:		Eastern Region Agricultural Development Authority (ERADA). Agricultural Research Authority (ARA).

Project Objectives and Description:

The project aims at increasing agricultural production and farmers' incomes, particularly in the agricultural areas benefiting from the recently constructed Marib flood control/irrigation scheme. This would be achieved through the development of a tertiary distribution system, the establishment of an operation and maintenance service for the Marib Scheme, and the strengthening of agricultural support services in the area. The project also aims at establishing a strong institutional framework for addressing the longer-term agricultural development needs of the Eastern Region (Marib and Al-Jawf Governorates), through the strengthening of the recently established ERADA and the augmenting of agricultural research. The project would provide for the above-mentioned services and institutions: development facilities in the form of technical staff, staff training, expert/consultant services, and studies; buildings; tertiary canals; vehicles and equipment. Also, the project would provide, through farmer participation, investments needed for on-farm development. To assist with project mobilization, a PPF advance (P-508-YAR) was established.

Benefits and Risks:

The project would benefit 2,600 farm families, or 15,000 people in the Eastern Region, through agricultural development. Farm production would increase resulting in higher incomes and less poverty for a majority of farmers. The project would also lay the foundation for future benefits for about 14,000 farm families (about 90,000 people).

At full development the project would increase annual fruit and vegetable production by about 24,000 tons, forages by about 18,000 tons and grains by about 6,000 tons. The main risks include possible problems related to modification of traditional water rights for spate irrigation from the Marib Dam; the difficulty of securing, in a timely manner, the necessary local funding to meet operating costs; possible delays in project mobilization and credit effectiveness; and potential aquifer contamination with fertilizer and pesticide residues. To minimize these risks, and to reduce tribal conflicts and help resolve problems related to water distribution, the Government has appointed an advisory council to ERADA, which includes representatives of beneficiaries, to assist in problem identification and solution. A technical committee within the advisory council would finalize operation plans for the Marib Scheme and provide technical support to the council in its contacts with the beneficiaries. The Government also indicated that because of expected revenues from oil exports and the high priority given to the development of the oil-producing Eastern Region, adequate budgetary allocations would be made to meet the necessary project operating costs. Regarding credit effectiveness, the Government indicated that appropriate action would be taken to streamline ratification procedures. ARA would monitor potential aquifer contamination and recommend remedial measures if necessary.

Project Costs ^{a/}

	<u>Local</u>	<u>Foreign</u>	<u>Total</u>
	-----	(US\$ Million)	-----
A. Regional Institutional Development	5.9	8.1	14.0
Strengthening of ERADA	3.1	2.5	5.6
Augmenting Agricultural Research	2.6	2.1	4.7
Technical Assistance, Training & Studies	0.2	3.5	3.7
B. Marib Scheme Development	1.6	2.9	4.5
Strengthening of the O&M Service	1.1	2.1	3.2
Development of a Tertiary Distribution System	0.5	0.8	1.3
C. On-Farm Development	1.0	1.6	2.6
Total Baseline Cost	8.5	12.6	21.1
Physical Contingencies	0.8	1.4	2.2
Price Contingencies	2.1	2.5	4.6
Total Project Cost	11.4	16.5	27.9
	====	====	====

a/ Exclusive of taxes and duties from which the project is exempt.

Financing Plan:

	<u>Local</u> -----	<u>Foreign</u> (US\$ Million)	<u>Total</u> -----
IDA	1.5	13.5	15.0
Government	5.8	3.0	8.8
Beneficiaries	<u>4.1</u>	-	<u>4.1</u>
TOTAL	<u>11.4</u> =====	<u>16.5</u> =====	<u>27.9</u> =====

Estimated Completion Date: December 31, 1995

Estimated Disbursements:

	IDA Fiscal Year							
	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
	----- (US\$ million) -----							
Annual	1.0	a/ 1.5	3.0	2.5	2.8	2.3	1.5	0.4
Cumulative	1.0	2.5	5.5	8.0	10.8	13.1	14.6	15.0

a/ Including refinancing of the PPF.

Economic Rate of Return: 17.8%

STAFF APPRAISAL REPORT

YEMEN ARAB REPUBLIC

EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

I. BACKGROUND

A. Project Background

1.01 Although agriculture is the single most important sector of the YAR economy and generates over 21%^{1/} of the country's GDP (Annex I, Tables 1 and 2), the potential for agricultural development is constrained by limited water resources and weak development institutions. The Government's aim is to increase the productivity of the existing areas under cultivation by improving water management techniques, introducing modern agricultural practices, and creating better agricultural support services.

1.02 The Government's initiative to develop agriculture, supported to a large degree by IDA, started in 1973 in the Western Region (Tihama Plains) and followed in the Southern (Taiz and Ibb Governorates), Central (Sana'a and Dhamar), and Eastern Regions (Al-Jawf areas). More recently, development has included the Northern Region (Saadah and Hajjah and some northern districts of the Sana'a Governorate). Regional institutions for agricultural and irrigation development have been/are being established for four of the five ecological zones of the country. A similar institution has been created for the Eastern Region (Marib and Al-Jawf Governorates) but has yet to be developed. The Government has also constructed a flood control/irrigation dam in the Marib Governorate, but its newly created operation and maintenance service needs strengthening.

1.03 In continuation of its development drive, the Government of YAR requested IDA to support an agricultural development project in the Eastern Region of the country. The proposed project was prepared with assistance from the Food and Agriculture Organization/World Bank Cooperative Program (FAO/CP) in November 1987 on the basis of an earlier (August 1987) FAO/CP identification mission.

B. The Agricultural Sector

The Macroeconomic Framework

1.04 Since the early seventies, YAR has been changing from a subsistence economy with a small external sector to a more developed economy, in large part propelled by remittances from Yemenis abroad and foreign aid. Workers'

1/ Excluding qat.

remittances peaked in 1980 and amounted to US\$1.3 billion or 49% of GDP. Due to the economic slowdown in neighboring oil-producing countries, these inflows have since declined to about US\$0.4 billion in 1987. Rapid economic and social progress was made during the 1970s and early 1980s. Foreign aid, notably from friendly neighboring countries, helped finance the Government's development program. The increase in income from migrant workers' remittances particularly benefited people in rural areas. Private initiative responded favorably to the growth in public sector spending and private sector income. The Government's development program was further facilitated by liberal pricing policies and an open trade regime.

1.05 While incomes increased during the 1970s and early 1980s, several structural economic issues emerged. Tax revenues and external aid lagged behind government expenditures. Maintenance of a fixed parity vis-a-vis the U.S. dollar resulted in a loss of international competitiveness, which was further weakened by a rapid increase in wages. The fiscal deficit reached 26% of GDP in 1982. With most of the deficit financed by the banking system, liquidity expansion averaged 27% a year between 1982-84. For some time liquidity was partially absorbed by the rapid growth of imports and resulting balance-of-payments deficits. The financing of these deficits was, however, clearly unsustainable and eventually there was a suspension in the sale of foreign exchange by the Central Bank to the commercial banks and a sharp depreciation of the Yemeni Rial. This, coupled with high liquidity expansion, resulted in increasing pressure on prices. Since 1983, the Government has been implementing a number of measures to reduce the fiscal deficit (about 10% of GDP in 1986 and 22% in 1987) and to address its foreign exchange problem. These measures include the introduction of a system to channel scarce foreign exchange resources towards priority imports, such as essential foodstuffs (cereals and flour), intermediate goods, and raw materials. With respect to the Government budget, total current expenditures fell from 55% of GDP in 1982 to 43% in 1987, while the expansion of domestic liquidity was reduced to 25% per annum. Inflation, nevertheless, increased to about 20% in 1987. Inflation, as measured by the CPI, exceeded interest rates in 1984-86. The reduction of external resources, on which the economy remains highly dependent to finance investment and growth, has caused investment to decline sharply, from 25% of GDP in 1982 to 13% in 1987. However, the recent discovery of oil and gas is expected to increase the country's foreign exchange resources in 1988 and to reduce the Government's budget deficit. Based on recent projections, inflation is expected to fall below 10% by 1991.

Agriculture in the Economy

1.06 The share of agriculture in GDP declined from 25% in 1982 to 21% in 1987 (Annex I, Table 2). This drop reflects both an actual decline in value-added in agriculture during the 1981-84 period due to the drought, as well as the more rapid growth of other sectors, particularly the oil sector. The agriculture sector, which employs about 60% of the domestic labor force, is constrained by a generally low rainfall and the consequent scarcity of water. Of 20 million ha of land in YAR, about 1.35 million are presently under cultivation, with 1.12 million ha rainfed (400 mm and above annually) and about 0.23 million ha irrigated. An additional 3.5 million ha could support agriculture if water were available. About 2.15 million ha of these potentially arable lands are in low rainfall areas (less than 400 mm annually)

and are cultivated only once every 3-4 years, depending on the amount of precipitation. The lack of a predictable supply of water for most rainfed agricultural operations strongly influences farm management decisions. Choices are based primarily on ensuring food self-sufficiency and minimizing the risk of crop failure for individual farmers, even though this often impairs production efficiency. In areas with assured water supplies, production is increasingly oriented towards the market, although the objective of food self-sufficiency for individual farm families still receives a very high priority.

1.07 Agricultural Economic Policies & the Role of the Private Sector. The YAR Government has traditionally pursued liberal agricultural economic policies. There are no price support programs in YAR except for cotton and minor subsidies for seeds and seedlings. There are, however, important trade restrictions: the import of apples, oranges, and bananas was banned in 1984^{1/} and only a parastatal company is authorized to import meat. The scarcity of foreign exchange resulted in greatly restricting import licenses for fertilizers, cereals other than wheat, and vegetables and fruits. However, the Government has indicated that import restrictions are temporary and will be eased as the foreign exchange situation improves. Most of the agricultural activities are carried out by the private sector, with the Government essentially providing agricultural services and infrastructure for agricultural and irrigation development. With the exception of two parastatal organizations [the Yemen Agricultural Marketing Company (YAMCO), a subsidiary of the Military Economic Corporation (MECO), and the General Organization for Trade and Grain], the marketing of domestically produced wheat, fruits, and vegetables is handled by the private sector, which is expected to maintain its dominant role in marketing, transportation, storage, grading, and packaging.

1.08 As domestic food production has been insufficient to meet the demands of a rapidly growing population and high income growth, substantial imports have become necessary. Food and live animal imports have been rising and amounted to about US\$370 million in 1985 and 1987 (Annex I, Tables 1 and 3). Cereals and flour have dominated agricultural imports since fruit imports were banned in 1984, and little foreign exchange is being allocated for noncereal imports. Agricultural exports have been insignificant, increasing from US\$2.7 million in 1980 to only US\$5 million in 1985. In recent years there has been a change in the pattern of agricultural production: while wheat and maize production have recovered to predrought levels, sorghum and millet production for human consumption continues to decrease (1981: 635,000 tons; 1987: 477,000 tons) (Annex I, Table 4). The decreasing importance of sorghum grain and millet reflects changing consumer preferences. In addition, sorghum has become less attractive to grow because of the low import price of wheat. It is, however, being increasingly used as livestock feed. The production of vegetables and fruits has been showing sustained rapid growth since 1980, while the production of traditional crops such as barley and dry legumes has declined. The growth in the production of fruits and vegetables has been mainly due to income growth, a selective ban on the import of some fruits, and the lack of foreign exchange to import other fruits and vegetables.

^{1/} The Government imposed a ban on the import of apples, oranges and bananas in 1984 to encourage local production and save foreign exchange. Prior to the ban, annual imports of these fruits totalled 95,000 tons.

Livestock and Poultry

1.09 Livestock in YAR is estimated at about one million cattle, 4.3 million sheep and goats, and some 60,000 camels. Animal production remains traditional, with little or no selective breeding, and no controlled mating season. Livestock care is mainly the province of women, whom the existing extension services have barely reached. Animal production is also handicapped by inadequate veterinary services and meager feed supplies. As a result, livestock performance is far below its potential. Commercial poultry production, which only started in 1978 and often involves large size operations, has experienced very high growth. In 1986, about 250 broiler farms and 2 commercial layer producers were in operation, producing a total of 5,300 tons of broilers and 236 million eggs.

Supply and Demand

1.10 Regional agricultural development projects financed by IDA have significantly contributed to increased agricultural production, particularly of vegetables, fruits, sorghum and wheat. Total annual incremental production at full development (2000) of all IDA-assisted projects undertaken in YAR since 1973 is estimated to be over 300,000 tons of fruits and vegetables in addition to nearly 100,000 tons of sorghum grain and 25,000 tons of wheat (Annex I, Table 5). Some projects (Tihama I, II III, IV and SURDP I & II) have or soon will attain full development, while others (Tihama V, Central Highlands, Wadi Al-Jawf, SRADP, NORADP, and ERADP) will reach full development over the next decade. The increase in production of fruits and vegetables in YAR from 574,000 tons in 1981 to 830,000 tons (including dates) in 1987 (Annex I, Table 6) largely reflects the benefits of these projects to date. This increase was stimulated by quantitative restrictions on the import of fruits and vegetables (arising from the scarcity of foreign exchange and the Government's import policy), high population growth rates of 3% per annum, moderately rising per capita GNP, and urbanization. The production of grain sorghum in 1987 (477,000 tons) is well below the predrought level of 635,000 tons in 1981, while wheat production increased from 70,000 tons to 100,000 tons during the same period.

1.11 Marketing problems are not anticipated for wheat since YAR imports about 600,000 tons of wheat and flour annually. The annual production of sorghum over the next decade (530,000 tons) is expected to remain less than the predrought level. However, even if allowance is made for the decreasing importance of sorghum grain for human consumption, excess supply is not expected to become a major problem since farmers can shift production to other crops. Sorghum fodder for animal production, for example, makes a significant contribution to family income and nutrition. Under ERADP, sorghum production is assumed constant in the project area, and certain crops (particularly tomatoes and watermelons) would be available for export.

1.12 Despite the expected increase in fruit and vegetable production, a recent study on the marketing of fruits and vegetables in YAR, commissioned by the Tihama Development Authority, concluded that, assuming unchanged policies, domestic demand at current real prices will exceed supply until 1990. This trend is likely to continue until the year 2000. The mission estimates that production of fruits and vegetables will increase from 0.83 million tons in

1987 (including potatoes) to at least 1.0 million tons in 2000, when the full potential of all IDA-financed projects is expected to be realized (Annex I, Table 6). FAO demand forecasts (Annex I, Table 7) estimate fruit and vegetable consumption at about 1.02 million tons in 1990 (0.66 million tons of vegetables and 0.36 million tons of fruits), rising to nearly 1.68 million tons in the year 2000 (1.07 million tons of vegetables and 0.61 million tons of fruits).

1.13 Even if more conservative demand estimates are used, excess supply is not anticipated on an annual basis; however, the seasonality of supply could cause marketing bottlenecks, lower prices, and higher losses. Project analysis assumes that the financial and economic prices of fruits and vegetables would decline by 25%-30% over five years, and the financial prices of wheat and grain sorghum would fall by 30%-50% and converge with import parity prices over seven years.

Marketing

1.14 Until recently, the agricultural economy of YAR was subsistence-oriented, and only a small portion of surplus output reached the market. In recent years, an increasing number of farmers in high rainfall or irrigated areas have grown cash crops (fruits, vegetables, and qat), principally for the domestic market. Although some inefficiencies exist within the marketing system (mainly inadequate rural roads, storage, grading, and packing facilities), it is fairly competitive. In general, domestically produced agricultural commodities are traded freely. The marketing system in YAR has been characterized by many small, widely dispersed producers selling directly to individual merchants, retail shops, and consumers. The emergence of large wholesale traders and retail outlets in cities and the development of commercial farms suggest that the marketing system is moving towards higher volume operations in the main cities. The Government's role is confined to the construction of wholesale markets for fruits and vegetables in some of the major cities. Nevertheless, to improve the marketing situation, the market information system within the Ministry of Agriculture and Fisheries (MAF) should be strengthened. This would enable extension agents to advise farmers on market prospects, appropriate varieties, and crop sequencing. The fruit and vegetable marketing study conducted in 1986 recommended measures to strengthen the management of major wholesale markets, improve market intelligence, strengthen extension services for fruit and vegetable growers, and improve packing. It further recommended that the Government's role in marketing should include assisting the private sector by the establishment of basic infrastructure at markets of national importance.

Main Constraints

1.15 Restrictions to agricultural growth in YAR include:
(a) institutional constraints; (b) poor water resources management; and
(c) the limited availability of foreign exchange with a resultant shortage of agricultural inputs.

- (a) Institutional Constraints. The increasing commercialization of the agricultural sector has been accompanied by a rapid growth in demand for institutional services, notably extension,

research and credit. The lack of managerial and skilled manpower and weak institutional performance have constrained the expansion of these services. The establishment of sector-specific training institutions, notably the agricultural faculty of the University of Sana'a, and the ongoing local and overseas training and technical assistance efforts are expected to partially satisfy demand, particularly for skilled manpower. Actual or proposed improvements in three principal areas of institutional development are discussed below:

- (i) Extension and research have been the most effective in dealing with these constraints. Foreign assistance programs and technical assistance are already supporting the development of extension services in most of the Tihama Plain, the Southern and Central Regions and parts of the Eastern Region. The impact of these recently established extension services is now being felt in the sector. Research is carried out by the Agricultural Research Authority (ARA), supported by IDA Credit 1259-YAR, with the main focus on the Tihama and Southern and Central areas of the country; less attention has been paid to the Northern and Eastern Regions. Provisions included in the recently approved Northern Region Agricultural Development Project (NORADEP) are geared to strengthen research efforts in the Northern Region. The proposed project would focus on strengthening research in the Eastern Region.
- (ii) Past efforts to improve the performance of MAF have had limited success. To enhance its effectiveness in directing agricultural policy and developing and overseeing the implementation of development programs, the Ministry has delegated most of its functions to five existing and newly established area development units and authorities.^{1/} These entities would perform MAF's functions in the five regions into which the country is divided. This strategy is intended to mobilize the strength and experience of existing area authorities in supporting MAF's functions, while necessitating a considerable tightening of MAF's control over policy, regulation, monitoring and implementation. To strengthen the Ministry's central coordinating role, directors of regional area authorities would report directly to the Minister. Limited manpower resources would be concentrated on planning and budgeting functions. The proposed National Agricultural Development Project (FY90) would focus on the institution building of MAF (particularly for sectoral planning, research, extension and training) and on the consolidation and further strengthening of activities under the ongoing regional development projects.

^{1/} Tihama Development Authority, Southern Uplands Rural Development Unit, Central Highlands Unit, Eastern Region Agricultural Development Authority, and Northern Regional Development Authority.

(iii) Cooperative and Agricultural Credit Bank (CACB). CACB, which was established in 1982 when two existing credit institutions were merged, is the primary source of institutional credit for agriculture in YAR. CACB operates through 16 branches and 5 subbranches throughout the country. The volume of total agricultural lending has doubled from YRls 93 million in 1982 to YRls 186 million in 1986. CACB's financial statements register a profit. This profit derives mainly from nonlending sources, such as trading activities and income from LCCD deposits which are noninterest bearing accounts. CACB's institutional development has been weak; efforts under the Agricultural Credit Project (Cr. 1308-YAR) to improve the institutional performance of CACB have met with limited results so far. With CACB the primary source of agricultural credit, the improvement of its performance is essential to the development of agriculture. The volume of agricultural lending dropped from YRls 186 million in 1986 to YRls 145 million in 1987 mainly due to foreign exchange restrictions and input availability. This has meant a reduced demand for credit and a significant decline in trading volume for CACB. Loan administration costs are about 12%-13% of outstanding loans. The interest rate in agriculture has two aspects: (a) preferential rates for the Eastern Region (7%)^{1/} and low interest rates in agriculture (10%). Lower rates in the Eastern Region are decreed by the President of YAR and are based on socio-economic considerations: The semi-nomadic nature of the population with little or no previous exposure to commercial lending. The temporary nature of this rate has been confirmed by Government. The importance of low interest rates in agriculture has diminished recently as a result of projected lower inflation rates (15% in 1989, 10 % in 1990, and 8% in 1991 and 1992). Discussions regarding the interest rate would be pursued with YAR officials within the context of macroeconomic dialogue. The loan recovery rate dropped from 69% in 1986 to 55% in 1987 mainly due to the fall in loan recovery rates in the Eastern Region (where outstanding loans account for 22% of CACB's total loan portfolio). The low loan recovery rates in the Eastern Region are largely due to CACB's inexperience and new presence in tribal areas where agricultural lending is not customary. CACB's financial position continues to deteriorate as a result of the decreasing volume of lending and trading, low service charges, low and falling recovery rates, and the high cost of loan administration. These issues are being addressed under Credit 1308-YAR. It is expected that the action plan for improving loan recovery rates, agreed with CACB (para. 2.21), and the easing of the foreign exchange situation will improve CACB's financial position.

^{1/} To encourage farming in the newly developing border areas of Marib and Al-Jawf, the Government has reduced the interest rate in this area by 3% as a temporary measure.

- (b) **Water Resources Management Constraints.** The potential for agricultural development in YAR depends primarily on the efficient management of water resources. Surface and groundwater policy, however, is not specifically articulated; rather it exists as a mixture of Islamic legal principles and tribal customs. Surface water rights permit the first in line to take what is legitimately required, allowing less water for downstream farmers. Groundwater rights are common to land ownership where landowners legally have limited drilling and pumping rights. The Government is therefore unable to husband the country's limited groundwater resources. This, and the fact that water planning has given less than adequate consideration to agro/economic and geologic factors, has resulted in the inefficient/unsustainable use of limited water resources. In addition, the available groundwater is not used efficiently due to poor conveyance and application techniques. The results of this poor management are unnecessary water loss, high pumping costs, and generally low irrigation efficiency. Irrigation development should be based on in-depth studies of water resources in all regions in YAR. The Government of YAR is conscious of the severity of the problem and has established a high level Water Council to coordinate action at the national level. Also, the United Nations Development Programme (UNDP) is coordinating support from various donors to assist the Government in the formulation of an appropriate water resources management plan.
- (c) **Foreign Exchange Constraints.** Constrained by the shortage of foreign exchange, the Government has imposed a ban on the import of selected fruits and has restricted the availability of foreign exchange for the import of certain fruits and vegetables. These restrictions have had a noticeable effect on the production of some fruits, including bananas, papayas, oranges and apples, and many vegetables. In order to provide continuous incentives to fruit and vegetable growers, the Government intends to continue these restrictions for the present time. The lack of foreign exchange has also restricted imports of agricultural inputs, notably fertilizer, pesticides, and, to a smaller extent, machinery. The Government lacks a clear policy regarding the priority of agricultural inputs in receiving foreign exchange allocations. It has indicated, however, that it will endeavor in the future to make foreign exchange more readily available to the agricultural sector. It is expected that future oil exports will substantially ease the shortage of foreign exchange and, hence, reduce the prevailing input shortages. The foreign exchange situation has recently improved somewhat as evidenced by the increased availability of fertilizers through MAF and the private sector. As of September 1988, 28,000 tons have already been imported.

Government Sector Strategy

1.16 The Government's strategy for the sector has been detailed in the Third Five-Year Plan (TFYP) for the period 1987-1991. The main objectives of the Plan are:

- (i) to improve the planning/implementation capacity of MAF;
- (ii) to improve food self-sufficiency and increase agricultural exports wherever possible;
- (iii) to modernize agricultural production techniques and increase value added;
- (iv) to reduce gat production; and
- (v) to increase the supply of agricultural raw materials to the domestic manufacturing industry.

With the exception of item (iv), these objectives appear realistic. The growth of gross output of the sector, which amounted to 2.4% during the Second Five-Year Plan, is expected to increase to 3.4% per annum. The area under cultivation is expected to increase by 1.3%, and yields by 2.1% annually. The strategy to achieve these growth rates focuses on:

- (i) improving agricultural services throughout the country, particularly research and extension;
- (ii) improving water resources management;
- (iii) expanding the availability of agricultural inputs;
- (iv) reducing desertification through sand dune fixation;
- (v) modernizing the livestock sector by upgrading breeding and disease control;
- (vi) controlling groundwater use and introducing efficient irrigation methods;
- (vii) improving marketing of agricultural products by providing market and storage facilities; and
- (viii) encouraging private, mixed and cooperative agricultural enterprises.

1.17 Total investment outlays of TFYP amount to YRls 3,900 million (US\$400 million) for agriculture (10% of the total outlay), of which 34% would be financed by the Government. The Government's development strategy appears largely sound; however, not all of its objectives or strategy goals might be attainable with equal success. Notably, implementation of measures to control groundwater use and reduce gat production might face stiff resistance. In addition, competition from imported wheat and higher returns for vegetables and fruits do not favor a rapid increase in foodgrain production. Policies to encourage a rapid increase in irrigated grain production on mechanized farms appear ill-advised, as local production costs might substantially exceed world market prices and alternative crops might have a higher rate of return.

IDA's Role in the Sector

1.18 **Strategy.** IDA's strategy in the agriculture sector has been to help raise agricultural productivity and improve farmers' living standards by financing development projects which emphasize the institutional development of agricultural services (extension, research, credit and irrigation) and infrastructure. IDA projects account for a large segment of total public sector investment, and IDA involvement has attracted substantial cofinancing resources.

1.19 IDA's focus on institution building and infrastructure was facilitated in the 1970s and early 1980s by the Government's traditional open market economy and its generally appropriate incentive system. However, recent measures to protect some parts of the agricultural sector, restrict foreign exchange available for the import of essential inputs, and maintain a relatively inflexible foreign exchange and interest rate regime are a matter of concern. The Government has repeatedly indicated that most of these measures reflect prevailing foreign exchange shortages, which are likely to become less constraining, and that it has no intention of departing from its open market policy.

1.20 In view of the apparently temporary nature of most of these policies, and of the Government's intention of making more foreign exchange available for input imports, it appears prudent, for the time being, to maintain IDA's focus on institutional development, notably of agricultural services and of MAF. This will facilitate the completion of nationwide agricultural research and extension services and strengthen credit delivery while enhancing the import of agricultural inputs. Simultaneously, a review of sector policies, including those related to interest, foreign exchange rate levels, import bans, and food self-sufficiency, should continue as part of the country's macroeconomic dialogue.

1.21 **Completed and Ongoing IDA-assisted Projects.** IDA has, to date, assisted in financing 16 agricultural projects in YAR, of which 7 (the Tihama I, II and IV, SURDP I, SURDP II, Grain Storage and Processing, Livestock Credit and Processing) have been completed. In general, these projects have been successful in achieving their main objectives, particularly the establishment and strengthening of institutions in extension and research. Success is also due, however, to the Government's increased participation in the sector via an increase in investment and recurrent costs. In the case of Tihama IV, the project performance credit report questions the appropriateness of building permanent water diversion structures where water flow is characterized by a high peak and little or no base flow. The report implies that greater emphasis of groundwater development would be more appropriate.

1.22 Ongoing IDA-assisted agricultural projects are making satisfactory progress, although some start-up difficulties were experienced due to delays in the selection of consultants. The ongoing Fisheries Project (Cr. 1025-YAR) has made good progress with its infrastructure components but has been proceeding slowly with the introduction of a fishery extension and the execution of the technical assistance program. Four other agricultural projects: Agricultural Research and Development (Cr. 1259-YAR), Agricultural

Credit (Cr. 1308-YAR), the Central Highlands Agricultural Development (Cr. 1453-YAR), and the Wadi Al-Jawf Project (Cr. 1584-YAR) are at different stages of implementation. The Tihama V Project (Cr. 1667-YAR) and the Southern Regional Agricultural Development Project (SRADP) (Cr. 1772-YAR) are in the start-up stage. NORADEP (Cr. 1886-YAR) was signed on August 4, 1988. Difficulty in finalizing cofinancing arrangements, delays in ratification of documents, and fulfillment of conditions for credit effectiveness have emerged as serious delaying factors in some of the recently approved IDA credits.

1.23 Wadi Al-Jawf Agricultural Development Project (Cr. 1584-YAR) was initiated in 1986 and is designed to provide, *inter alia*, improvement in irrigation infrastructure, a project implementation unit, agricultural support services, construction of buildings and feeder roads, and development studies in the Al-Jawf Governorate of the Eastern Region. The project has experienced delays in implementation, primarily due to financial (foreign and local) and managerial issues, as well as tribal friction relating to new settlements and delays in rehabilitating the water control systems. Following intensive supervision, and the placement of the project under the overall responsibilities of ERADA, chaired by an experienced and capable chairman, the project status has improved. The foreign financial issues have been resolved with the cofinancier (Arab Fund); ratification has been completed and project funds are now being disbursed. Appointment of key staff (local and foreign) has taken place. Agreements between the two main tribes on water sharing of Al Hazam and Al Khalaq spate irrigation schemes has been secured and designs for the rehabilitation of irrigation structures has been completed. Some key project facilities are under construction and others are under procurement. A study to determine the rehabilitation requirements of existing wells is ongoing. Design and tender documents for feeder roads have been prepared and construction is expected to start in July 1989. The extension program has been initiated. Despite these improvements, however, some unresolved issues remain. These include the removal of temporary earth diversion structures involving tribal conflicts, the completion of housing facilities and the transfer of staff to the project site. The September 1988 supervision mission worked out a detailed action plan for resolving these issues with project officials. Progress is being closely monitored. Another development that merits watching is the Government's preparation of a study under the Sanaa Basin Project for the construction of a dam in the catchment area of the Al-Jawf Project. This is likely to affect the Al Kharid scheme. The Al-Jawf project authority is maintaining close contact with the Sanaa Basin Authority, and the development status of the dam will be regularly communicated to IDA.

1.24 Lessons Learned. The Project Performance and Audit Reports (PPAR) for the Tihama I (Cr. 376-YAR), SURDP I (Cr. 545-YAR) and Tihama II (Cr. 805-YAR) Projects are generally positive on the achievements, particularly the establishment of organizations and extension services, and the implementation of physical infrastructures. The PPAR for the Tihama IV (Cr. 978-YAR) project was critical of the investment made for surface water improvement. The report indicated that, unlike well irrigation, the surface irrigation component suffered from a low economic rate of return. Its cropping pattern and cropping intensity were below appraisal expectations. Moreover, these reports, as well as the report on the Grain Storage and Processing Project (Cr. 636-YAR) and the Livestock Credit and Processing Project (Cr. 662-YAR), highlight the principal difficulties in YAR. They are:

(a) shortage of trained technical and administrative staff; (b) escalations in project costs due to delayed execution; (c) ineffectiveness of monitoring and evaluation programs; (d) weak coordination between research and extension; (e) absence of O&M services; and (f) delays in mobilization of the newly established implementing agencies. Institutions in YAR have been found to be weak, both technically and administratively, particularly after project completion. As a result, allocations for O&M are not utilized efficiently or are inadequate, and M&E becomes much less effective. The lessons learned from completed and ongoing projects have been taken into account in formulating the scope and design of subsequent projects, including the proposed project. The proposed Eastern Region Agricultural Development Project (ERADP) would provide technical assistance and training, strong linkages between research and extension, as well as regular O&M and monitoring and evaluation services. Also, the mobilization of implementation agencies would be expedited by setting up realistic deadlines and assistance through PPF advance, where needed, and by the timely appointment of consultants and the preparation of procurement documents.

II. THE PROJECT AREA AND DEVELOPMENT POTENTIAL

A. Physical Features

2.01 Location and Topography. The Eastern Region encompasses the provincial boundaries of the Marib and Al-Jawf Governorates (Map, IBRD No. 20584). It is bordered to the north and east by the Kingdom of Saudi Arabia (SA), to the east and southeast by the People's Democratic Republic of Yemen (PDRY), to the south by the Al-Beida Governorate, and to the west by the Sana'a and Dhamar Governorates. The project area consists primarily of the eastern slopes of the central mountainous region (2,000-3,000 m above mean sea level (amsl)) and the Adhanah and Al-Jawf wadis, or streams, which drain into the eastern plateau (about 1,200 meter amsl). The total land area is about 30,000 km², of which about 90,000 ha are cultivable with spate and well water. About 6,000 ha would benefit directly from the recently constructed Marib Dam (para. 2.06). Rainfed agriculture is limited to about 3,000 ha scattered in the high elevations.

2.02 Climate. Climatic data for the region are available for only a few years. Studies of the Al-Jawf Agricultural Development Project and the Marib Irrigation Scheme have been based on analysis of records from neighboring areas (Najran in Saudi Arabia and Wadi Beihan in PDRY). Based on data from meteorological stations in the project area, rainfall is mainly in the periods from April to June and from September to October. It ranges from 50 to 100mm in the plateau and from 100 to 400 mm in the mountains. The temperatures are typical of semidesert conditions, with wide diurnal variations, but favorable for the production of a range of crops. Relative humidity is low and mean temperatures range from 7°C to 25°C in December and from 25°C to 42°C in summer (June - August).

2.03 Soils. In the wide wadi basins of Al-Jawf and Marib, deep alluvial soils have been deposited from upstream mountainous areas. Soils are relatively fertile, but they have very low organic matter and nitrogen

content. They are often calcareous and have a high pH, leading to induced deficiencies in phosphorus and micronutrients. Salinity and alkalinity are generally low and water holding capacity is good (20% to 25%).

B. Water Resources

2.04 Surface Water. The region is served by the two main catchments of Wadi Al-Jawf (14,000 km²) and Wadi Adhanah (10,000 km²), and by a number of smaller catchments (Wadis Harib, Jubah, Khabb, Silbah, etc.) (Map, IBRD No. 20585). These wadis have their source in mountainous areas to the west where annual rainfall is up to 400 mm. Wadi Al-Jawf is supplied with a perennial flow from two main tributaries, Wadi Al Kharid and Wadi Madhab. Wadi Adhanah is supplied from the catchment area of Jabal Balak where the Marib Dam has been constructed. The average rainfall at the catchment area is 280 mm with average annual runoff of 200 million M³. Surface water resources of other catchments (Harib, Jubah, Khabb, Silbah) have not yet been studied. However, spate flow can usually be counted on once or twice a year.

2.05 Groundwater. Because of the low rainfall and limited surface water, groundwater resources in the region are very important. Nevertheless, the potential is not fully known. Studies currently being undertaken for the Marib Dam command area, with assistance from the Government of the Netherlands, would improve the data base for groundwater resources in the project area. There is no inventory of wells for the region. Based on crop area data, however, it is estimated that about 8,500 wells exist with yields ranging between 5 and 10 l/s. Preliminary results of the water resource study for Wadi Adhanah indicate that the number of wells downstream of the Marib Dam was about 2,000 in 1987. About one-third of these are located within the area to be served by the Marib Scheme. Most of the others are located in adjacent areas expected to benefit from improved groundwater recharge. The groundwater overall conveyance efficiency is 40% but would be increased to an average of 52%. Irrigation improvement under the proposed project would be mainly due to: (a) improved hydraulic conditions of canals (lining, realignment, rehabilitation) and (b) improved field efficiency due to land levelling and on-farm development.

2.06 Marib Dam. The Marib Dam, financed by the Abu Dhabi Government at a cost of about US\$100 million, including primary and secondary canals, was first conceived as a flood control structure. Following design of the main dam and spillway, the purpose of the dam was changed to include flood control and storage for regulated surface irrigation. Accordingly, the distribution system was designed so that water could be discharged into the wadi and then diverted downstream into the primary canal system. The objective was to irrigate 6,500 ha. The dam is 38 meters high with conduit outlet for release of up to 35 m³/s of water; it has a saddle spillway for flood release and two diversion structures. It is designed for an average annual inflow of 200 Mm³, a maximum storage of 400 Mm³, and a maximum safe water level of 1,214.3 meters amsl corresponding to 190 Mm³ of storage. At full development it is estimated that for a ten-year average annual inflow of 200 Mm³, the yield for irrigation purposes at dam outlet is 149.7 Mm³. This yield represents about 91% of the total baseline surface water demand of

the proposed cropping pattern of 164 Mm³ and 75% of the average flow at 200 Mm³. The simulated model also reveals that the annual water release at the secondary outlet is about 64 Mm³. This parameter has been used to determine the cropping pattern and to estimate the water tariff and the areas that can be irrigated by surface water.

2.07 The dam and the conveyance and distribution system, referred to as the Marib Scheme, are under construction. The dam, its appurtenant structures, diversion structures from Wadi Adhanah, and primary canals have already been built. Upon construction of the reservoir, the few settlers have been compensated in kind (wells and pumps) and settled downstream. Design and work on secondary canals is well advanced. The contracts let for designing (Electrowatt) and for the construction (Dogus) of the secondary canals, including offtakes to tertiary blocks, stipulate completion in 18 months from February 10, 1988. Taking the current slight implementation delays into account, the work is expected to be finished by end of December 1989. Tertiary canals would be built by the beneficiaries and by ERADA as an integral part of the proposed project. Hydrological studies on the dam catchment area and on the recharge of the aquifer downstream of the dam are being carried out by the Government, with assistance from the Government of the Netherlands. This would continue in coordination with ERADA. The overall conveyance efficiency of the system is 20%. This is broken down as follows: (a) from the dam to the diversion structure (wadi bed) = 50%; (b) primary canals = 95%; (c) secondary canals = 90%; (d) tertiary canals = 85%; and (e) field efficiency = 55%. The 50% conveyance efficiency from the dam to the diversion structures is a realistic estimate based on knowledge of the Wadi bed and the recent monitoring of water flow by project authorities. Monitoring would be continued on a regular basis and as part of the O&M service under the proposed project; adjustments, if necessary, would be made during project implementation. A core O&M service for the Marib Scheme has been established under the overall responsibilities of ERADA. Some provisions for strengthening the service (30 staff months of foreign training for local staff and 14 staff months of consultant services) have been made under the Northern Region Agricultural Development Project. The consultancy is designed to assist the Government in the formulation of a detailed operational manual and in the planning and implementing of the training program, which is expected to begin by November 1988 under PPF No. P-454-YAR. Further strengthening of the service would be provided for under the proposed project.

2.08 The following concerns regarding the dam, its appurtenant structures and the distribution system were raised during appraisal and appropriate actions taken to address them.

- (a) The first concerns safety; the dam has been examined by a specialist, with particular attention paid to its structural design and operating procedures. Technical experts representing IDA, the Government of YAR, the Abu Dhabi Fund, and the Engineering Consultants agree on the stability of the dam in the normal operating range. However, to further increase the safety of the dam and its appurtenant structures, it was agreed to install a filter blanket at the toe of the dam to protect against seepage and potential piping, and to enlarge the stilling basin to improve the discharge capacity of the dam.

These works are estimated to cost about US\$350,000, and sufficient funds for implementing them have been approved by the Government of YAR outside the scope of the project. Before credit effectiveness, Government would enter into a contract satisfactory to IDA for the execution of these works (para. 6.02).

- (b) The second concern is the damage to the primary BN canal from the flooding of an adjacent wadi in February 1988. The September 1988 postappraisal mission reviewed two preliminary proposals prepared on behalf of the Government by Electrowatt, the site engineering consultant firm, for repairing and preventing a recurrence of the damage. Preliminary cost estimates are about US\$0.8 million. It was found that one of the proposals was technically acceptable but lacked the necessary details, particularly for the flood control protection. The Abu Dhabi Fund has agreed to finance the studies/designs needed for the repair of the BN canal damage and the flood control measures to prevent its recurrence, and Electrowatt is preparing the necessary designs for restoration works. Government has allocated YR 10 million in ERADA's 1989 budget outside the scope of the project to complete the repair of the damage of the BN canal by August 1989 and its flood control measures by February 1990.

2.09 Water Quality. Surface water flow, generated by runoff from the watersheds or from saturated soils, and underground sources of water are of suitable quality for irrigation and domestic use. As farmers begin to adopt improved production technology, however, the use of fertilizers will increase; in the long run, nitrates may contaminate the aquifer. This probable risk would be assessed and equilibrium concentration of nitrates would be determined under the proposed project, taking into consideration current studies of the aquifer and future levels of fertilizer use. Recommendations would be made on how to maintain the equilibrium of nitrate concentration at an acceptably low level and would be implemented by the Agricultural Research Authority (ARA) (paras. 3.16 and 3.41).

2.10 Water Rights. In spate irrigated areas, farmers located upstream traditionally have priority to divert and use water as needed, provided they do not abuse this right. Water rights are currently governed by collective written agreements for use among farmer beneficiaries of the same bahiya (barrage), and between one bahiya and another. The construction of the Marib Dam has somewhat altered these traditional rights. However, this is not expected to pose a major problem because: (a) regulated water flow would be available on a year-round basis and would reach more beneficiaries; (b) water right agreements would be sought among beneficiaries and between beneficiaries and ERADA for operation of the water distribution system, at the tertiary block level; and (c) collective units of beneficiaries often belong to the same tribe. Furthermore, the proposed advisory council would facilitate the resolution of any potential tribal conflicts arising from water rights (para. 4.09).

C. Socioeconomic Features

2.11 Population and Labor Force. Historically, the Eastern Region, including the Marib Scheme command area, is seminomadic, dominated by local tribes who have the right of individual ownership to cultivated and pasture lands with clear boundaries. During the dry season, the tribes move to collectively owned pasture lands in the hills while maintaining their individual dwellings in the irrigated areas. Extrapolation from the 1986 census establishes the current population of the region at about 220,000 inhabitants (94% rural) who live in 550 villages or hamlets (388 in Marib and 162 in Al-Jawf). The number of households is about 34,000 (19,500 in Marib and 14,500 in Al-Jawf). The average rural household size is six members with only about 2.1 member equivalent available for agricultural work on a daily basis throughout the year (0.4 represents livestock care). Assuming 250 work days during the year and taking into account the seasonality of labor demand, the remaining 1.7 workers are able to work only 70% of the year. This proportion could be increased to 80% with perennial irrigation and changes in cropping pattern.

2.12 Land Tenure and Farm Size. According to the 1983 MAF census, virtually all land in the project area is privately owned and almost all farms are owner-occupied and managed. For the Marib and Al-Jawf Governorates, available statistics indicate a total of 18,500 holdings; about 87,000 ha have an average holding size of about 5 ha. A survey of the Marib Scheme command area indicates a total of 1,600 land holdings, covering an area of about 8,000 ha (6,500 ha are within reach of the surface water distribution system; about 1,500 ha, which mainly depend on well irrigation, are located adjacent to the system and benefit from its recharge capacity to the aquifer). About 20% of these holdings have less than 2 ha; 25% have between 2 and 5 ha; 25% have 5 to 10 ha; 17% have 10 to 20 ha; and 13% have more than 20 ha. Many of the larger holdings are located in areas which have been abandoned because of sand invasion. Although the command area is under tribal domain (eight main tribes), cultivated fields benefitting from the scheme, both surface and groundwater, are owned by individual families who have the right to cultivate and to transfer this right through inheritance or sale.

2.13 Education. The illiteracy rate in the project area is still very high (92.5%). The number of schools in the area is increasing, as is the number of enrolled students, but the supply of educated youths with a secondary education remains limited. The number of Yemeni university students in agriculture (686) and engineering (1,849) indicates that the present shortage of qualified personnel is slowly becoming less acute.

2.14 Role of Women. Women occupy an important role in the agricultural development of YAR, as well as in the project area. Field observations indicate that, in addition to the usual home activities (cooking, washing, child care, food processing, etc.), women also carry out substantial field work in agriculture and livestock. Female labor is mainly used for harvesting alfalfa and other agricultural operations, except land preparation. Women are also responsible for animal husbandry. Because of the more conservative nature of the social system in the project area and the sensitivity of women's

issues under tribal social systems, the project would aim at initiating a modest Women in Development Program, concentrated mainly in the Harib and Al-Jubah districts of the Marib Governorate where participation in the program is more likely.

D. Organization and Agricultural Support Systems

2.15 Existing Administrative Setup. The project area falls within the administrative jurisdiction of the governorates of Marib and Al-Jawf, in the towns of Marib and Al Hazm, respectively. MAF's directorates of agriculture, set up in the governorate headquarters, have so far provided minimal agricultural services. This has been mainly due to insufficient funds, the shortage of technical staff and a lack of transport facilities. Under the ongoing Wadi Al-Jawf Project (Cr. 1584-YAR), which covers the Wadi Al-Jawf Governorate, provisions have been made for strengthening the agricultural services. After some delay, project implementation is now under way (para. 1.23). In the Marib Governorate, on the other hand, a small cadre of staff has been employed for the development of the Marib Scheme. This unit also requires strengthening and would be covered under the proposed project.

2.16 Agricultural Research. Small scale research has been carried out by ARA on rented land in the project area, particularly in the Marib Scheme command area. To date the emphasis has been on wheat variety verification, and encouraging results have been obtained. In the absence of any facilities in the region, these research activities have been conducted from ARA's headquarters at Dhamar. Some provisions were made under the Al-Jawf project to establish research facilities in the Al-Jawf Governorate. These, which include the construction of a research substation and some office space and housing facilities, are in the early stages of implementation. Also, the Government has agreed to provide the necessary budgetary allocations to ARA to appoint four research officers and seven research assistants to be placed in Marib before June 1989. Further strengthening of research capabilities on a regional basis would also be provided for under the proposed project.

2.17 Agricultural Extension. MAF already has some agricultural extension operations in the region. In Al-Jawf, the service is being established under the Al-Jawf Project. Provisions include staffing, staff training, and the construction and equipping of seven centers. Currently, nine extension agents and two extension supervisors, mostly expatriate experts assisted by a few subject matter specialists (SMS), are operating in the project area. In the Marib Governorate, the service consists of the Director of Agriculture, six extension agents and one expatriate horticulturist. The extension programs in both Governorates deal mostly with wheat, fruits and vegetables; they concentrate on improving varieties, fertilizer recommendations, planting dates, irrigation layouts, plant protection, and orchard establishment and management. Extension successes to date have been largely the work of expatriate experts. Local extension staff require more training in subject matter as well as in extension methodology. Staff, particularly SMS, are needed to provide the extension agents with the necessary technical support. Also, linkage with research is almost nonexistent. More vehicles, inputs,

and appropriate machinery for field demonstrations, as well as housing and office facilities, are also necessary. These would be provided for under the proposed project.

2.18 Nurseries. A 10 ha nursery is being developed for the Al-Jawf Governorate under the Al-Jawf Project. MAF has a 5 ha nursery at Marib headquarters for the production of fruit trees and forest species (capacity of about 100,000 plants). The staff of the MAF Agricultural Affairs Department at Marib are already assisting six progressive farmers in establishing nurseries. These farmers, with some assistance to increase production and ensure quality of output, would be able to satisfy the entire demand created by the project. To assist in nursery production and in the upgrading of orchards, the project would establish a mother tree orchard at the Government Farm at Al Shabwan.

2.19 Veterinary Services. Veterinary services in the region have been run by MAF on a very small scale. Recently the British Government has provided some help in the form of medicine and staff training. However, the service which focuses on vaccination against sheep pox and endo- and ectoparasite treatment is constrained, particularly by a shortage of staff and transport facilities. Considering the importance of livestock in the region, especially small ruminants, the present service needs to be strengthened. The proposed project would provide for such strengthening (para. 3.11).

2.20 Inputs. Agricultural chemicals, seeds and machinery are available in the project area. In addition, engines, pumps and pipes for well irrigation are sold by local suppliers. At present, however, chemical fertilizer is not available. The use of fertilizers and agricultural chemicals in the Marib Governorate is very limited, mainly due to the unfamiliarity of most farmers with fertilizers, but also due to the shortage of foreign exchange. Once demand is established, fertilizer is expected to become more readily available. Also, the recent availability of fertilizers at the national level is expected to spill over to the project area. Since fertilizer requirements of the project area during the six-year project implementation period are not expected to be large (about 3,000 tons), the project makes no provision for import of inputs.

2.21 Agricultural Credit. CACB has operated in the project area since July 1985 through two branches -- Marib and Al-Jawf. About YR1s 90 million, mostly for wells and tractors, have been disbursed to about 800 farmers during the period July 1985 to December 1987. Credit has outpaced other agricultural support services, resulting, in many instances, in the underutilization of financed facilities. Due to CACB's inexperience in the project area and its recent establishment in tribal areas not familiar with agricultural lending, loan recovery rates have been low (15% in Marib and 7% in Al-Jawf in 1987). An action plan to improve loan recovery rates has recently been agreed upon with CACB under the ongoing Agricultural Credit Project (Cr. 1308-YAR). The main features of the plan are as follows: (i) identifying delinquent loans and rescheduling deserving cases on a case-by-case basis; (ii) segregating recovery rates by branch and size of loan and aging delinquent loans; (iii) setting targets for loan recovery by branch and supervising borrowers more intensively; (iv) closely monitoring operations of Marib and Al Jawf branches; (v) investigate the possibility of establishing a special fund for

the Eastern Region, which would be administered by CACB on behalf of Government; (vi) costing of administrative expenses by branch; and (vii) preparation of a five-year staffing and financial plan. During negotiations, the chairman of CACB indicated that (i) the plan for improving loan recovery would be launched in January, 1989, (ii) discussions are on-going with Government officials concerning the special fund for the Eastern Region, and (iii) CACB will evaluate personnel at the branch level and intensify training when needed to improve efficiency and reduce loan administration costs.

2.22 Marketing. The area is served by a relatively efficient network of traditional markets through which the bulk of marketable surplus is sold. Cereals are sold mainly to private traders and in limited amounts to the General Corporation for Grain and Trade. Fruits and vegetables are sold at farmgate to private traders, in village markets, to retail shops, or to YAMCO. During the peak season, some farmers sell their produce in wholesale markets in Sana'a. Increased production of fruits and vegetables and seasonality of supply, could result in some marketing bottlenecks. To improve the marketing situation, an intelligence system within MAF should be established and strongly linked with agricultural research and the extension services. Agents within ERADA could then advise farmers on market prospects and research findings regarding optimal dates of planting, crop varieties, etc.

2.23 Rural Organization. The development of rural infrastructure is carried out by Local Councils for Cooperative Development (LCCD). At the Governorate level, each LCCD has a democratically elected administrative board comprising a Chairman, Secretary General and Treasurer. At the national level, the LCCDs are represented by the Confederation of Local Councils for Cooperative Development (CLCCD). LCCDs in the project area have been established only recently and are still financially and technically weak. Their budgets, which mainly come from Zakat collection and which is low in the Region, are not sufficient to improve or maintain infrastructure development. This is expected to improve, however slowly, as Zakat collection improves. It is expected that the Engineering Department of ERADA would provide the LCCDs with technical assistance in matters related to infrastructure development.

2.24 Infrastructure. The main access to the region is by an asphalt road from Sana'a to Safer via Marib. A secondary road is under construction from this road to Hazm Al-Jawf. Roads are under construction from Marib to Harib via Al Jubah. There are also plans for the construction or upgrading of roads from Hazm to other agricultural areas in the Al-Jawf Governorate, and from Marib to Sirwah and from there to Sana'a. All other roads are rough tracks only, but all villages can be reached by four-wheel-drive vehicles. Two airports (Al-Jawf and Marib) exist in the project area with a weekly and semiweekly connection to Sana'a, respectively. The Government of YAR is providing safe drinking water facilities through CLCCD. A number of such facilities have already been constructed (52 in Al-Jawf and 15 in Marib). More are needed, particularly in the Marib Governorate. Safe drinking water, which is outside the scope of the proposed project, is being addressed by the Government, with foreign assistance.

2.25 Wadi Al Jawf Agricultural Development Project (Cr. 1584-YAR). This project, which is cofinanced by IDA and the Arab Fund, aims at improving agriculture in the Wadi Al-Jawf Governorate by increasing the use of available land and water resources through suitable technology, and by upgrading the irrigation infrastructure in the Governorate. The project would rehabilitate perennial stream flow irrigation on about 3,100 ha and spate irrigation on 2,050; it would develop 1,650 ha with tubewells and introduce extension, research and animal health services. Forty-five kilometers of feeder roads would be constructed. The project aims to bring direct production benefits to 1,700 farm households and ancillary benefits to some 50,000 inhabitants through infrastructure components. The project became operative in October 1986. After initial delays and following intensive project supervision, the status has improved and the project is now progressing under the newly established ERADA (para. 1.23).

2.26 Sand Dune Stabilization and Afforestation in Marib. This UNDP/FAO project began activities in June 1988. The project, estimated to cost US\$1.09 million and the YAR Government contribution of YR1s 5.46 million (US\$0.5 million equivalent), is scheduled to run for three to four years. With MAF (now ERADA) as counterpart the project would: (a) diagnose the problems of desertification in the Marib Governorate; (b) implement a sand dune fixing and stabilization program to protect 850 ha of fertile agricultural land in selected sites along 4 km of irrigation canal; (c) train three professional staff and five technicians to enable the National Forestry Department to fight desertification; and (d) promote villagers' participation in the execution of sand stabilization programs through extension, training, and plant/seedling distribution. The project would establish a nursery at Al Shabwan for the production of 350,000 seedlings annually. Project activities would be entirely compatible with the proposed irrigation development in the Marib Scheme command area. The Government, with foreign assistance, intends to expand on the program outside the scope of this proposed project.

E. Irrigation and Agricultural Practices and Potential

2.27 Irrigation Practices. Irrigation is based on spate flows, perennial streams, and groundwater pumped from tubewells and boreholes. Rainfed farms comprise only a small part of the cropped area. Present use of agricultural land is estimated to be as follows:

Table 2.1: PRESENT LAND USE

Source of Water	Marib		Al Jawf		Total	
	Ha ('000)	%	Ha ('000)	%	Ha ('000)	%
Irrigation						
Spate	20.0	30	4.8	23	24.8	28
Streams	0.5	1	0.7	3	1.2	1
Pump	19.4 a/	29	2.8	13	22.2	26
Subtotal	39.9	60	8.3	39	48.2	55
Rainfed	2.5	4	0.3	1	2.8	3
Abandoned or Fallow	23.6	36	12.7	60	36.3	42
TOTAL	66.0 =====	100 ===	21.3 =====	100 ===	87.3 =====	100 ===

a/ This is expected to increase with the project to about 21,000 ha; the difference is mainly from abandoned or fallow land.

When the Marib dam becomes operative (late 1989), about 4,250 ha are expected to receive surface irrigation through constructed primary and secondary canals, in conjunction with pump irrigation. About 2,000 ha outside the surface command area of the dam would continue to be irrigated by pumped water, benefiting from improved aquifer recharge as a result of the Marib Scheme.

2.28 Irrigation Methodology. For spate irrigation, simple earth structures are constructed across the wadi, and water is conveyed through bunds and earth canals to individual fields. Water is held in the field until the soil is saturated, then passed to lower areas by breaking the bunds at various points. Ground water is pumped from a well or borehole, delivering water into a stilling basin. The water is conveyed by gravity through a network of noncompacted earth canals to banded fields. In both types of irrigation, field water losses are high. Field efficiency is estimated at 35% and 40% for surface and well irrigation, respectively.

2.29 Cropping Pattern. About 50% of the crop area, which depends on spate flow, is under cultivation during the summer season. The main crops are sorghum and millet, with small areas of sesame. In areas served with perennial irrigation from groundwater or streams, winter crops such as wheat, vegetables, and barley are commonly grown; they are followed in summer by vegetables, sorghum and maize (Chart C-1, World Bank No. 42499.1). Alfalfa is also grown all year round for livestock feeding. Areas given to fruit orchards are increasing rapidly, with the most common being citrus. There are

also areas of guavas, pomegranates, grapes, dates and, in the more temperate climate of Jubah Murad (Marib Governorate), deciduous fruits. Crop area estimates are given below:

Table 2.2: CROP AREAS

	<u>Marib</u>	<u>Al Jawf</u>	<u>Total</u>
Sorghum	33	5	38
Maize/millet	2	0.1	2.1
Wheat/barley	12	2	14
Sesame	2	1	3
Alfalfa	2	1	3
Vegetables (summer)	0.2	0.2	0.4
Vegetables (winter)	0.4	0.2	0.6
Fruit Orchards	<u>0.2</u>	<u>0.1</u>	<u>0.3</u>
	51.8	9.6	61.4
	=====	=====	=====

2.30 Cultural Practices. Mechanical equipment is widely used for the construction of diversion structures and bunds and for land leveling. Virtually all land preparation is carried out mechanically. Field crops and fruit trees are normally irrigated in flooded bunds, and vegetables in furrows. Seeding is carried out by hand broadcasting, resulting in uneven plant density. Improved seeds are seldom used, except for some vegetables and wheat. The use of fertilizer is practically nonexistent. Weeding is mostly done by hand with little interrow cultivation, mainly because farmers are unaware of the options and available tractors are inadequate for the job. Some pest control is done chemically. Average yields suffer from low levels of inputs and poor cultural and irrigation practices. Harvesting is largely done by hand, with the exception of cereal threshing. This is done by a tractor drawing a trunk or flat stone over the crop. There appear to be good opportunities for mechanizing harvesting, with the introduction of small, motorized harvesters and the use of stationary threshers. This machinery would be introduced to the region under the proposed project.

2.31 Livestock Production. Based on the 1981 Agricultural Census there are, in the region, about 700,000 sheep and goats, 20,000 cattle and 40,000 camels and donkeys. Livestock is an important contributor to family nutrition and income. Most families keep sheep and goats, and 10-15% of the families also keep cattle for milk production. Livestock is usually confined, and their feed requirements come predominantly from crops and crop residues. Pens and buildings used for confining flocks are unsanitary, and, in the case of stables, the ventilation is poor. In general, disease is not a major constraint, but there are occasional outbreaks of rinderpest and sheep pox, which can be prevented by vaccination. Most lambs are sold at an age of 5 to 7 months, with a liveweight of 20 to 25 kg. Livestock prices are high (YRls 50 to 60 per kg), realizing about YRls 1,200-1,400 per lamb. Prices of

forage crops and crop residues, which constitute about 80% of the feed requirement, are also high (alfalfa at YRls 0.7 per kg green, wheat straw at YRls 2.0 per kg, and sorghum stover at YRls 1.2 per kg). Given the attractive prices in the region and the importance of livestock to family nutrition, there are opportunities for improving livestock production and increasing farm income. These will be addressed under the proposed project.

2.32 Agricultural Development Potential. The potential for agricultural development in the Eastern Region and the improved techniques for early dissemination to farmers are proven by farmer experience and some preliminary research activities. Simple improved techniques are available for yield and production increases. Variety trials and field demonstrations carried out by ARA have indicated good potentials for wheat. The MAF Agricultural Affairs Department in Marib and the Al-Jawf Project have, based on experience from other locations in YAR, introduced simple programs aimed at specific problems. Improved wheat, maize and potato seeds have been distributed, and MAF makes recommendations for these crops as well as for sesame, sorghum fodder and vegetables (tomatoes and melons). Improved fruit tree planting materials are also distributed and recommendations are made for nursery and orchard management.

III. THE PROJECT

A. Project Objectives, Rationale and Scope

3.01 Project Objectives. The main objectives of the proposed project are: (a) to establish the institutional framework for addressing the longer term agricultural development needs of the region through: (i) establishing and strengthening agricultural support services, including agricultural extension under ERADA, and (ii) augmenting agricultural research; and (b) to provide for the early use of the production potential created by the Marib Scheme and ensure its sustainability through the development of: (i) an operation and maintenance service, (ii) a tertiary distribution system for the Marib Scheme, and (iii) on-farm development. The project would help increase agricultural productivity and farmers' incomes by promoting the use of improved agricultural and irrigation practices and upgrading the management of land and water resources. Agricultural production increases would be mainly in cereals, vegetables and fruits.

3.02 Project Rationale. The area of the proposed project, which until recently has only marginally benefited from public investments in agriculture, has high agricultural potential. Soils and water, particularly that of the Marib Dam command area, are of good quality and the climate is favorable for diversified cropping, high crop yields and expanded production. Currently, however, production is well below potential. Yields are low, due primarily to inefficient agricultural and irrigation practices, the lack of fertilizers and the inefficient use of scarce water resources. Recognizing these constraints, and in line with previous agricultural development in the country, the Government has endeavored to provide assistance (IDA supported) to the Wadi Al-Jawf Governorate (para 2.25). With the support of the Abu Dhabi Government, it has recently completed the construction of the Marib Dam. The

Government, in its TFYP, designated the further agricultural development of the Eastern Region a high priority. This would entail the development of the distribution system, the operation and maintenance of the Marib Scheme, and the establishment and strengthening of regional agricultural support services, including extension and research. The development program is consistent with IDA's strategy in YAR, and the proposed project would help to address the Government's priorities. IDA has been successfully involved in the development of YAR's agriculture sector and has assisted the Government in establishing support services in several ecological zones of the country. On the basis of its past experience, IDA can play an important role in assisting the Government in designing and implementing agricultural development projects. Continuous involvement in such projects would help IDA pursue an active dialogue with the Government by effectively addressing such sectoral issues as the establishment of viable institutions, the efficient use of resources, and the development of manpower.

3.03 Project Scope and Components. The proposed project aims at developing the agricultural institutions, primarily ERADA and ARA, in order to address the long-term agricultural development needs of the region and to tap the production potential of the Marib Scheme command area. The project components would comprise the following:

- (i) Regional Institutional Development, which includes:
 - (a) strengthening ERADA and its agricultural support services;
 - (b) augmenting agricultural research; and
 - (c) providing technical assistance, training and studies;
- (ii) The Marib Scheme Development, which includes:
 - (a) strengthening the O&M service;
 - (b) developing a tertiary distribution system; and
- (iii) On-farm Development.

B. Detailed Project Features

Regional Institutional Development (Base Cost: US\$14.0 Million)

3.04 ERADA and Its Support Services (Base Cost: US\$5.6 Million). In June 1987, the Government of YAR created (law number 23-1987) a semiautonomous Eastern Region Agricultural Development Authority (ERADA), on the same lines as the Tihama Development Authority (TDA), for carrying out agricultural and rural development in the Governorates of Marib and Al-Jawf. The proposed project would provide assistance for the establishment of ERADA and its agricultural and engineering support services. These services include agricultural extension, animal health, the establishment of a mother tree orchard, engineering, and the Marib Scheme O&M service (para. 3.22). The engineering service would be responsible for preparation of designs and for the maintenance of agricultural facilities and infrastructure. For the establishment of these services, vehicles and equipment are estimated to cost about US\$0.9 million; the recurrent costs (over the six-year implementation period) are estimated at US\$2.5 million. Civil works are estimated to cost

about US\$2.3 million. They would mainly consist of the construction of offices (1,000 m²) and houses (1,800 m²), nine extension and veterinary centers (1,260 m²), one block center (450 m²) and the establishment of an 8 ha mother tree orchard. This is in addition to the houses owned by the Abu Dhabi Fund and currently used by the consultant (about 1,600 m²). The ADF has already agreed to hand over these buildings to Government (ERADA) by August 1989.

3.05 Regional Agricultural Services. ERADA (para. 4.02) would be responsible for the agricultural programs for the region, including those being developed under the ongoing Wadi Al-Jawf Project (Cr. 1584 YAR). It would also develop the agricultural programs for the Marib Governorate, including agricultural extension, animal health services and the establishment of a mother tree orchard. Development in the Marib Governorate would focus, in this phase, on the Marib Scheme command area with some pilot activities in other high potential areas of the Governorate. The agricultural extension service would be structured with a single line of command and clear definition of responsibility and accountability. The organization would ensure strict planning, proper monitoring and evaluation, staff training, and technical support, as well as strong and effective coordination with agricultural research, credit institutions, and the marketing department of MAF.

3.06 Regional Agricultural Extension Service. The regional service would bring extension within the reach of about 2,600 farm holdings in the Marib Governorate, in addition to the 1,700 farm holdings expected to be reached under the ongoing Wadi Al-Jawf Project. It would also lay the foundation for expanding this coverage to reach about another 14,200 farm holdings in the region. The service in the Marib Governorate would consist of 9 extension agents (5 within the Marib Scheme command area), or about 1 to every 300-350 farm holdings. There would be one extension supervisor supported by nine higher-level headquarter staff (6 SMS, 1 extension planning/training officer, a communication officer, and a women-in-development female officer), and two SMS for the Harib area (outside the Marib Scheme command area). The higher-level headquarter extension staff would also provide technical and planning/training support to extension staff under the Wadi Al-Jawf Project. Of these, four village-level extension agents and five higher-level extension staff are already employed. However, current staff do require training in subject matter as well as in extension methodology (para. 3.20). An additional five extension agents, one extension supervisor, and six higher level staff would be recruited during the six-year project implementation period. Local staff are expected to be available for such recruitment.

3.07 Each agent, operating from one extension center (the locations of which are given in Annex I, Table 9), would be assigned responsibility for a specific territory and be held accountable for providing assistance in all aspects of farming (including livestock production). To allow for complete mobility, each agent would be provided with one motorcycle. The agents would be regularly supervised by the extension supervisor and would receive technical support and regular in-service training from the SMS in their special areas of expertise.

3.08 The service would support two complementary, and mutually reinforcing, approaches to extension and information transfer. These would be based on personal contact between extension agents and farmers and mass communication. Personal contact would be achieved through regular farm visits to lead and contact farmers; through farmers' meetings; and through field demonstrations and field days attended by farmers, ARA and CACB representatives, and private traders. Mass communication would be achieved through the use of audiovisual aids: slides, movies, videos and publications.

3.09 Collaboration between extension and research staff would also be enhanced through verification trials and field demonstrations. Extension agents would become better acquainted with research findings, and the research staff would learn more about the specific difficulties encountered by farmers. ERADA and ARA would institute joint extension and research groups, with farmer participation, in order to review progress and analyze the impact of extension, the adequacy of technological packages, and the problems to be addressed by research. The extension service would also maintain close linkages with CACB to ensure that agricultural credit is provided for sound investments and in accordance with the recommended technology.

3.10 Women in Development. The project area has a strong tribal character allowing very little exposure for women. Women, however, play an important role in agricultural development in the area through direct participation in agriculture and livestock production. The proposed project would adopt a modest approach to women in development by gathering data on women's activities and their role in agriculture. It would also identify areas of interest to women and define approaches to resolving their most pressing concerns. Simultaneously, the project would initiate activities in animal production and in home economics, including nutrition, food processing, and health and child care. The program would be run by one women-in-development expert assisted by two local counterparts.

3.11 Regional Veterinary Service. The proposed project aims at strengthening and expanding the animal health services for the Marib Governorate. The main focus would be on the prevention of animal diseases in the area and on the improvement of clinical and surgical treatment. The project would provide veterinary equipment, vehicles and training for veterinary technicians. Additional local staff to be provided under the project include one veterinary officer and three veterinary assistants (para. 2.19). The veterinary staff in the region would be under the administrative control of ERADA but would work within the framework of, and in accordance with, national programs determined by the National Veterinary Service of MAF.

3.12 Mother Tree Orchard Establishment. Farmers adopting techniques introduced through the extension service would require upgraded planting/grafting materials for orchard improvement. It is estimated that by the sixth year of the project implementation period, 50,000 plants would be needed for orchard establishment and about 40,000 plants/grafts would be needed for the improvement of existing orchards. Farmers already producing nursery materials could satisfy this demand, provided adequate assistance to increase production and ensure quality of output is provided. In order to

provide such assistance, ERADA would establish an 8 ha mother tree orchard at an estimated base cost of US\$0.26 million. Following existing policies, the Government would sell to farmers grafting and/or planting materials at cost.

3.13 Engineering Service. An engineering service would be established for the Eastern Region to: (i) maintain existing project facilities and infrastructure [excluding the Marib Scheme (para. 3.22)]; (ii) provide detailed designs, procurement documents, and work supervision for infrastructure; (iii) technical support to LCCDs in the operation and maintenance of rural roads and village water supply schemes; and (iv) provide assistance to the extension service in the design and implementation of farm irrigation works. The project would provide staff, staff training, civil works and vehicles.

Regional Agricultural Research (Base Cost: US\$4.7 Million).

3.14 Agricultural research in YAR is the responsibility of ARA. Due to limited resources, ARA has been focusing on the Tihama and the Southern and Central areas of the country, with very little attention given, so far, to the Eastern Region. Although the agricultural potential of this region has been demonstrated and simple improved techniques are available for early transfer to farmers, research to improve and sustain the data base is required to address the region's long-term development needs. Modest provisions made under the Al-Jawf Project currently under implementation address part of those needs. The proposed project would complement these efforts by providing research staff and staff training; farm and laboratory equipment and vehicles; and civil works for offices, laboratories, ancillary facilities and houses. A regional research station would be established in Marib and the research substation in the Al-Jawf Governorate would be upgraded. During negotiations, Government confirmed that an adequate area within the existing Government farm in Marib would be set aside for the regional research station.

3.15 The Research Program. Research in the Eastern Region would be organized in units reporting directly to corresponding units at ARA headquarters and would focus on regional requirements and priorities. Most ARA commodity, as well as support, programs would be represented in the region. Because of the wide range of crops that can be grown in the region and the shortage of research data to date, agricultural research would be diversified, adaptive and problem-oriented in nature. The program would focus on cereals (maize and wheat); vegetables (tomatoes and melons); fruit trees (citrus); alfalfa and other forage alternatives; and livestock. Research would be conducted both in the station and on farmers' fields, particularly when the research station is not representative of farmers' problems. Research priority would be given to testing high-yield, disease-resistant and early-maturing varieties, as well as to appropriate, economically sound agronomic practices. Intercropping cereals and forage legumes would be investigated as an alternative to alfalfa. In an effort to improve the efficiency of irrigation, on-farm water management techniques, application rates and water exploitation would be researched; groundwater would be monitored, and drainage and salinity would be examined. Appropriate machinery for harvesting, threshing and spraying would also be tested. Livestock research would emphasize management of local breeds, including the maintenance of breeding flocks and the fattening of young animals using crops and their by-products.

3.16 As an adjunct to commodity research, the plant protection unit of ARA headquarters and its representative in the Eastern Region would conduct integrated pest management research aimed at identifying economically and environmentally sound pest control methods (para. 3.41). The unit would also conduct safety training programs for extension agents. The effect of chemical pest control and long-term fertilizer use, particularly the nitrates (paras. 2.09 and 3.41), on the quality of groundwater for domestic use would be studied and periodically monitored as well.

3.17 The improved packages being generated by the various research programs would be economically evaluated by an agricultural economist within ARA's staff to determine their optimal use and application to the farming system in the Eastern Region. The agricultural economist would also carry out research on the economics of farming systems. On-farm verification trials would be carried out and tested (jointly with the extension service) prior to dissemination to farmers. The research program would be responsive to market requirements by emphasizing market quality, harvest and postharvest technology, as well as strategies to avoid market bottlenecks. The liaison officer would be responsible for establishing and sustaining strong linkages with extension. He/she would also identify research training needs, coordinate extension training provided by research staff, and, with assistance from the Communication and Training Unit at ARA headquarters, prepare technical bulletins, pamphlets and audiovisual aids for improved packages.

Technical Assistance, and Training (Base Cost: US\$ 3.7 Million)

3.18 To assist in the establishment of agricultural, engineering, and O&M services under ERADA, and in the strengthening of the research capability of ARA in the region, the proposed project would provide about 51 staff years (s/y) of expert services: 38.5 s/y in agricultural research, extension and veterinary medicine; and 12.5 s/y in engineering (irrigation, hydrogeology, design and operation, and maintenance). The project would also provide 17 staff months (s/m) of short-term consultancies: 3 s/m for annual dam inspection at 0.5 s/m annually for six years; 6 s/m for preparation of designs for 300 ha of tertiary canals for the Marib Scheme; 6 s/m for a flood protection study; and 2 s/m for an archeological study. The agricultural advisors, particularly the cereal specialist, irrigation agronomist, horticulturist, livestock specialist and plant protection expert, would support both the extension and the research programs. Technical assistance has been designed so that the experts assist the Government in project implementation and in training of local staff. It is expected that expert services be gradually phased out over 4-5 years to be replaced by local counterparts. A flood protection study would be conducted in the Marib Scheme command area aimed at surveying the extent of likely water flow from adjacent wadis and their effects on the existing distribution system. The study would make recommendations for any further flood protection measures to be implemented by ERADA. A study would be conducted by Government under the project by June 30, 1989 at a cost of 2 s/m to survey archeological sites and outline and carry out a plan for preserving archeological and historical sites [para. 6.01(n)]. Terms of reference for the experts/consultants would emphasize training of Yemeni staff, which would pave the way for a smooth and effective takeover of the major project tasks. Three key experts (research,

extension and O&M engineer) and two associate experts (livestock and horticulture) are being recruited under PPF No. P-508-YAR. Three other key experts (irrigation agronomist, cereal specialist, and hydrologist/hydrogeologist) would be recruited by October 1, 1989. Assurances were obtained during negotiations that the Government would appoint qualified and experienced experts and consultants in accordance with an agreed schedule of implementation for ERADP for 1989 [para. 6.01 (b)].

3.19 **Training.** In addition to on-the-job project-related training provided by appointed experts, the project would provide for short-term foreign training as well as local training (para. 3.20). The former, which comprises 72 s/m (36 s/m for the engineering staff, mainly the O&M service of the Marib Scheme; and 36 s/m for agricultural extension and research), would involve participation in training courses given by international research centers such as ICARDA, ICRISAT and CIMMYT. Senior local staff would also visit countries where successful programs in relevant fields were under implementation. Advanced-degree training needs would be assessed by the upcoming proposed National Agricultural Development Project (NADP) planned for FY90.

3.20 Local training under the proposed project would focus mainly on project-related technology and extension methodology. It would aim at strengthening the technical capabilities of the agricultural and engineering staff, and the communication abilities of the extension staff with farmers. More specifically, the training unit of ERADA's extension service would provide training to extension agents in the following courses: (a) general agriculture, including livestock production, extension methodology and project orientation (about 16 weeks); and (b) project-related technology in livestock, crop production, plant protection, irrigation technologies and mechanization (about one week per subject matter, for a total of about six weeks). Refresher courses in improved technology would be offered (2-3 day workshops), mainly by ARA staff to SMS and extension supervisors.

3.21 The training unit, in providing these courses, would seek assistance from ARA and ERADA senior agricultural staff and experts/consultants provided by the project. The staff of the Marib Scheme O&M service would also receive regular in-service training in dam operation and maintenance, and in the operation of heavy machinery related to the service. Senior engineering staff in ERADA, along with senior engineering staff in other regional organizations, would provide the training.

Marib Scheme Development (Base Cost: US\$4.5 Million)

3.22 **Marib Scheme O&M Service (Base Cost: US\$ 3.2 Million.** The proposed project would provide for the strengthening of the existing Marib Scheme O&M service. In particular, it would provide for staffing and staff training, houses, vehicles, and equipment.

3.23 The functions of the O&M service would include the following: (a) the overall management of the scheme, including the operation and maintenance of (i) the dam and its appurtenant structures, (ii) the wadi bed, (iii) the diversion structures, and (iv) the irrigation conveyance and distribution system; (b) the formulation of an annual operation plan, in

coordination with the agricultural department of ERADA and the farmers, which would take into consideration the availability of water in the dam, the estimated inflow, appropriate cropping patterns, crop water requirements and water demand; (c) the preparation of the designs for the tertiary distribution system and supervision of its construction; (d) the monitoring of the catchment area hydrology; and (e) the monitoring of the recharge and abstraction of underground water within the Marib Scheme command area. The annual operation plans would then be translated into daily work plans subject to modification.

3.24 Tertiary Distribution System (Base Cost: US\$ 1.3 Million). The proposed project would provide for the construction of the tertiary distribution system (canals) for about 4,250 ha in about 200 tertiary blocks of 15-25 ha each. Detailed designs, specifications and cost estimates of each tertiary block would be provided by the Engineering/Marib Scheme O&M Service of ERADA. The design of the tertiary canals would allow for a minimum conveyance efficiency of 85% and a flow rate of 2.0 l/s/ha gross, permitting adequate delivery of water requirements at peak demand during the daytime. The detailed design would be initiated (for about 15 blocks) under the PPF Advance (P-508-YAR), with the rest to be done during project implementation. Regarding construction of the canals as per the proposed design, ERADA would either contract the work, following local competitive bidding procedures, and charge the farmers for the cost (paras. 4.09 and 5.09), or provide construction supervision to farmers who choose to construct the canals themselves. It is expected that about 75% of the farmers will elect to entrust ERADA with the construction work. Prior to release of water to the tertiary blocks, final inspection of the works would be provided by ERADA.

On-Farm Development (Base Cost: US\$ 2.6 Million)

3.25 Following the full operation of the Marib Scheme and the successful demonstration of improved agricultural and irrigation practices, farmers are expected to, within the six-year project implementation period, make irrigation investments on about 2,700 ha, establish about 200 ha of new orchards, and purchase some 400 mechanization units (mostly sprayers and harvesting and threshing equipment). The cost of these investments, excluding family labor, is estimated at US\$2.6 million. It is assumed that about 50% of these farmers would require credit at about 80% of investment costs, generating incremental demand for agricultural credit equivalent to US\$1.1 million. During negotiations, assurances were given by the Government that funds would be made available to CACB, under terms and conditions that are consistent with CACB's national policies for lending to agriculture.

C. Cost Estimate

3.26 Project cost, including physical and price contingencies, is estimated to be YRls 341.6 million (US\$27.9 million equivalent), with a foreign exchange component of US\$16.5 million, accounting for 59% of total cost. The base costs are calculated using unit costs as of November 1988. The average cost per staff month of technical assistance is US\$5,600. The cost of vehicles, equipment and machinery includes spare parts. The project will be implemented over six years with the disbursement period extending to seven years. Physical contingencies have been calculated at 15% for civil

works, 10% for vehicles, equipment and technical assistance; and 5% for local staffing. Annual allowances for expected price increases on the foreign exchange component were calculated at 5.3% for 1989 and 1990 and 4.1% for 1991 and thereafter; and for local inflation rates at 15% for 1988 and 1989, 10% for 1990, and 8% for 1991 and subsequent years. Calculations have been based on the assumption that purchasing power parity would be maintained over the project implementation period. These estimates do not include taxes and duties, from which the project is exempt. The total incremental recurrent cost during the project implementation period in 1988 prices is estimated at US\$4.9 million equivalent. The total annual recurrent cost (in 1988 prices) in year six and onwards required to sustain the services established and/or strengthened under the project is US\$2 million equivalent. Assurances during negotiations were obtained from the Government that sufficient funds would be available to ERADA and ARA in a timely manner to meet the full recurrent costs of the Project [para. 6.01(d)]. Details of cost estimates summarized below (Table 3.1) are presented in Annex I, Tables 11(a), 11(b) and 11(c).

Table 3.1: PROJECT COST ESTIMATE

	YR: '000					(US\$ '000)				
	Local	Foreign	Total	% Total		Local	Foreign	Total	% Total	
				% Foreign Exchange	Base Costs				% Foreign Exchange	Base Costs
A. REGIONAL INSTITUTIONAL DEVELOPMENT										
SUPPORT TO ERADA	30,362.9	24,702.1	55,065.0	45	27	3,114.1	2,533.5	5,647.7	45	27
SUPPORT TO ARA	24,992.4	20,462.7	45,455.0	45	22	2,563.3	2,098.7	4,662.1	45	22
TECHNICAL ASSISTANCE, TRAINING & STUDIES	1,786.5	33,943.5	35,730.0	95	17	183.2	3,481.4	3,664.6	95	17
Sub-Total REGIONAL INSTITUTIONAL DEVELOPMENT	57,141.8	79,108.3	136,250.0	58	66	5,860.7	8,113.7	13,974.4	58	66
B. MARIB SCHEME DEVELOPMENT										
ON-FARM SERVICE	11,207.4	20,203.7	31,411.0	64	15	1,149.5	2,072.2	3,221.6	64	15
TERTIARY DISTRIBUTION SYSTEM	5,100.0	7,650.0	12,750.0	60	6	523.1	784.6	1,307.7	60	6
Sub-Total MARIB SCHEME DEVELOPMENT	16,307.4	27,853.7	44,161.0	63	21	1,672.5	2,856.8	4,529.3	63	21
C. ON-FARM DEVELOPMENT										
Total BASELINE COSTS	83,523.4	122,276.6	205,800.1	59	100	8,566.5	12,541.2	21,107.7	59	100
Physical Contingencies	7,480.6	13,887.0	21,367.6	65	10	767.2	1,424.3	2,191.5	65	10
Price Contingencies	31,276.4	63,154.1	94,430.5	55	56	2,064.6	2,517.0	4,581.7	55	22
Total PROJECT COSTS	142,280.4	199,317.7	341,598.1	58	166	11,398.4	16,482.5	27,880.9	59	132

D. Financing

3.27 The IDA credit of US\$15.0 million equivalent (SDR 11.0 million) would finance 91% of the foreign exchange component or about 54% of the total project costs. The Government would finance US\$8.8 million equivalent, and the balance, US\$4.1 million equivalent, would be financed by the beneficiaries. The detailed project financing plan is given in Table 3.2 below.

Table 3.2: PROJECT FINANCING PLAN

	IDA	YAR Government	Beneficiaries (US\$ Million)	Total		Total
				Foreign	Local	
Investment Costs						
Civil Works	5.4	1.6	-	4.2	2.8	7.0
Vehicles and Equipment	4.1	0.4	-	4.1	0.4	4.5
Experts	4.0	0.2	-	4.0	0.2	4.2
Foreign Training	0.3	-	-	0.3	-	0.3
Tertiary Canals	1.2	0.3	0.4	1.1	0.8	1.9
On-Farm Development	-	-	3.7	2.2	1.5	3.7
Subtotal	15.0	2.5	4.1	15.9	5.7	21.6
Recurrent Costs	-	6.3	-	0.6	5.7	6.3
Total	15.0	8.8	4.1	16.5	11.4	27.9
	====	====	====	====	====	====

E. Procurement

3.28 Procurement of goods, works, and services financed by IDA will be carried out in accordance with World Bank Guidelines for Procurement of May 1985 and Bank's Guidelines for the Use of Consultants of August 1981.

3.29 **Works.** The construction of office buildings and houses for ARA and ERADA regional headquarters (including the O&M service of the Marib Scheme) and ARA houses for the Al-Jawf Governorate are estimated to cost US\$5.0 million (IDA financing: US\$3.9 million) and would be procured through International Competitive Bidding (ICB). Yemeni bidders would be given a civil works domestic price preference of 7.5% over foreign bidders. The following items, up to an aggregate of US\$3.5 million (IDA financing: US\$2.7 million) (para. 3.31) would be procured through Local Competitive Bidding (LCB): (i) the construction of tertiary canals, (ii) research ancillary facilities and ARA offices in the Al-Jawf Governorate; (iii) extension facilities in the Marib Governorate; and (iv) the establishment of mother tree orchards which, for procurement purposes, cannot be grouped, and would each cost less than US\$400,000.

3.30 **Goods.** Equipment, furniture, machinery and vehicles estimated to cost US\$3.9 million (IDA financing: US\$3.6 million), including contingencies, would be procured through ICB. Domestic preference of 15% or applicable customs duties, whichever is less, would be given to local manufacturers competing for the supply of goods under ICB. Miscellaneous goods (vehicles financed under PPF No. P-508-YAR, tools, small equipment, laboratory and engineering instruments, etc.), which cannot be grouped and would each cost less than US\$50,000, could be procured by local shopping up to an aggregate cost of US\$0.6 million over the entire project implementation period (para. 3.31).

3.31 Local Competitive Bidding (LCB) procedures in YAR are generally consistent with the need for economy and efficiency in the execution of the project. There are, however, a few procedures which are inconsistent with Bank procurement guidelines and others which require clarification. During negotiations, agreement was reached regarding the changes needed to make the procedures acceptable to the Bank.

3.32 Services. Recruitment of experts/consultants at an estimated cost of US\$4.2 million (IDA financing: US\$4.0 million) would be made in accordance with the Bank's Guidelines for the Use of Consultants. Recruitment would be either on an individual basis or on a group basis through consulting firms. The expert services are expected to be 51 s/y and the consultants' services are expected to be 17 s/m.

3.33 Contract Review. During negotiations, the borrower will agree with IDA on draft bidding documents for procurement of goods and works financed by IDA (drafted following the Bank's Sample Bidding Documents). For civil works estimated to cost the equivalent of US\$400,000 or more, and for goods estimated to cost the equivalent of US\$250,000 or more, IDA would review and approve the text of invitation to bid, tender documents, award proposals, and contracts before they are issued/awarded. IDA would thus carry out prior review of procurement documents and awards for at least US\$11.6 million out of a total cost of US\$13.0 million (IDA financing: US\$10.7 million).

3.34 The procurement methods to be followed for project elements to be financed by IDA are given in Table 3.3 below.

Table 3.3: PROCUREMENT PLAN ^{a/}

	Procurement Procedures					Not Applicable	Total
	ICB	LCB	Shopping	Others	By Beneficiaries		
	(US\$ Millions)						
Civil Works	5.0 (3.9)	2.0 (1.5)	-	-	-	-	7.0 (5.4)
Vehicles and Equipment	3.9 (3.6)	-	0.6 (0.5)	-	-	-	4.5 (4.1)
Expert Services	-	-	-	4.2 (4.0)	-	-	4.2 (4.0)
Foreign Training	-	-	-	0.3 (0.3)	-	-	0.3 (0.3)
Tertiary Canals	-	1.5 (1.2)	-	-	0.4 (-)	-	1.9 (1.2)
On-Farm Development	-	-	-	-	3.7 (-)	-	3.7 (-)
Recurrent Cost	-	-	-	-	-	6.3 (-)	6.3 (-)
TOTAL	8.9 (7.5)	3.5 (2.7)	0.6 (0.5)	4.5 (4.3)	4.1 (-)	6.3 (-)	27.9(15.0)

a/ Costs include contingencies. Values between parentheses refer to IDA financing.

F. Disbursements

3.35 The proposed IDA credit of SDRs 11.0 million (US\$15.0 million) would be disbursed in seven years in accordance with IDA guidelines for withdrawal of proceeds of loans/credits as given in Table 3.4 below. The credit closing date would be December 31, 1996.

Table 3.4: DISBURSEMENT

Category	<u>Expenditure to be Financed</u> ----- (US\$ Million) -----	%
Civil Works	4.7	77% of Total Expenditures
Tertiary Canals	0.8	77% of Total Expenditures
Goods (Vehicles, machinery, equipment and furnitures)	3.7	100% of Foreign Expenditures and 80% of items procured locally
Technical Assistance, Foreign Training and Studies	3.8	100% of Foreign Expenditures and 90% of Local Expenditures
PPF Advance	0.4	Amounts disbursed under PPF advance and accrued charges
Unallocated	<u>1.6</u>	
TOTAL	<u>15.0</u>	

3.36 Special Account. Provisions would be made that ERADA open and maintain a US\$1.0 million Special Account for funding the items to be financed by IDA (para. 3.27). The IDA financing would be channelled through a commercial bank chosen by the Central Bank of Yemen. The Special Account would be operated on terms and conditions satisfactory to IDA. IDA may, however, directly accept, in appropriate cases, withdrawal applications in excess of US\$150,000 for direct payment and agreement to reimburse.

3.37 Full documentation is necessary for all foreign currency or local currency contracts above US\$50,000 equivalent. For all contracts under US\$50,000 equivalent in foreign exchange or in local currency, however, withdrawals from the Credit Account would be carried out on the basis of Statement of Expenditure (SOE). Related contracts and supporting documents,

such as invoices, bills of lading, receipts, etc., would be retained by ERADA and made available for review by IDA staff on supervision missions. The internal control and operational arrangements required for SOE operation are satisfactory.

3.38 The estimated schedule of disbursements given below in Table 3.5 and detailed in Annex I, Table 12 is generally consistent with the country profile.

Table 3.5: DISBURSEMENT SCHEDULE

Disbursements	IDA Fiscal Year							
	1990	1991	1992	1993	1994	1995	1996	1997
	----- (US\$ Million) -----							
Annual	1.0 <u>a/</u>	1.5	3.0	2.5	2.8	2.3	1.5	0.4
Cumulative	1.0	2.5	5.5	8.0	10.8	13.1	14.6	15.0
Profile(%)	6.7	16.7	36.7	53.3	72.0	87.3	96.0	100.0
YAR Portfolio(%)	2.0	11.0	31.0	50.0	69.0	85.0	93.0	100.0

a/ This includes disbursements under the PPF.

G. Accounts and Audits

3.39 ERADA would maintain separate records and accounts reflecting the project receipts and expenditures clearly identifying the goods and services procured and works performed. Also, ARA and the O&M service for the Marib Scheme would maintain separate accounts and records of project expenditures related to their activities under the project.

3.40 The project accounts of ERADA, including the O&M service for the Marib Scheme, and of ARA would be audited annually in accordance with appropriate auditing principles consistently applied by independent auditors acceptable to IDA. The auditor's report would include, inter alia, a statement that the funds advanced by IDA for the Special Account and SOE were used for the purpose for which they were provided. MAF's auditing practices on the previous and ongoing IDA-assisted projects have been satisfactory. Assurances were given by the Government during negotiation that auditing firms with qualifications and experience acceptable to IDA would be employed for this project and that a certified copy of audited accounts, together with the auditor's report, would be submitted to IDA within nine months of the close of each fiscal year [para. 6.01(e)].

H. Environmental Impact

3.41 The proposed project is not expected to generate any environmental hazards, although the use of agricultural chemicals, mainly fertilizers and pesticides, is expected to increase as a result of project activities. The selection of pesticides in the research program and extension packages and the optimum use of farm chemicals would constitute an important part of the training of extension and research staff. The strong research/extension linkage foreseen under this project (para. 3.09) would be catalytic in developing an appropriate pesticide and fertilizer management technology. Dealers/agents, because of their important role in educating farmers, would be advised of the proper storage of chemicals and disposal of chemical containers. Pesticides would be prudently and economically researched and used (para. 3.16), and pest control would be complemented with nonchemical measures, including the use of resistant crop varieties and improved cultural practices. In addition, the long-term effect of pesticides and fertilizers, particularly the nitrates, on the quality of groundwater use for domestic purposes would be assessed and measured to reduce or eliminate the likelihood of water pollution (para. 2.09). Research, in coordination with the extension service, would assess and monitor these activities. Assurances were obtained from the Government during negotiations that (a) selection, handling and use of pesticides in research trials and extension packages would be in accordance with IDA guidelines [para. 6.01(f)] and (b) a monitoring system would be established by ARA to monitor potential water pollution with fertilizer and pesticide residues [para. 6.01(g)].

I. Riparian Issues

3.42 All flows, including that of the Marib Dam in the Eastern Region, have catchment areas within the political boundary of YAR. Therefore, there is no international rights problem in the use and regulation of these flows for agricultural development in the region.

J. Status of Project Preparation

3.43 Secondary canals for the Marib Scheme are under construction and are expected to be completed by end-1989. Adequate budgetary allocations have been made to meet the 1989 investment and operating costs of ERADA and ARA. An agreed upon 1989 work program has been developed (Annex I, Table 13). For construction of buildings, MAF has standard designs which evolved in IDA-supported projects in the Tihama, Southern and Central Regions, and more recently in the Northern Region. These would be adapted for the conditions of the Eastern Region. Assistance in preparing designs and tender documents is being obtained from expert services employed under the Wadi Al-Jawf Project. Recruitment is underway for preparation of designs for a tertiary distribution system for the first 300 ha in the Marib Scheme area. This is being financed under PPF Advance (P-508-YAR) and designs would be completed by the end of June, 1989. Designs for the rest of the tertiary network would be completed in the first two years of project implementation. Candidates for three expert positions (one each for research, extension and O&M services) have been identified and recruitment is underway. Local staff (two research officers, four research assistants and six technicians) are being recruited to strengthen the research activities in the region. Land has already been

acquired for ERADA and ARA headquarters and the regional research station in Marib (para 3.14). Preliminary designs and draft tender documents for key buildings, equipment, and vehicles for ERADA and ARA have been submitted to IDA.

IV. ORGANIZATION AND MANAGEMENT

A. Institutional Arrangements

4.01 Implementing Agencies. The Eastern Region Agricultural Development Authority (ERADA), established by the Government of YAR (para. 4.02), would be responsible for all aspects of project implementation including, but not limited to, field investigations, planning, design, procurement, construction, and agricultural and O&M services. ARA would be responsible for carrying out the research program and would coordinate with ERADA in procuring project facilities for such a program. CACB would handle the credit requirements for the region. The organization structure of these institutions is presented in Chart C-3 (World Bank No. 42499.3).

4.02 ERADA. In June 1987, the Government of YAR established ERADA as a semiautonomous body responsible for all agricultural development activities in the region, a role previously assumed by the departments of agriculture at the Al-Jawf and Marib Governorates (para. 2.15). Staff of these departments would function under the technical and administrative control of ERADA and the respective Governors. ERADA, which is headquartered in Marib, would have three regional departments: one department for Agriculture, Engineering, and Administration and Finance; one department for the Al-Jawf Governorate; and another for the Marib Scheme O&M service. In addition to their regional responsibilities, the departments would also be responsible for developmental activities for the Marib Governorate. Each department would be headed by a director under an overall Director General who reports directly to the Chairman. The Governors would provide administrative coordination for ERADA's provincial departments. The key positions in ERADA would be filled by drawing on new graduates and on experienced staff from TDA and SURDU (Annex I, Table 14).

4.03 ARA would operate in the region with its headquarters in Marib and a branch in Al-Jawf. The research programs relevant to the region would be carried out by units that report to corresponding sections at the ARA headquarters in Dhamar. Administration would be handled by a Director at the regional level and a Station Manager at Al-Jawf. Twelve key positions (about 5 M.Sc. and 7 B.Sc.) (Annex I, Table 14) would be filled from available graduates mixed with experienced ARA staff currently operating in other regions in the country.

4.04 CACB would be the principle agency providing credit to beneficiaries of the region. In evaluating loan applications, particularly those that involve major on-farm investments, CACB would coordinate its credit policies and operations with technical advice provided by ERADA.

B. Project Implementation

4.05 Project implementation is planned for six years with the seventh year provided to complete all disbursements (Chart C-2, World Bank No. 42499.2). The first three years would mainly emphasize staffing, staff training, institution building, and the finalization of designs of tertiary canal. Procurement of civil works and equipment would be staggered throughout the implementation period. A PPF Advance (P-508-YAR) of US\$400,000 (mainly for experts and consultant services) has been approved to facilitate project mobilization, particularly in the areas of research, extension and O&M services.

4.06 **Agricultural Support Services.** The proposed project would establish an Agricultural Department at the regional level, which in addition to its regional agricultural responsibilities, would provide services in extension, animal health, and a mother tree orchard for the Marib Governorate. The staffing composition of the service is provided in Annex I, Table 14. Upon project completion, the services would continue operating on a regional basis until such time as a national service was established to take over administration of the governorate level services.

4.07 **Engineering Services.** Services, viz. building design, water resource studies, and irrigation technology, would be administered by the Engineering Department for the Region as a whole and for the Marib Governorate. Also, the engineering service would provide support to local organizations (LCCDs) in O&M of rural roads and water supply schemes.

4.08 **Marib Scheme O&M Service and Development of Tertiary Distribution System.** The proposed project would strengthen ERADA's O&M Service Department for the Marib Scheme that would include three units: Headwork, Irrigation, and Workshop. The Headwork Unit would be responsible for the O&M of the dam and its appurtenant structures (spillway, outlet system valve and instrumentation), the wadi bed, the diversion structures (A and B), the aquifer recharge, and the meteorological and gauging stations in the catchment area of the dam. The Irrigation Unit would be responsible for the O&M of the primary and secondary canals, including the outlets that deliver water to the tertiary blocks. The Workshop Unit would be responsible for the O&M of vehicles, and the equipment and machinery of ERADA. The administration and finance requirement of the service, including its accounts, and water charges and cost recovery for the construction of the tertiary distribution system would be met by ERADA's Department of Administration and Finance.

4.09 **Tertiary Development Policy.** Before the Marib Scheme could be made operative, and prior to releasing water to the tertiary blocks, certain policies would have to be agreed upon: (a) ERADA would deal with the beneficiaries of each tertiary block as one collective unit; (b) each unit would be responsible for ensuring (i) the construction, operation and maintenance of the tertiary canals; (ii) water distribution and water charges according to the cropping and irrigation plan (para. 3.24); and (iii) the election of an official to represent the unit in dealing with ERADA; (c) the cost of construction of tertiary canals when done by ERADA would be recovered in full (para. 5.09); (d) tertiary canals constructed by the collective unit would be designed, supervised, inspected and approved by ERADA; and

(e) written contracts regarding points (b), (c) and (d) would be agreed upon and signed by beneficiaries of the same collective unit, as well as by the unit's representative and ERADA. This arrangement, which represents a departure from the existing system of spate-water distribution common to the tribal population of the area, may cause some problems related to water rights, water charges, etc. To minimize these potential problems, and ensure smooth operation of the scheme, the Government has appointed an advisory council to ERADA whose members represent ERADA, ARA, CACB, the Marib Governorate, the Ministry of Interior, and beneficiaries. The advisory council would assist ERADA in anticipating and resolving problems related to water distribution rights, cost recovery of tertiary canals built by ERADA, collection of water charges, and other problems that might arise.

4.10 Training and Fellowship. The thrust of training (para. 3.19) would be on project-related technology through in-service training, special courses and foreign training. The training program would be prepared by ERADA (in coordination with ARA for the agricultural part) in consultation with IDA and implemented through the respective departments. For foreign training, arrangements would be made with suitable institutions and universities. Local training would be handled directly by ERADA (with assistance from the extension planning/training and the O&M experts that are being recruited under the PPF), which would prepare detailed training curricula and be responsible for implementation. Counterpart training would be included in the terms of reference of the expatriate experts/consultants who would be required to periodically report on progress.

C. Monitoring and Evaluation

4.11 Monitoring and evaluation (M&E) would be performed by the M&E Unit to be established under ERADA and assisted by staff from the various support services.

4.12 The scope of the M&E Unit would include: (a) project inputs, including water cost recovery (para. 5.09), measured against the annual work program in physical and financial terms; (b) the impact of the extension service on farmers; and (c) the status and quality of surface and groundwater resources. For monitoring project inputs, each governorate would submit periodic reports to the appropriate departments at ERADA and ARA headquarters. Such reports would indicate both financial and physical progress compared with annual target plans. For project output monitoring, each governorate would report annually on a set of indicators, measuring progress towards specific objectives. Adoption rate studies and yield surveys developed by the extension service, in close coordination with research, would be undertaken annually at the governorate level to assess the impact of the technological packages disseminated under the project, and thus the impact of the project on the farming community. The use of fertilizers and pesticides in the project area would also be monitored. The field supervisors at the governorate level, with the assistance of the SMS, would collect and summarize the information and prepare semiannual progress reports which would highlight achievements, problems, and recommendations for consideration by the extension service. Farmers' problems, including marketing, would be periodically assessed and recommendations would be made for adjustments in the research program. The quality of water, both underground and surface, would be periodically monitored for any contamination by pesticides and fertilizers.

Surface water would also be tested for bilharzia. Rainfall would be recorded, groundwater level studied, and surface water evaluated on a regional basis, particularly for the areas benefiting from the Marib Scheme.

4.13 To strengthen the data base on the agricultural and socioeconomic condition of farmers in the project area, particularly the Marib Scheme, a baseline survey would be carried out in the first year of project implementation. The M&E system would compile baseline data which would include the stratification of farm holdings by farming system and a detailed summary of resources, potential and constraints. This data would be utilized by the research and extension services to outline and develop the research program and to devise extension packages suitable for farmers. The system, benefitting from experience gained under ongoing agricultural development projects in YAR, would be developed with assistance from the M&E Advisor of the Wadi Al-Jawf project. A mid-term review of the impact of the project would be carried out jointly by IDA and the Government of YAR at the end of the third year of project implementation (end-June 1992). Government assurances in this regard were obtained during negotiations [para. 6.01(h)].

D. Work Plans and Progress Reporting

4.14 ERADA and ARA would prepare annual work plans, including budgetary requirements, and ERADA would consolidate such plans and submit them to IDA before the end of the ninth month of the preceding calendar year. Along the same lines and in accordance with a format satisfactory to IDA, detailed and comprehensive progress reports (one covering the period January through June and another covering the whole year) would be prepared and submitted to IDA, three months following the report periods. The Government would also prepare a Project Completion Report (PCR) and submit it to IDA no later than six months after the credit closing date, or by such later date as the Government and IDA agree upon. Assurances in that regard were obtained from the Government during negotiations [paras. 6.01(i) and (j)]. The estimated project completion date is December 31, 1995.

E. Lands for Project Facilities

4.15 The Government owns, or is able to acquire, enough land in the project area for the construction of buildings, including extension centers and research facilities. The land sites for ERADA and ARA headquarters and the regional research station in Marib have already been acquired. Land for the remaining facilities, primarily the extension centers, would be acquired by December 1989. Assurances to that regard were obtained during negotiations [para. 6.01(k)].

V. PROJECT BENEFITS, JUSTIFICATION AND RISKS

A. Production

5.01 The project would promote agricultural development in the Eastern Region through efficient utilization of the production potential created by the Marib Scheme. It would also ensure continued development by establishing an institutional framework for addressing the longer term needs of the region. More specifically, agricultural development would be promoted by strengthening the extension services in the region (with focus on the Marib

Scheme command area) through accelerating the adoption of proven technical packages and pursuing research and studies. The project would also: (a) support the development of the Marib Scheme through the strengthening of the O&M service and the construction of tertiary canals; and (b) promote on-farm investment in irrigation improvements and in the establishment of fruit tree orchards, particularly citrus. It is estimated that at full development, about 2,600 farmers (1,600 within the Marib Scheme area) would be covered by the project, with about 2,150 farmers (1,400 within the Marib Scheme area) adopting extension recommendations to enhance production. Extension would focus on improved irrigation technology, on the use of fertilizer and improved varieties, on pest control, and on livestock management. Because of these irrigation improvements and the availability of surface water from the scheme, the cultivated area in the total project would be expanded from about 6,900 ha to 8,750 ha (net increase of about 1,850 ha); and the cropped area from 8,900 ha (cropping intensity of 129%) to 12,100 ha (cropping intensity of 138%), a net increase of about 3,200 ha (Annex I, Table 15). Crop yield, areas and production increases are expected mainly from vegetables, sorghum fodder, fruits, alfalfa and wheat. At full development the project would increase annual fruit and vegetable production by about 24,000 tons, forages by about 18,000 tons, and grains by about 6,000 tons (Annex I, Table 16). In addition, the animal health service would provide treatment for an estimated 75,000 ruminant animals, thereby improving their health and productivity. Demand projections indicate the existence of adequate markets for the sale of the incremental production of the project. Moreover, a relatively efficient marketing network exists in the project area, with the private sector playing the dominant role.

5.02 Farm Models. The project area contains a range of farm types and sizes. To analyze the benefits of farm development, four basic farm models are used (Table 5.1).

Table 5.1: FARM SIZE AND AREA UNDER DEVELOPMENT

Farm Model	Unit Size Ha	No. of Holdings		No. of Holdings	
		Total	To be Covered by Ext. Prog.	Participating Full Development	
		Marib Governorate		Marib Governorate	Marib Scheme
1. Marib Scheme Surface/ Well--currently irrigated	5	800	800	700	700
2. Marib Scheme Surface/ Well--Currently Abandoned	6	300	300	260	260
3. Well Irrigated	3	1,900	900 ^{a/}	710	260
4. Spate and Well	8	2,000	600 ^{b/}	480	180
Total		5,000	2,600	2,150	1,400

a/ Three hundred holdings are within the Marib Scheme command area.
b/ Two hundred holdings are within the Marib Scheme command area.

Farm models 1 and 2 represent farms that use surface water from the Marib Dam in conjunction with underground water. Farm model 3 represents well irrigation and farm model 4 represents well and spate. About 500 model 3 and 4 farms would benefit from underground water recharged from the Marib Dam. Farm models 2-4 have two variants (A and B), while model 1 has variant B only (Table 5.2). Variant A depicts farmers who adopt extension recommendations for increasing crop yield, but who make no, or only minimal, investments in farm improvement. Variant B represents farmers who adopt extension advice to improve yields and invest in land and irrigation development to improve water use efficiency. Present field efficiency of groundwater use is estimated at 40%, increasing to an average of 52% with investment in piped (PVC pipes) distribution systems. The use of Marib Scheme surface water is assumed to be at 35% field efficiency, increasing to an average of 47% with the installation of tertiaries and irrigation improvements. The total net water requirement for models 1 and 2 is estimated at 51.4 Mm³, of which 32.6 Mm³ would come from the surface water of the Marib Scheme, and 18.8 Mm³ from groundwater. A detailed breakdown of water requirements by crop and month is given in Annex I, Table 17.

5.03 Farm models 1 and 2 represent about 800 existing holdings of about 5 ha each, and 300 abandoned farms of about 6 ha each, respectively. These farms previously depended on spate irrigation, supplemented by groundwater. Since the construction of the Marib Dam, spate flow has been interrupted and well drilling expanded to permit perennial irrigation, resulting in significant changes in the cropping patterns. However, falling groundwater levels caused by the interruption of spate flow has resulted in the abandonment of several farms. It is expected that within the six-year project implementation period, most farm holdings would carry out tertiary canal improvement and about 600 would adopt improved practices (increasing to about 850 at full development). About 40% of these are expected to make further investments to improve water use efficiency. Because of their proximity to dunes, many of the abandoned farms have been covered with sand layers, reaching in some cases to about 40 cm deep. Cultivation of these lands would, therefore, require the establishment and maintenance of windbreaks. Once the dam becomes operative and water begins to flow in the secondary canals, landowners should be able to cultivate their lands following the original irrigation distribution system. Also, they are expected to benefit from the sand dune stabilization program through the establishment of windbreaks (para. 2.26).

5.04 Farm Model 3, with an estimated 1,900 well-irrigated farms of 3 ha each (900 lie within the project extension program), is typical of farms which are not reached by spate flow. Those adjoining the Marib Scheme command area (about 300 farms) would benefit from groundwater recharge as a result of discharges from the dam. Farmers in this model are expected to respond quickly to extension messages once improved practices are demonstrated and materials are available. Farm Model 4 is representative of farms which have both spate irrigation and groundwater. The average holding size is 8 ha, but not more than 5 ha are cultivated in any one year. There are about 2,000 holdings in this category with about 600 that fall under the project extension program (200 within the Marib Scheme command area). ERADA would provide extensive agricultural support services for these 500 farms (models 3 and 4)

that lie within the Marib Scheme command area. This would result in about 190 farms adopting improved practices by year six of project implementation, increasing to about 440 at full development. For the remaining 3,400 farms, agricultural support services would be provided on a pilot basis covering, under this project, about 1,000 farms; about 750 are expected to adopt improved practices at full development. Coverage of the remaining 2,400 farms would have to be done at a later stage, after ERADA has been better established, and the data base is expanded.

5.05 Prices. Input and output prices used in the financial analysis are average farmgate prices for 1988 (Annex I, Tables 18 and 19). The prices of domestically produced agricultural commodities, except fruits and vegetables whose import is restricted or banned, are determined by market forces. The relatively high product prices of domestically produced agricultural commodities reflect trade restrictions, high marketing costs, and high input costs due to inadequate allocation of foreign exchange and high transport costs. Financial prices of wheat are high partly because of a strong consumer preference for local production, and partly because only a small percentage of production enters trade. However, cereal prices are assumed to fall by about 30%-50% over a 7-8 year period and would eventually converge with import parity prices. Vegetable prices are assumed to fall by about 30% over 5 years, and fruit prices by about 25%.

B. Financial Results

5.06 Financial crop budgets indicate that net returns per ha, after labor cost, are highest for vegetables and alfalfa (under surface irrigation), followed by fruits, sesame, and wheat (under surface irrigation) (Annex I, Table 20). Under well irrigation, the returns are positive for fruits and vegetables but low or negative for grain and forage crops. This is due to the high cost of pumping water and low yields. Those crops which are commonly grown by farmers of the area would be, until higher yields can be achieved, gradually phased out from well irrigation cropping patterns and replaced by higher value crops such as fruits and vegetables. As a result of crop intensification and the application of improved techniques, the annual demand for labor at full development would increase by about 960 man-years. About 40% of this increase (390 man-years) is expected to be met by family labor, with the remaining 570 man-years to be met by hired labor (mostly migrant workers from other areas in YAR and Yemeni laborers returning from the Gulf countries). The Eastern Region would also compete with the nonfarm sectors for labor; thus labor requirements at full development reflect a possible shortage of hired labor. This is expected to stimulate farmers to mechanize agricultural activities.

5.07 Farm Incomes. The financial returns of farm models are attractive. Incremental annual farm family benefits at full development would range from about YRls 28,200 for spate and well-irrigated farms which adopt extension advice with no investment (4A), to about YRls 64,400 for farms in the Marib Scheme surface water command area which benefit from extension and undertake irrigation investments (1B). Returns per family-day of labor (farm income divided by the number of family labor) would increase substantially for all farm models; the highest increase would be in models 1 and 2 as detailed in Table 5.2.

Table 5.2: FARM INCOME AND RETURNS TO FAMILY LABOR ^{a/}

Farm Model	No. of Farms	Net Farm Income ^{b/} (YRls '000 per year)			Return to Family Labor (YRls/Family Day of Labor)	
		Without Project	With Project	Incremental	Without Project	With Project
1B	800	6.9	71.3	64.4	23.0	222.8
2A	180	7.5	62.3	54.8	73.5	194.7
2B	120	7.5	66.9	59.4	73.5	196.8
3A	600	3.2	37.5	34.3	17.3	139.7
3B	300	3.2	42.3	39.1	17.3	132.9
4A	420	12.6	40.8	28.2	47.7	136.0
4B	180	12.6	43.9	31.3	47.7	129.0

a/ At full development for farmers adopting improved technology.

b/ Net of hired labor.

These benefits can be attributed to (a) the present low level of technology in the area; (b) increased quantities of surface water from the Marib Scheme with relatively small investments in tertiary development; (c) the presence of small/medium size landholders who are expected to quickly adopt improved techniques and invest in irrigation improvement; and (d) sunk investments already made in irrigation infrastructure (dam, primary and secondary canals).

C. Taxes and Cost Recovery

5.08 Taxes. The project is expected to generate a considerable increase in the tax base through zakat, a religious tithe, and cooperation taxes. Zakat is a flat tax on the gross value of production at the rate of 10% for spate and rainfed areas, and 5% for well-irrigated areas. Cooperation taxes are 2.5% of the gross value of production of all farms. If fully collected, incremental annual zakat and cooperation taxes at full development would be about YRls 12.7 million (US\$1.3 million) annually (Annex I, Table 21). Collection of zakat in Eastern Region is negligible at present; and improvement in collection will involve a long educational process, stressing the services these taxes can provide, and increased collection efforts.

5.09 Cost Recovery. Incremental zakat, cooperation tax and water charges would cover about 65% ^{1/} of the annual recurrent and investment costs of ERADA, ARA, TA, and the O&M service of the Marib Scheme (Annex I, Table 22). The annual cost of the O&M service (amortization of investment and

^{1/} Forty-two percent if 25% of zakat and cooperation tax are collected (with full recovery of water charges).

recurrent costs) is estimated at about YRls 13.7 million in 1988 prices. The full cost of the O&M service would be recovered by Government on a semiannual basis from surface water beneficiaries of the Marib Scheme (tertiary collective units). This would be done through a water tariff assessed on a volumetric basis at outlets of secondary canals, and adjusted periodically (every three years) taking into account actual costs and inflation.^{1/} Written agreements would be signed among beneficiaries of tertiary blocks regarding water distribution rights, similar to existing agreements to share spate flow (para. 4.09); this will minimize potential conflicts among beneficiaries who often belong to the same family or tribe, and it also allows for more controlled releases of water and regular collection of water charges. (ERADA/the Advisory Council will maintain close contacts with tribal leaders to clarify the benefits of the low cost of surface water in relation to pumped water and that beneficiaries are not charged for the cost of the dam or primary and secondary canals.) This mechanism represents a departure from current Government water charge policy followed in other areas, namely, the collection of a tariff equivalent to 2% of the gross value of farm production, in addition to zakat, with the objective of recovering recurrent and investment costs of the O&M service without interest over a period of 20-25 years. To date, this policy has not been effective: collection of zakat is about 30% while collection of water charges is even less. The water tariff, estimated at about YRls 0.21/m³ in 1988 prices, is equivalent to 13.5% of the gross value of crops grown using surface water (6% of the gross value of farm production). This level of tariff covers 100% of the costs attributed to the O&M service, including buildings, houses and furniture, staffing and staff training, construction materials, and vehicles and equipment (Annex I, Table 23). The Ministry of Finance would collect water charges from beneficiaries, but Government would provide adequate funds to prefinance the O&M service of the Marib Scheme (para. 3.26). Assurances regarding the level of tariff and the provision of adequate funds for the O&M service were obtained from Government during negotiations ([para. 6.01(d) and (m)]. The cost of tertiary canals built by ERADA would be fully recovered (including 7% interest) from beneficiaries over a period of eight years beginning one year after completion of works, according to a written agreement between ERADA and beneficiaries. This would amount to about YRls 500/ha (about YR 250/ha semi-annually); payments would be adjusted to reflect actual costs at the start of construction works. Collection would be done semiannually. Assurances to this effect were obtained from Government during negotiations [para. 6.01(1)].

5.10 Impact on Government Budget. As a result of the project, the Government would incur by year six an expenditure in 1988 prices of about US\$2.1 million equivalent in annual recurrent costs. This compares to annual incremental Government revenues of US\$1.3 million at full development,

1/ During negotiations, Government proposed to study alternative modes of water tariff assessment, and submit a proposal to IDA, if any, by June 1989; IDA did not object, provided the alternative proposed is based on full recovery of the O&M cost, and does not lead to inefficient use of surface water.

assuming full collection^{1/} (para. 5.08). Also, the cost recovery of the O&M service of the Marib Scheme would bring additional annual revenues to the Government at US\$1.4 million equivalent (para. 5.09).

D. Benefits and Beneficiaries

5.11 The main project benefits would result from (a) the introduction of improved on-farm technology (improved seed and varieties, better land preparation, pest control and the use of fertilizer); (b) the increase in surface water with a relatively small investment in the construction of tertiary canals; and (c) on-farm investments to improve the efficiency of irrigation water use and to establish fruit orchards, particularly citrus. The project would also benefit from sunk investments in irrigation infrastructure (Marib Dam and primary and secondary canal network). Quantifiable economic benefits of the project would derive from the incremental production of vegetables and fruits, wheat, sorghum fodder and alfalfa. In addition, the production of meat and milk (primarily for home consumption) is expected to increase. At full development, the net value of farm production at 1988 financial prices is expected to increase by 62%, from YRls 135 million in the without-project situation (including the dam and the primary and secondary canals) to YRls 218 million in the with-project situation.

5.12 Beneficiaries and Poverty Alleviation. The project is specifically designed to reach poor farm families (with per capita farm income^{2/} of less than US\$200 equivalent) who make up 75% of the expected beneficiaries (2,600 farm families of about 15,000 people). Benefits would be realized through improved productivity in agriculture and increased farm income resulting in poverty alleviation for these farmers. The project is also expected to provide 960 man-years of labor, 570 of which would be hired labor for landless farmers. The project would ultimately benefit an additional 14,200 farm families (about 90,000 people) through extension and research services in the region, including Al-Jawf.

5.13 Economic Prices. The economic farmgate prices (Annex I, Table 19) for traded goods (cereals,^{3/} citrus fruits and fertilizers) are import parity prices derived from the Bank's commodity price projections of January 1988. These are expressed in constant 1988 US\$ and YRls, with appropriate adjustment for handling, marketing, and transportation costs. Alfalfa, fodder, and straw were treated as nontraded goods, and economic prices were derived by applying a conversion factor of 0.70 to allow for restrictions in meat imports.^{4/} For inputs (except fertilizer), and local investments,

1/ US\$0.3 million if collection is 25%.

2/ Estimates of nonfarm income (tribal duties, civil service, trade, etc.) are not available but are assumed to represent about 25% of farm income.

3/ Due to the strong preference of Yemenis for locally grown cereals, a 20% premium over world prices has been included.

4/ Compared with a standard conversion factor of 0.85.

the standard conversion factor was applied in economic analysis. The economic cost of water was assumed to equal the financial cost adjusted for duties (gasoline is not subsidized and the official exchange rate is about the same as the market rate). The import parity price of citrus exceeds the economic price obtained by applying the standard conversion factor; this is due to high transport costs and quality differentials. Also, the import parity prices for vegetables^{1/} are equivalent to economic prices based on the SCF; consequently, economic prices of fruits and vegetables that are based on the standard conversion factor were used in economic analysis. It was also assumed that financial and import parity prices of cereals would converge over six years, and that economic prices of fruits and vegetables would fall by 25%-30% over 5 years. Due to an expected tight labor situation, the shadow wage rate for labor was assumed to equal the financial wage rate (incremental annual labor requirements at full development would be about 960 man-years).

E. Economic Rate of Return

5.14 Economic analysis has been undertaken for the area benefitting from the Marib Scheme in the Marib Governorate (about 6,000 ha), namely, (a) the Marib Scheme surface water command area, and (b) the adjoining well and spate irrigated areas which would benefit from recharging of the aquifer by the Marib Dam (base case). Also, economic analysis has been undertaken for the total project, i.e., including the pilot areas covered by the project but outside the Marib Scheme command areas.

5.15 Quantifiable benefits used in the economic analysis were derived from the incremental production of fruits and vegetables, cereals, sesame, fodder and alfalfa from 1,600 farms on about 8,750 ha. Economic costs, allocated on the basis of beneficiaries and areas, include: (a) 100% of farm production investment (including tertiary canal development) and operating costs; (b) 100% of investment costs of additional dam safety measures; (c) 100% of the investment and recurrent costs of the Marib Scheme O&M service for surface water; (d) 100% of investment costs of damage repair of the primary BN canal; and (e) 50% (75% for the total project) of investment and recurrent costs for ERADA (extension services, veterinary services, and mother tree orchard), ARA, and technical assistance, training, and studies. The costs of the construction of the Marib Dam and primary and secondary canals which were financed by the ruler of Abu Dhabi and specifically earmarked for this purpose (para. 2.06) were excluded from the economic analysis. All benefits and costs were calculated in constant 1988 prices. A project life of 25 years has been assumed and investments replaced when necessary. Since some technological improvement will occur even in the absence of the project, the without-project situation reflects correspondingly increased production. On the basis of the costs and benefits stream outlined in Annex I, Table 24, the economic rate of return (ERR) is 17.8% for the base cost (16.7% for the total project). The present value of the net benefits stream, assuming a 12% opportunity cost of capital, is YRls 50.5 million (YRls 54.6 million for the total project). Sensitivity analysis (Annex I, Table 25) shows that a 20% increase in costs reduces the ERR to 12.8% (12.0% for the total project) while a 20% fall in benefits results in an ERR of 11.5% (10.9% for the total project). A two-year

^{1/} Considering Jordan as the country of origin.

lag of benefits gives an ERR of 11.6% (11.2% for the total project). Switching values analysis indicates that the ERR would not fall below 12%, despite an 18.7% (16.8% for the total project) reduction in benefits or a 23.0% (20.2% for the total project) increase in costs.

F. Project Risks

5.16 Risks associated with project benefits, costs, the development period, and implementation delays have been tested in sensitivity analysis. One risk which could affect project viability, and which other IDA-assisted projects in YAR have faced in recent years, is inadequate local budgetary support, resulting in delays in construction, staffing, and implementation. The risk is minimized, however, by the expected flow of oil revenue in late 1988 and by the importance the Government now attaches to this oil-producing area. At negotiations, assurances were given by the Government that adequate funds would be made available to meet recurrent costs of this project [para. 6.01(d)].

5.17 Another concern involves the tribal nature of the population in the Marib area and its possible impact on traditional water rights and on the construction of tertiary canals. To minimize potential problems and tribal conflicts, and to ensure proper water distribution, the Government has agreed to require that, prior to the release of dam water, beneficiaries of each tertiary block sign a written agreement among themselves and with ERADA. Water distribution rights, the construction and operation of tertiary canals, and payment of water tariffs to cover the cost of the O&M service of the Marib Scheme would be covered under this agreement.

5.18 In reviewing the structural design and operational procedures of the dam, it was found that the dam is safe in the normal operating range. However, to further increase the safety of the dam, it was agreed among all parties concerned to provide a filter blanket at the toe of the dam and to enlarge the stilling basin. Adequate funds have been allocated by Government for these works. Signing a contract satisfactory to IDA for the execution of these works is a condition of credit effectiveness [paras. 2.08(a) and 6.03].

5.19 Other risks could arise from the potential contamination of aquifers with fertilizer and pesticide residues. ARA would establish a program to monitor if these threats exist and, if so, recommend remedial measures (para. 3.16).

5.20 Lengthy delays in credit effectiveness have been experienced in recent projects due to slow credit ratification procedures. Steps proposed to expedite future processing include the early involvement of the CPO's legal department in the project cycle. In addition, the Government has agreed to follow up and expedite ratification procedures. To accelerate project mobilization, the Government has (a) agreed to acquire land sites needed for the project by December 1989, and (b) prepared preliminary designs and sample tender documents for key buildings and equipment. Also, a PPF advance (P-508-YAR), in the amount of US\$400,000, has been established to assist in early project mobilization and in the establishment of agricultural research, extension, and O&M services for the Marib Scheme.

VI. AGREEMENTS TO BE REACHED AND RECOMMENDATIONS

6.01 Assurances were obtained from the Government of YAR during negotiations that:

- (a) the Government would complete the repair of the damage of BN canal by August 1989, and its flood control measures by February 1990 [para 2.08 (b)];
- (b) the Government would appoint qualified and experienced experts in accordance with a schedule satisfactory to IDA (para. 3.18);
- (c) Government would make available to CACB funds necessary to meet the incremental credit requirements of the Project under terms and conditions satisfactory to IDA, and consistent with CACB's national lending policies in agriculture;
- (d) the Government would make available to ERADA and ARA in a timely manner sufficient funds to meet the recurrent costs of the Project (para. 5.16);
- (e) auditing firms with qualifications and experience acceptable to IDA would be employed for this project and that a certified copy of audited accounts, together with the auditor's report, would be submitted to IDA within nine months of the close of each fiscal year (para. 3.40);
- (f) selection, handling and use of pesticides in research trials and extension packages would be in accordance with IDA guidelines (para. 3.41);
- (g) a program would be established by ARA to monitor potential aquifer contamination with fertilizer or pesticide residues (para. 5.19);
- (h) a mid-term review of the project would be carried out jointly by IDA and the Government of YAR by end June 1992 (para. 4.13);
- (i) ERADA and ARA would prepare annual work plans including budgetary requirements, and ERADA would consolidate such plans and submit them to IDA before the end of the ninth month of the preceding calendar year (para. 4.14);
- (j) ERADA and ARA would prepare one semiannual and one annual progress report, to be consolidated by ERADA and submitted to IDA no later than three months following the reports period; the Government would prepare a PCR and submit to IDA no later than six months after the credit closing date (para. 4.14);

- (k) land required for the construction of extension centers and other remaining facilities would be acquired by Government by December, 1989, or any such later date as the Association may agree (para. 4.15);
- (l) Government would collect semiannually from beneficiaries the full cost of tertiary canals constructed by ERADA amortized over an eight year period beginning the first year after work completion (para. 5.09); and
- (m) Government would collect from the beneficiaries (tertiary collective unit) that receive surface water from the Marib Scheme secondary outlets an annual water tariff to cover actual O&M costs adjusted periodically (every three years) for inflation and changes in cost (para. 5.09).
- (n) Government would carry out by June 30, 1989 an archaeological and historical sites survey in the project area, and, on the basis of exchanging views with IDA on the findings and recommendations of the study, carry out a plan for the conservation of archaeological and historical sites (para. 3.18).

6.02 Condition of Credit Effectiveness. Before credit effectiveness, the Government would enter into a contract satisfactory to IDA for the installation of a filter blanket at the toe of the dam and enlargement of the shilling basin [2.08 (a)].

6.03 Subject to the conditions set out above being met, the project is suitable for an IDA credit of SDRs 11.0 million (US\$15.0 million equivalent) on standard terms with 40 years maturity. The Borrower would be the Government of the Yemen Arab Republic.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Gross Domestic Product by Economic Sectors, 1982-87

	1982	1983	1984	1985	1986	Est. 1987
	(YR1s Millions)					
	(At current prices)					
Agriculture, forestry and fishing a/	5,035	5,224	6,236	8,033	10,680	12,163
Mining and Quarrying	168	190	210	241	506	659
Manufacturing	1,720	2,258	2,683	3,465	4,620	5,012
Electricity and water	138	173	226	257	320	465
Construction	1,215	1,255	1,367	1,541	1,285	1,426
Housing and business services	1,536	1,811	2,178	2,817	3,270	3,955
Trade	2,349	2,458	2,866	3,911	4,573	5,199
Transportation and communication	2,209	2,346	2,781	3,489	4,106	4,766
Financial services	363	440	582	773	930	1,097
Other private services	378	397	436	538	659	762
Government services	2,996	3,145	3,177	3,643	4,088	5,336
Less-accounted-for banking services	-246	-260	-406	-651	-524	-540
GDP at factor cost	17,861	19,437	22,336	28,057	34,513	40,300
Customs duties/indirect taxes	2,071	2,433	2,420	2,912	3,876	3,159
GDP at market prices	19,932	21,870	24,756	30,969	38,389	43,459
	(At constant 1981 prices)					
Agriculture, forestry, and fishing	3,854	3,418	3,414	3,704	4,126	4,221
Mining and quarrying	163	178	187	172	424	556
Manufacturing	1,627	2,005	2,153	2,404	2,662	2,875
Electricity and water	138	173	216	239	286	340
Construction	1,167	1,159	1,213	1,101	857	878
Housing and business services	1,506	1,651	1,744	1,878	1,993	2,326
Trade	2,289	2,241	2,300	2,380	2,548	2,627
Transportation and communication	2,048	2,038	2,131	2,406	2,549	2,804
Financial services	361	433	555	558	627	690
Other private services	374	380	393	410	448	476
Government services	2,180	2,262	2,269	2,291	2,314	2,578
Less-accounted-for banking services	-245	-248	-367	-512	-353	-361
GDP at factor cost	15,462	15,690	16,208	17,031	18,481	20,010
Customs duties/indirect taxes	2,061	2,261	2,350	2,371	2,736	2,230
GDP at market prices	17,523	17,951	18,558	19,402	21,217	22,240

Source: Central Planning Organization.

a/ Excluding qat.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Agricultural Sector Development - Key indicators

	<u>1973-80</u>	<u>1980-87</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Agriculture Annual Growth Rate (%) a/	6.8	8.7	4.6	-11.3	-0.1	8.5	11.4	2.3
Agriculture as % of GDP a/	-	-	24.9	21.8	21.1	21.7	22.3	21.1

Source: CPO, IBRD.

a/ At factor cost in constant 1981 prices (excluding qat).

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Imports Classified by Commodity
1982-85

Commodity Group	Percentage				1982	1983	1984	1985
	1982	1983	1984	1985				
	----- (YRLs Millions) -----							
Food and Live Animals	29.3	22.9	22.9	28.4	2,033.1	1,673.3	1,912.0	2,724.0
Beverages and Tobacco	1.7	3.3	3.2	2.3	120.5	237.2	271.0	226.0
Raw Materials	0.5	0.5	0.5	3.8	34.2	40.4	46.0	363.0
Fuels and Lubricants	11.9	8.9	8.9	6.7	828.4	650.0	743.0	640.0
Animals & Vegetable Oils	0.8	0.6	0.6	2.0	55.8	43.3	49.0	191.0
Chemicals	6.6	8.4	8.4	8.3	454.5	613.6	701.0	791.0
Classified Man. Goods	21.6	22.0	22.0	20.0	1,499.2	1,602.6	1,831.0	1,914.0
Transport & Mach. Equpmt.	19.3	24.9	25.0	23.1	1,341.6	1,818.1	2,077.0	2,212.0
Miscellaneous Manufactures	7.3	7.0	7.0	5.0	504.6	507.2	580.0	478.0
Non-Classified Comm.	1.0	1.5	1.5	0.4	67.9	107.3	123.0	34.0
TOTAL	100	100	100	100	6,939.8	7,293.0	8,333.0	9,573.0
	===	===	===	===	=====	=====	=====	=====

Source: CPO

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Production, Area and Yield of Major Crops, 1982-87

(Production in thousand metric tons; area in thousand hectares; yield in tons per hectare)

	1981	1982	1983	1984	1985	1986	1987
Cereals (total)							
Production	813	760	964	372	419	666	665
Area	769	830	826	834	833	844	808
Sorghum and millet							
Production	635	579	266	271	283	490	477
Area	617	681	681	694	690	690	653
Yield	1.03	0.85	0.39	0.39	0.41	0.71	0.73
Wheat							
Production	70	67	35	37	64	85	100
Area	66	61	61	58	59	65	67
Yield	1.06	1.10	0.57	0.64	1.08	1.31	1.50
Barley							
Production	54	53	30	28	32	41	40
Area	52	52	50	48	46	48	47
Yield	1.04	1.02	0.60	0.59	0.69	0.85	0.86
Maize							
Production	54	59	30	38	44	49	49
Area	34	36	36	34	38	41	41
Yield	1.58	1.63	0.84	1.12	1.16	1.20	1.20
Legumes							
Production	80	75	40	38	44	47	39
Area	74	70	70	23	25	27	24
Yield	1.08	1.08	0.57	1.67	1.77	1.73	1.63
Potatoes							
Production	144	148	161	195	220	221	115
Area	12	12	12	8	9	9	9
Yield	12.0	12.33	13.42	24.38	24.44	24.55	12.78
Vegetables							
Production	287	301	331	346	370	432	455
Area	29	31	34	18	19	22	24
Yield	9.90	10.00	9.73	19.22	19.52	19.64	18.95
Grapes							
Production	67	67	74	82	81	107	133
Area	13	13	14	14	14	15	15
Yield	5.15	5.15	5.28	5.86	5.78	7.13	8.86
Other Fruits							
Production	85	85	85	88	95	104	125
Area	15	15	15	15	16	16	17
Yield	5.66	5.68	5.66	5.87	5.94	6.50	7.35
Coffee							
Production	4	3	3	4	4	4	4
Area	8	8	8	16	16	16	17
Yield	0.46	0.44	0.42	0.26	0.25	0.25	0.24
Cotton							
Production	5	6	6	4	4	5	5
Area	5	7	7	6	6	6	6
Yield	0.94	0.88	0.88	0.66	0.71	0.75	0.75
Tobacco							
Production	6	6	6	5	5	5	5
Area	6	6	6	3	3	3	3
Yield	1.00	1.00	0.89	1.66	1.66	1.66	1.66
Sesame							
Production	5	6	4	3	4	4	4
Area	10	10	10	10	10	10	11
Yield	0.53	0.55	0.42	0.33	0.42	0.43	0.35
Alfalfa							
Production	470	490	490	480	520	580	700
Area	11	11	11	11	11	12	14
Yield	42.70	44.50	44.50	43.60	47.30	48.30	50.00

Source: Ministry of Agriculture.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Incremental Production of Fruits and Vegetables and Cereals of
IDA-Financed Projects at Full Development
Year 2000

<u>Project</u>	<u>Effectiveness</u>	<u>Incremental Production</u>				
		<u>Fruits</u>	<u>Vegetables</u>	<u>Total</u>	<u>Sorghum</u>	<u>Wheat</u>
		----- ('000 tons) -----				
Tihama I	1973	-	9.1	9.1	6.2	-
II	1978	10.0	9.6	19.6	n.a.	n.a.
III	1980	19.4	14.4	33.8	8.4	-
IV	1981	12.1	3.3	15.4	1.1	-
V	1987	27.0	41.0	68.0	18.0	-
SURDP I	1976	0.6	9.9	10.5	19.7	5.3
II	1981	15.0	6.9	21.9	5.8	2.0
Central Highlands	1986	2.1	12.0	14.1	3.6	1.8
Wadi Al Jawf	1987	2.0	8.6	10.6	0.4	1.7
SRADP	1988	28.0	9.0	37.0	22.0	9.0
NORADEP		23.0	26.0	49.0	9.3	0.4
ERADP		9.0	15.1	24.1	0.0	4.5
Total		148.2	164.9	313.1	94.5	25.1

Source: Regional development projects SARs.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT
Estimated Supply of Fruits and Vegetables in YAR
Year 2000

	<u>Fruits</u>	<u>Vegetables</u>	<u>Total</u>	<u>Sorghum</u>	<u>Wheat</u>
	----- ('000 tons) -----			-----	-----
1987 Production ^{a/}	265.0	565.0	830.0	477.0	100.0
Incremental Production to be Attained by 2000 ^{b/} under IDA Projects					
Tihama I	0	0	0	0	0
II	0	0	0	0	0
III	3.9	2.9	6.8	1.7	0
IV	3.6	2.3	5.9	0.8	0
V	27.0	41.0	68.0	18.0	0
SURDP I	0	0	0	0	0
SURDP II	4.5	2.1	6.6	1.7	0.6
Central Highlands	1.8	9.6	11.4	2.9	1.4
Wadi Al Jawf	2.0	8.6	10.6	0.4	1.7
SRADP	28.0	9.0	37.0	22.0	9.0
NORADP	23.0	26.0	49.0	9.3	0.4
ERADP	9.0	15.1	24.1	0	5.2
Total	102.8	116.6	219.4	56.8	18.3
Estimated 2000 Production	367.8	681.6	1,049.4	533.8	118.3

Source: IDA and mission estimates.

a/ MAF. 1987 was a normal production year, and hence used as a benchmark.

b/ Prorated since date of effectiveness, and assuming full development is attained in year 10 (15 years for fruits).

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT
Projected Demand for Selected Commodities in YAR

<u>Commodity</u>	<u>Per Capita Demand kg/yr</u>				<u>Total Demand - '000 tons</u>			
	1985	1990	1995	2000	1985	1990	1995	2000
Vegetables	52.5	58.5	64.4	70.3	360	463	596	765
Potatoes	22.6	24.6	26.5	28.4	155	195	245	309
Subtotal	75.1	83.1	90.9	98.7	515	658	841	1,074
Fruits	40.7	45.9	51.1	56.4	279	363	473	613
(Oranges)	(2.9)	(3.4)	(3.9)	(4.6)	(20)	(27)	(36)	(50)
Total Fruits & Vegetables	115.8	129.0	142.0	155.1	794	1,021	1,314	1,687
Sorghum	72.0	70.9	69.8	69.8	492	562	647	760
Wheat	90.2	101.5	114.3	128.6	618	805	1,059	1,400

Source: FAO

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

List of Vehicles and Major Equipment and Machinery

	<u>ERADA</u>	<u>ARA</u>	<u>Marib Scheme O&M Service</u>	<u>Total</u>
<u>Vehicles</u>				
4wd Long	5	5	1	11
4wd Short	14	3	4	21
4wd Pickups	9	4	6	19
Truck (3 ton)	1	2	2	5
Dump Truck (15 ton)	-	-	2	2
Motorcycles	21	-	18	39
<u>Equipment and Machinery</u>				
Tractor (60-70hp)	-	2	1	3
Tractor Implement (sets)	-	2	-	2
Trailers	-	2	1	3
Threshers	2	2	-	4
Choppers	2	2	-	4
Motorize Sprayers	4	4	-	8
Seed cleaners	2	2	-	4
Harvesters	4	2	-	6
Levellers	2	2	-	4
Fertilizer Spreaders	2	2	-	4
Seeders	2	2	-	4
Audio Visual Aids (sets)	1	-	-	1
Workshop Equipment (sets)	-	2	1	3
Tractor (150-160hp)	-	-	1	1
Front End Loader (75hp)	-	-	2	2
Motor Grader (150hp)	-	-	2	2
Water Tanker (15 ton)	-	-	2	2
Compacting Roller (10 ton)	-	-	1	1
Compressor	-	-	1	1

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Proposed Locations of Extension Centers

<u>Location</u>	<u>Population</u>
<u>Within Marib Scheme</u>	
Marib	9,800
Husn Al Jalal	4,300
Al Hazmah	7,400
Masil Al-Allah	2,500
Marda	5,550
<u>Outside Marib Scheme</u>	
Al-Jubah	11,850
Sirwah	7,300
Jabal Murad	4,650
Harib	23,800

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Technical Assistance, Training and Studies

Technical Assistance	No.	Staff Months	Date of Appointment
<u>Agriculture</u>			
Senior Research Officer	1	42	December 1, 1988 ^{1/}
Cereals Specialist	1	36	October 1, 1989
Livestock Production Specialist	1	36	January 1, 1990
Horticulturist	1	42	January 1, 1990
Irrigation Agronomist	1	36	October 1, 1989
Plant Protectionist	1	36	October 1, 1989
Extension Planning/Training Expert	1	36	December 1, 1988 ^{1/}
Women in Development Expert	1	36	July 1, 1990
Veterinary Adviser	1	42	July 1, 1990
Livestock Associate Expert	1	42	December 1, 1988 ^{1/}
Horticulture Associate Expert	1	42	December 1, 1988 ^{1/}
Soils Associate Expert	1	36	July 1, 1990
<u>Engineering/O&M</u>			
Dam O&M Engineer	1	42	December 1, 1988 ^{1/}
Irrigation Engineer	1	36	January 1, 1990
Hydrologist/Hydrogeologist	1	36	October 1, 1989
Design Engineer	1	36	January 1, 1990
<u>Short-term Consultancies/ Studies</u>			
Archaeology Study		2	June 1, 1989
Tertiary Canal Development		6	December 1, 1988 ^{a/}
Flood Protection		6	January 1, 1990
Dam Inspection		3	January 1, 1990
<u>Training (72 s/m)</u>			
Engineering		36	January 1, 1990
Agriculture		36	January 1, 1990

^{a/} Financed under PPF (P-508-YAR).

YEMEN ARAB REPUBLIC
ERADP
SUMMARY ACCOUNTS COST SUMMARY

	(YRIs '000)					(US\$ '000)				
	Local	Foreign	Total	% Total		Local	Foreign	Total	% Total	
				% Foreign Exchange	Base Costs				% Foreign Exchange	Base Costs
I. INVESTMENT COSTS										
A. CIVIL WORKS	20,472.0	30,088.0	50,560.0	60	25	2,099.7	3,085.9	5,185.6	60	25
B. VEHICLES	445.9	8,472.1	8,918.0	95	4	45.7	868.9	914.7	95	4
C. EQUIPMENT	2,637.2	22,256.8	24,894.0	89	12	270.5	2,282.7	2,553.2	89	12
D. EXPERTS	1,660.5	31,549.5	33,210.0	95	16	170.3	3,235.8	3,406.2	95	16
E. TERTIARY CANALS	5,100.0	7,650.0	12,750.0	60	6	523.1	784.6	1,307.7	60	6
F. FOREIGN TRAINING	126.0	2,394.0	2,520.0	95	1	12.9	245.5	258.5	95	1
G. ON - FARM DEVELOPMENT	10,074.3	15,314.7	25,389.1	60	12	1,033.3	1,570.7	2,604.0	60	12
Total INVESTMENT COSTS	40,515.9	117,725.1	158,241.1	74	77	4,153.5	12,074.4	16,229.9	74	77
Physical Contingencies	5,330.2	13,659.4	18,989.6	72	9	546.7	1,401.0	1,947.7	72	9
Price Contingencies	24,135.5	60,284.0	84,419.5	71	41	968.7	2,401.2	3,369.9	71	16
Total INCLUDING CONTINGENCIES	69,981.6	191,668.5	261,650.2	73	127	5,670.9	15,876.5	21,547.4	74	102
II. RECURRENT COSTS										
A. SALARIES	37,523.0	-	37,523.0	-	18	3,848.5	-	3,848.5	-	18
B. LOCAL TRAINING	933.0	-	933.0	-	0	95.7	-	95.7	-	0
C. VEHICLE O&M COSTS	3,928.5	3,928.5	7,857.0	50	4	402.9	402.9	805.8	50	4
D. EXTENSION FIELD DEMONSTRATIONS	228.0	228.0	456.0	50	0	23.4	23.4	46.8	50	0
E. RESEARCH INPUTS	395.0	395.0	790.0	50	0	40.5	40.5	81.0	50	0
Total RECURRENT COSTS	43,007.5	4,551.5	47,559.0	10	23	4,411.0	466.8	4,877.8	10	23
Physical Contingencies	2,150.4	227.6	2,378.0	10	1	220.6	23.3	243.9	10	1
Price Contingencies	27,140.9	2,870.2	30,011.0	10	15	1,095.9	115.9	1,211.8	10	6
Total INCLUDING CONTINGENCIES	72,298.7	7,649.2	79,948.0	10	39	5,727.5	606.0	6,333.5	10	30
Total BASELINE COSTS	83,523.4	122,276.6	205,800.1	59	100	8,566.5	12,541.2	21,107.7	59	100
Physical Contingencies	7,480.6	13,887.0	21,367.6	65	10	767.2	1,424.3	2,191.5	65	10
Price Contingencies	51,276.4	63,154.1	114,430.5	55	56	2,064.6	2,517.0	4,581.7	55	22
Total PROJECT COSTS	142,280.4	199,317.7	341,598.1	58	166	11,398.4	16,482.5	27,880.9	59	132

YEMEN ARAB REPUBLIC
ERADF
Summary Account by Project Component
(YRIs '000)

	REGIONAL INSTITUTIONAL DEVELOPMENT			MARIB SCHEME DEVELOPMENT			Physical Contingencies		
	SUPPORT TO ERADA	SUPPORT TO ARA	TECHNICAL ASSISTANCE, TRAINING & STUDIES	D&M SERVICE	TERTIARY DISTRIBUTION SYSTEM	ON-FARM DEVELOPMENT	Total	%	Amount
I. INVESTMENT COSTS									
A. CIVIL WORKS	24,128.0	18,200.0	-	8,232.0	-	-	50,560.0	15.0	7,584.0
B. VEHICLES	4,730.0	2,257.0	-	1,931.0	-	-	8,918.0	10.0	891.8
C. EQUIPMENT	3,644.0	6,850.0	-	14,400.0	-	-	24,894.0	10.0	2,489.4
D. EXPERTS	-	-	33,210.0	-	-	-	33,210.0	10.0	3,321.0
E. TERTIARY CANALS	-	-	-	-	12,750.0	-	12,750.0	15.0	1,912.5
F. FOREIGN TRAINING	-	-	2,520.0	-	-	-	2,520.0	10.0	252.0
G. ON - FARM DEVELOPMENT	-	-	-	-	-	25,389.1	25,389.1	10.0	2,538.9
Total INVESTMENT COSTS	32,502.0	27,307.0	35,730.0	24,563.0	12,750.0	25,389.1	158,241.1	12.0	18,989.6
II. RECURRENT COSTS									
A. SALARIES	16,212.0	15,081.0	-	6,230.0	-	-	37,523.0	5.0	1,876.2
B. LOCAL TRAINING	315.0	-	-	618.0	-	-	933.0	5.0	46.7
C. VEHICLE O&M COSTS	5,580.0	2,277.0	-	-	-	-	7,857.0	5.0	392.9
D. EXTENSION FIELD DEMONSTRATIONS	456.0	-	-	-	-	-	456.0	5.0	22.8
E. RESEARCH INPUTS	-	790.0	-	-	-	-	790.0	5.0	39.5
Total RECURRENT COSTS	22,563.0	18,148.0	-	6,848.0	-	-	47,559.0	5.0	2,378.0
Total BASELINE COSTS	55,065.0	45,455.0	35,730.0	31,411.0	12,750.0	25,389.1	205,800.1	10.4	21,367.6
Physical Contingencies	5,584.8	4,548.1	3,573.0	3,210.3	1,912.5	2,538.9	21,367.6	0.0	0.0
Price Contingencies	30,530.6	24,748.5	13,773.9	16,184.5	9,195.1	19,997.8	114,430.5	9.2	10,482.2
Total PROJECT COSTS	91,180.4	74,751.6	53,076.9	50,805.8	23,857.6	47,925.8	341,598.1	9.3	31,849.7
Foreign Exchange	40,420.5	33,170.8	50,423.0	32,077.3	14,314.6	28,911.5	199,317.7	10.2	20,327.0

YEMEN ARAB REPUBLIC
ERADP
Project Components by Year

	Totals Including Contingencies (YRIs '000)							Totals Including Contingencies (US\$ '000)						
	1	2	3	4	5	6	Total	1	2	3	4	5	6	Total
A. REGIONAL INSTITUTIONAL DEVELOPMENT														
SUPPORT TO ERADA	306.1	16,072.3	26,539.3	21,767.1	14,992.6	11,502.8	91,180.4	28.5	1,401.8	2,224.0	1,758.2	1,167.3	863.2	7,443.0
SUPPORT TO ARA	470.2	9,666.0	29,267.5	18,428.4	7,876.6	9,042.8	74,751.6	43.7	843.0	2,452.6	1,488.5	613.3	678.6	6,119.8
TECHNICAL ASSISTANCE, TRAINING & STUDIES	11,588.3	15,211.4	16,059.7	7,888.0	2,032.7	296.7	53,076.9	1,078.1	1,326.7	1,345.8	637.1	158.3	22.3	4,568.3
Sub-Total REGIONAL INSTITUTIONAL DEVELOPMENT	12,364.7	40,949.7	71,866.5	48,083.5	24,902.0	20,842.3	219,008.9	1,150.4	3,571.5	6,022.4	3,883.9	1,938.8	1,564.1	18,131.0
B. MARIB SCHEME DEVELOPMENT														
O&M SERVICE	67.4	5,081.0	10,367.8	8,168.0	3,342.2	3,779.5	50,805.6	6.3	443.1	2,544.8	659.8	260.2	283.6	4,197.8
TERTIARY DISTRIBUTION SYSTEM	-	677.9	2,462.1	6,381.7	6,892.2	7,443.6	23,857.6	-	59.1	206.3	515.5	536.6	558.6	1,876.1
Sub-Total MARIB SCHEME DEVELOPMENT	67.4	5,758.9	12,829.8	14,549.7	10,234.5	11,223.2	74,663.4	6.3	502.3	2,751.1	1,175.2	796.8	842.2	6,074.0
C. ON-FARM DEVELOPMENT														
	-	145.2	517.0	6,296.7	13,149.8	27,817.0	47,925.8	-	12.7	43.3	508.6	1,023.8	2,087.5	3,675.9
Total PROJECT COSTS	12,432.1	46,853.8	105,213.3	68,929.9	48,266.3	59,882.7	341,598.1	1,156.6	4,086.4	8,816.9	5,567.7	3,759.4	4,493.9	27,880.9

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Estimated Schedule of Disbursement of IDA Credit^{a/}

<u>IDA Fiscal Year/ Semester Ending</u>	<u>Semiannual Disbursements</u> ---- (US\$ Million Equivalent) ----	<u>Cumulative Disbursements</u>	<u>% of Total Credit</u>
1990 June 30, 1990	1.3 ^{b/}	1.3	8.7
1991 December 31, 1990	0.7	2.0	13.3
1991 June 30, 1991	1.3	3.3	22.0
1992 December 31, 1991	1.0	4.3	28.7
1992 June 30, 1992	1.2	5.5	36.7
1993 December 31, 1992	1.3	6.8	45.3
1993 June 30, 1993	1.2	8.0	53.3
1994 December 31, 1993	1.3	9.3	62.0
1994 June 30, 1994	1.5	10.8	72.0
1995 December 31, 1994	1.2	12.0	80.0
1995 June 30, 1995	1.1	13.1	87.3
1996 December 31, 1995	0.9	14.0	93.3
1996 June 30, 1996	0.6	14.6	97.3
1997 December 31, 1996	0.4	15.0	100.0

a/ Closing Date: December 31, 1996.

b/ Part of PPF Advance, for which disbursement is expected to begin in November 1988.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

ERADP 1989 SCHEDULE OF IMPLEMENTATION

I.	Procurement of Key Buildings, Equipment and Vehicles	
	(a) Preparation of Preliminary Design and Tender Documents	11/88
	(b) IDA Review	12/88
	(c) Finalization of Documents/Announcements	02/89
	(e) Evaluation of Bids	06/89
	(d) IDA Review	07/89
	(f) Contracting	11/89
	(g) Mobilization/Execution	01/89
II	Recruitment of Key Experts/Consultants	
	(a) Selection of Candidates/Firms	06/89
	(b) IDA Review	07/89
	(c) Contracting to Begin	11/89
III	Recruitment of Key Local Staff	Number
	(a) ERADA	6
	(b) ARA	4

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Key Project National Staff

	Pre- Project	Project Years						Incremental
		1	2	3	4	5	6	
ERADA (Headquarters)								
Chairman	1	1	1	1	1	1	1	-
Director General	-	-	1	1	1	1	1	1
Internal Auditor	-	-	-	1	1	1	1	1
Planning Monitoring & Eval. Officer	-	1	1	1	1	1	1	1
Public Relation Officer	1	1	1	1	1	1	1	-
Director Administration & Finance	1	1	1	1	1	1	1	-
Chief Accountant	-	1	1	1	1	1	1	1
Director Engineering	1	1	1	1	1	1	1	-
Irrigation Engineer	-	-	1	1	1	1	1	1
Hydrologist/Hydrogeologist	-	-	1	1	1	1	1	1
Design Engineer	1	1	1	1	1	1	1	-
Field Engineer	2	2	2	2	2	2	2	-
Director Agriculture	1	1	1	1	1	1	1	-
Ext. Planning/Training Officer	-	1	1	1	1	1	1	1
Ext. Subject Matter Specialist	7 a/	7	7	7	7	7	7	-
Women in Development Officer	-	-	-	1	1	1	1	1
Veterinarian	-	-	-	-	1	1	1	1
Ext. Subject Matter Specialist	-	-	-	-	2	2	2	2
Extension Supervisor	-	-	1	1	1	1	1	1
Extension Agents	4	-	5	8	9	10	10	6
Veterinary Assistants	4	-	5	6	7	7	7	3
O&M Service								
Director	1	1	1	1	1	1	1	-
Supervisors/Inspectors	6	6	7	8	8	8	8	2
Operators	6	6	8	12	14	16	16	10
Mechanics	1	1	2	2	3	3	3	2
Gauge Recorder	1	1	1	2	2	2	2	1
Subtotal								36
ARA (Marib-Eastern Region Headquarters)								
Director	1	1	1	1	1	1	1	-
Accountant	-	-	1	1	1	1	1	1
Research Officers	3	5	5	6	6	7	7	4
Research Assistants	4	-	5	6	8	8	8	4
Al-Jawf Governorate								
Station Manager	1	1	1	1	1	1	1	-
Research Officer	1	2	2	2	2	2	2	1
Research Assistants	3	4	5	6	6	6	6	3
Subtotal								12

a/ Of whom about 10 would require M.Sc. equivalent, 24 B.Sc. equivalent, and 14 secondary level educations.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Cultivated and Cropped Areas (ha) and Percent of Cropping Intensity a/

	Without Project	With Project	Incremental
Within Marib Scheme Command Area			
Cultivated Area (ha)	4,220	6,000	1,780
Cropped Area (ha)	5,030 (5,690)	7,700 (8,650)	26,670 (2,960)
% Cropping Intensity	119 (135)	128 (144)	9 (9)
Outside Marib Scheme Command Area			
Cultivated Area (ha)	2,660	2,765	105
Cropped Area (ha)	2,880 (3,240)	3,050 (3,500)	170 (260)
% Cropping Intensity	108 (122)	110 (127)	2 (5)
Total Project			
Cultivated Area (ha)	6,880	8,765	1,885
Cropped Area (ha)	7,900 (8,900)	10,750 (12,100)	2,850 (3,200)
% Cropping Intensity	115 (129)	123 (138)	8 (9)

a/ Numbers between parenthesis account for double the physical area occupied with perennial crops.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT
Present and Future Yields, Areas and Production

Crops	Yields (tons/ha)				Areas ('000)				Production ('000 tons)			
	Present	Future a/			Present	Future b/			Present	Future b/		
		Without Project	With Project	% Incremental Yield		Without Project	With Project	Incremental Areas		Without Project	With Project	Incremental Production
Sesame	0.5	0.6	0.9	50	650	650	609	(41)	0.3	0.3	0.4	0.1
wheat	1.4	1.7	2.7	59	2,970	2,970	3,856	886	4.1	5.0	9.5	4.5
Maize	-	1.8	3.0	66	-	-	369	369	-	-	1.1	1.1
Sorghum Grain	0.6	0.6	0.6	-	1,800	1,800	1,800	-	1.1	1.1	1.1	-
Sorghum Fodder	-	-	30.0	-	-	-	455	455	-	-	15.1	15.1
Alfalfa	55.0	60.0	78.0	30	620	620	549	(71)	34.1	37.2	40.0	2.8
Vegetables (Summer) c/	9.0	11.0	17.0	54	620	620	829	209	5.6	6.8	12.8	6.0
Vegetables (Winter) d/	9.0	11.0	16.5	50	850	850	1,245	395	7.7	9.4	18.5	9.1
Fruits (Citrus) e/	9.0	12.0	16.0	33	400	400	782	382	3.6	4.8	13.8	9.0

a/ At full yield development of adopters of improved practices.

b/ At full development.

c/ Mainly tomatoes.

d/ Mainly watermelon and potatoes.

e/ Includes new orchards at year 15.

YEMEN ARAB REPUBLIC

EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

COMMAND AREA NET WATER REQUIREMENTS (THOUSAND m³)
SURFACE WATER

		APR	MAY	JUN	JUL	AGU	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
ALFALFA	P	582	675	704	0	0	627	512	454	387	406	454	528	5329
WHEAT/BARLEY	W	0	0	0	0	0	3120	4306	4524	4555	2527	0	0	19032
SESAME	S	541	710	387	0	0	0	0	0	0	0	240	253	2131
SORGUM (fodder)	S	579	618	696	0	0	0	0	0	0	0	0	0	1893
MAIZE	S	698	882	594	0	0	0	0	0	0	0	360	320	2854
VEGETABLES (s)	S	173	177	205	0	0	0	0	0	0	0	107	111	773
VEGETABLES (w)	W	0	0	0	0	0	95	186	126	124	139	86	0	756
CITRUS	P	0	0	0	0	0	0	0	0	0	0	0	0	0
SUBTOTAL		2573	3062	2586	0	0	3842	5004	5104	5066	3072	1247	1212	32768
SUMMER	100	1991	2387	1882	0	0	0	0	0	0	0	707	684	7651
WINTER	100	0	0	0	0	0	3215	4492	4650	4679	2666	86	0	19788
PERENNIALS	100	582	675	704	0	0	627	512	454	387	406	454	528	5329
SUBTOTAL	100	2573	3062	2586	0	0	3842	5004	5104	5066	3072	1247	1212	32768
FROM AQUIFER (COM. AREA)		1397	1607	1845	3399	2392	1279	1428	1067	970	1061	1236	1003	18684
TOTAL		3970	4669	4431	3399	2392	5121	6432	6171	6036	4133	2483	2215	51452

COMMAND AREA NET WATER REQUIREMENTS (THOUSAND m³)
GROUND WATER

		APR	MAY	JUN	JUL	AGU	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
ALFALFA	P				720	685								1405
WHEAT/BARLEY	W													0
SESAME	S													0
SORGUM (fodder)	S	0	0	0	675	357	0	0	0	0	0	0	0	1032
MAIZE	S	0	0	0	0	0	0	0	0	0	0	0	0	0
VEGETABLES (s)	S	620	638	766	908	370	0	0	0	0	0	330	348	3980
VEGETABLES (w)	W	0	0	0	0	0	380	744	504	494	556	343	0	3021
CITRUS	P	777	969	1079	1096	980	899	684	563	476	505	563	655	9246
SUBTOTAL		1397	1607	1845	3399	2392	1279	1428	1067	970	1061	1236	1003	18684

NONECOMMAND AREA NET WATER REQUIREMENTS (THOUSAND m³)

SUBTOTAL		596	688	728	713	530	825	977	891	853	661	452	403	8317
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TOTAL AREA GROUND WATER REQUIREMENTS (THOUSAND m³)

TOTAL NET		1993	2295	2573	4112	2922	2104	2405	1958	1823	1722	1688	1406	27001
TOTAL GROSS		3633	4413	4948	7908	5619	4046	4625	3765	3506	3312	3246	2704	51925

**YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT**

**Financial Crop Budgets at Full Development^{A/}
(YRIs '000/ha)**

Crop	Gross Val. Of Product	Seed	Fertilizer	Chemicals	Tractor/ Mach. Hire	Irrig. Cost	Other	Total Inputs	Income Bef. Labor	Labor Cost	Net Rtns. Per Ha
Wheat surface	15.7	0.7	0.7	0.4	1.1	2.9	0.1	5.8	9.9	5.5	4.4
Wheat pumped	15.7	0.7	0.7	0.4	1.1	9.9	0.1	12.9	2.8	5.5	(2.7)
Maize surface	14.2	0.3	0.7	0.4	1.0	3.8	0.1	6.2	8.0	4.7	3.3
Maize pumped	14.2	0.3	0.7	0.4	1.0	12.9	0.1	15.4	(1.1)	4.7	(5.9)
Sorghum fodder surface	20.0	0.1	0.7	0.4	1.4	4.7	-	7.3	12.7	10.0	2.7
Sesame surface	22.5	0.2	0.4	0.2	1.0	3.2	-	5.1	17.4	10.0	7.4
Sesame pumped	22.5	0.2	0.4	0.2	1.0	10.9	-	12.8	9.7	10.0	(0.3)
Alfalfa surface	54.6	0.2	0.9	0.2	1.8	10.1	-	13.1	41.5	24.0	17.5
Alfalfa pumped	54.6	0.2	0.9	0.2	1.8	34.3	-	37.4	17.3	24.0	(6.8)
Vegetable summer surface	35.7	0.4	0.9	0.8	2.0	4.2	1.4	9.7	26.0	13.6	12.4
Vegetable summer pumped	35.7	0.4	0.9	0.8	2.0	14.3	1.4	19.8	15.9	13.6	2.3
Vegetable winter surface	46.2	0.4	0.9	0.8	2.9	2.8	1.3	9.0	37.2	16.5	20.7
Vegetable winter pumped	46.2	0.4	0.9	0.8	2.9	9.5	1.3	15.7	30.5	16.5	14.0
Orchard existing (surface)	57.0	-	1.3	1.0	2.0	26.0	1.6 ^{B/}	31.9	25.1	20.0	5.1 ^{C/}
Orchard new (surface)	60.8	0.4	1.5	1.2	2.4	26.0	1.7 ^{B/}	32.8	28.0	20.0	8.0 ^{C/}

a/ At full development with project, 1988 prices; differences due to rounding.

b/ Bags, manure and boxes.

c/ If orchard establishment is considered (over 50 years at OCC=10%) net returns per hectare would be 1.7 and 4.3, respectively.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Incremental Annual Taxes^{A/}
(YRIs '000)

Farm Model	No. of Farms	Incremental Gross Value of Production	Incr. Zakat per Farm	Incremental Cooperation Tax per Farm	Incremental Total Tax per Farm	Incremental Total Tax All Farms
1. Marib Scheme Surface/Well-currently Irrigated						
1B	800	97.5	4.9	2.5	7.4	5,920
2. Marib Scheme Surface/Well-Currently Abandoned						
2A	180	71.9	3.6	1.8	5.4	972
2B	120	106.1	5.3	2.7	8.0	960
3. Well Irrigated						
3A	600	33.6	1.7	0.9	2.6	1,560
3B	300	44.4	2.2	1.1	3.3	990
4. Spate & Well ^{B/}						
4A	420	33.4	2.5	0.8	3.3	1,386
4B	180	60.5	3.5	1.5	5.0	900
						<u>12,688</u>

a/ At full development.

b/ Assuming 50% of production is spate irrigated and 50% irrigated from groundwater.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Cost and Rent Recovery at Full Development^{a/}
(YR1s million)

1.	Incremental gross value of production	82.7
2.	Incremental Non-Labor Input Costs	8.5
3.	Net Incremental Income	74.2
4.	<u>Less</u> Imputed Value of Incremental Family Labor	9.8
5.	<u>Less</u> Imputed Value of Management and Risk ^{b/}	7.4
6.	Incremental Rent (3-4-5)	57.0
7.	Incremental Taxes	
	a. Zakat	8.6
	b. Cooperation Tax	4.1
	c. Water Charges 13.6 ^{c/}	
	d. Total	26.3
8.	Rent Recovery Index (7/6)	46.1%
9.	Net Incremental Income Recovery (7/3)	35.4%
10.	Public Investment	
	a. Infrastructure ^{d/}	17.9
	b. Recurrent Cost ^{e/}	22.9
	c. Total	40.8
11.	Cost Recovery Index (7/10)	64.5%

a/ For all farms benefiting from project (total project).

b/ Assumed 10% of net incremental income.

c/ Water charges of 0.21 YR1s/m³.

d/ ERADA + ARA, + O&M + TA 25 years at 12%.

e/ Recurrent cost of ERADA + ARA + O&M Marib Scheme.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Marih Dam Scheme Surface Water O&M Cost^{a/}

<u>Investment</u>	<u>Total</u> (YRls '000)	<u>Economic Life</u>	<u>Annual Cost</u> (YRls 'million)
Buildings, workshop	3.864	25	0.332
Houses	9.387	25	0.806
Equipment, Vehicles, and Furnitures	<u>17.963</u>	4-12	<u>2.558</u>
Subtotal	31.214		3.696
 <u>RECURRENT</u>			
Vehicles O&M			3.990
Construction Materials			2.100
Salaries			3.570
Others			<u>0.300</u>
Subtotal			9.960
TOTAL			13.656 =====
Tariff Charges ^{b/} - YRls/m ³	0.213		

a/ Costs include physical contingencies of 15% for civil works, 10% for vehicles, equipment and furniture, and 5% for other items.

b/ Based on average of 64 mm³ at outlets of secondary canals and 7% interest over economic life.

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Economic Analysis
(YRIs million)

(Base Case-Marib Scheme)

Year	Benefits	Incremental Costs	Incremental Net Benefits
1	-	19.0	-19.0
2	0.1	20.1	-20.0
3	0.4	24.2	-23.8
4	1.6	18.4	-16.8
5	7.2	12.2	-5.0
6	19.4	17.8	1.6
7	31.8	21.0	10.8
8	44.4	31.7	12.7
9	52.0	29.6	22.4
10	59.8	32.8	27.0
11	67.6	36.7	30.9
12	74.1	38.7	35.4
13	80.0	50.1	29.9
14	83.7	42.7	41.0
15	86.6	43.9	42.7
16	88.6	44.9	43.7
17	90.3	45.7	44.6
18	91.5	51.1	40.4
19	92.4	46.6	45.8
20	92.9	47.8	45.1
21	93.1	47.5	45.6
22	93.2	47.9	45.3
23	93.2	55.9	37.3
24	93.2	47.2	46.0
25	93.3	47.2	46.1

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Sensitivity Analysis
(Base Case-Marib Scheme)

	Present Value at 12% OCC YR million	ERR %
Base Case	50.5	17.8
Costs up 10%	28.6	15.3
Benefits Down 10%	23.5	15.0
Costs up 10% & Benefits Down 10%	1.6	12.2
Costs up 20%	6.7	12.8
Benefits down 20%	-3.5	11.5
Costs up 20% & Benefits Down 20%	-47.4	5.1
Benefits lag 2 years	-4.2	11.6
Costs down 20%	94.4	23.6
Benefits up 20%	104.5	22.5

YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT

Selected Documents and Data Available in the Project File

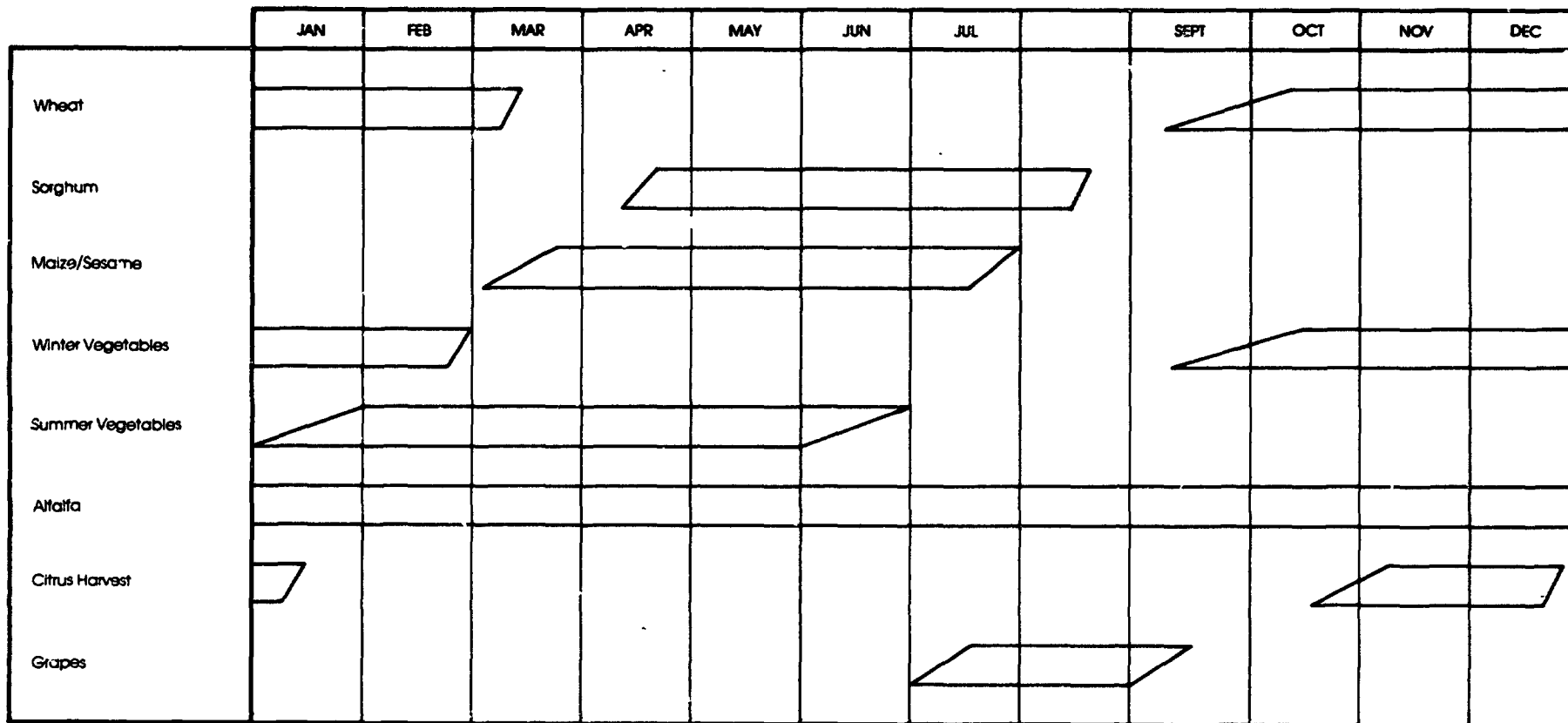
A. Reports Relating to the Project

- A.1 FAO/IBRD/CP - Eastern Region Agricultural Development Project Preparation Report (9/88 CP-YEM 30 Two Volumes)
- A.2 Marib Dam Feasibility Study - Electrowatt, Zurich 1978

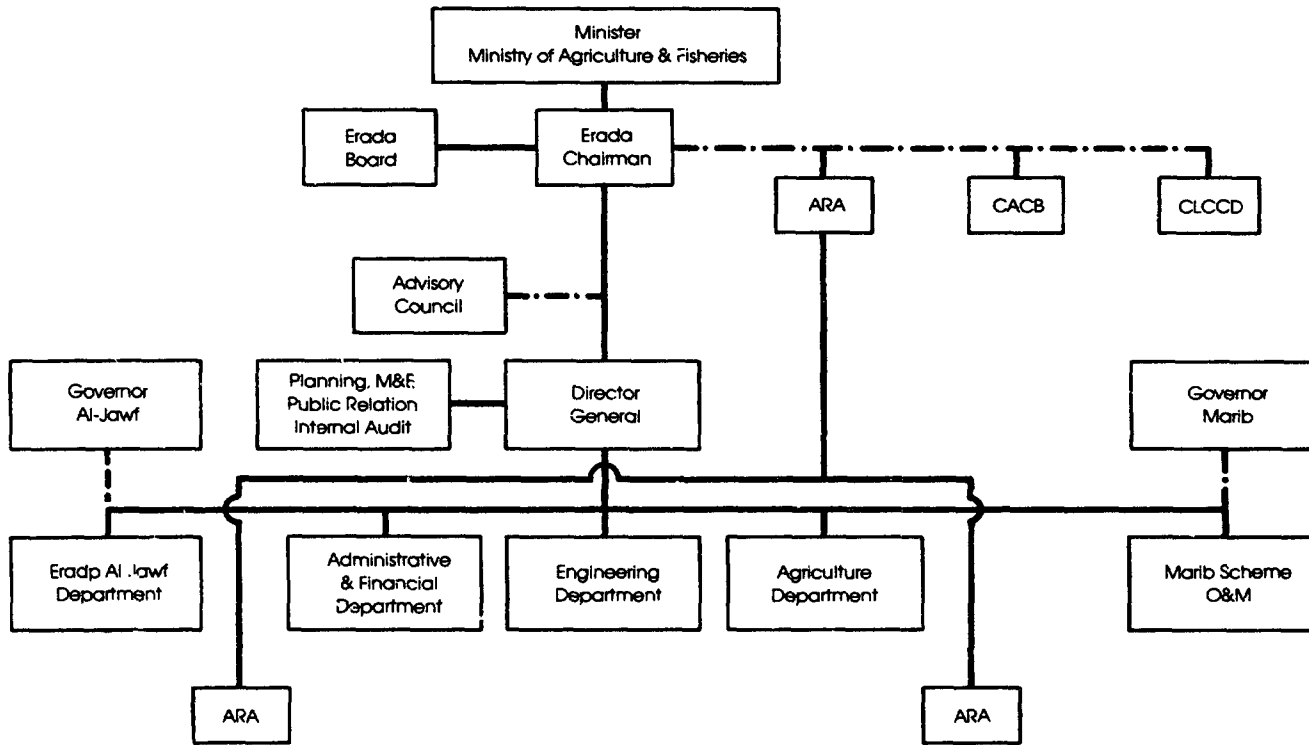
B. Working Documents

- B.1 Agricultural Development
- B.2 Marib Scheme Development
- B.3 Cost Estimates
- B.4 Economic and Financial Data

**YEMEN ARAB REPUBLIC
EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT
Crop Calendar**

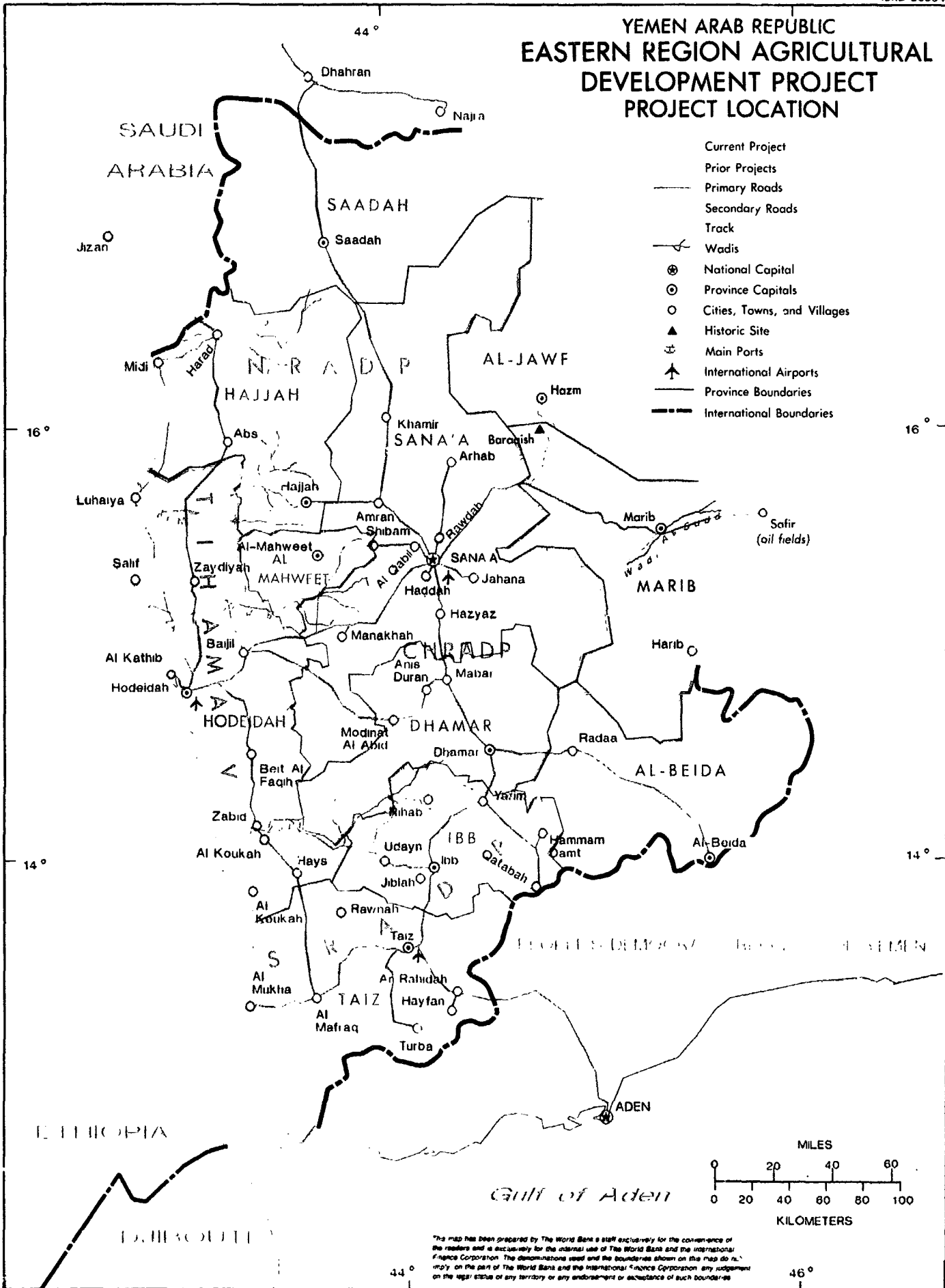


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EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT
Organization of Implementing Agencies

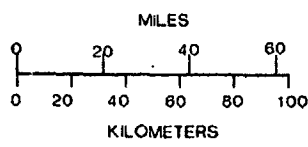


- Administrative & Technical Control
- - - - - Technical Coordination
- . - . - Administrative Coordination

YEMEN ARAB REPUBLIC EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT PROJECT LOCATION

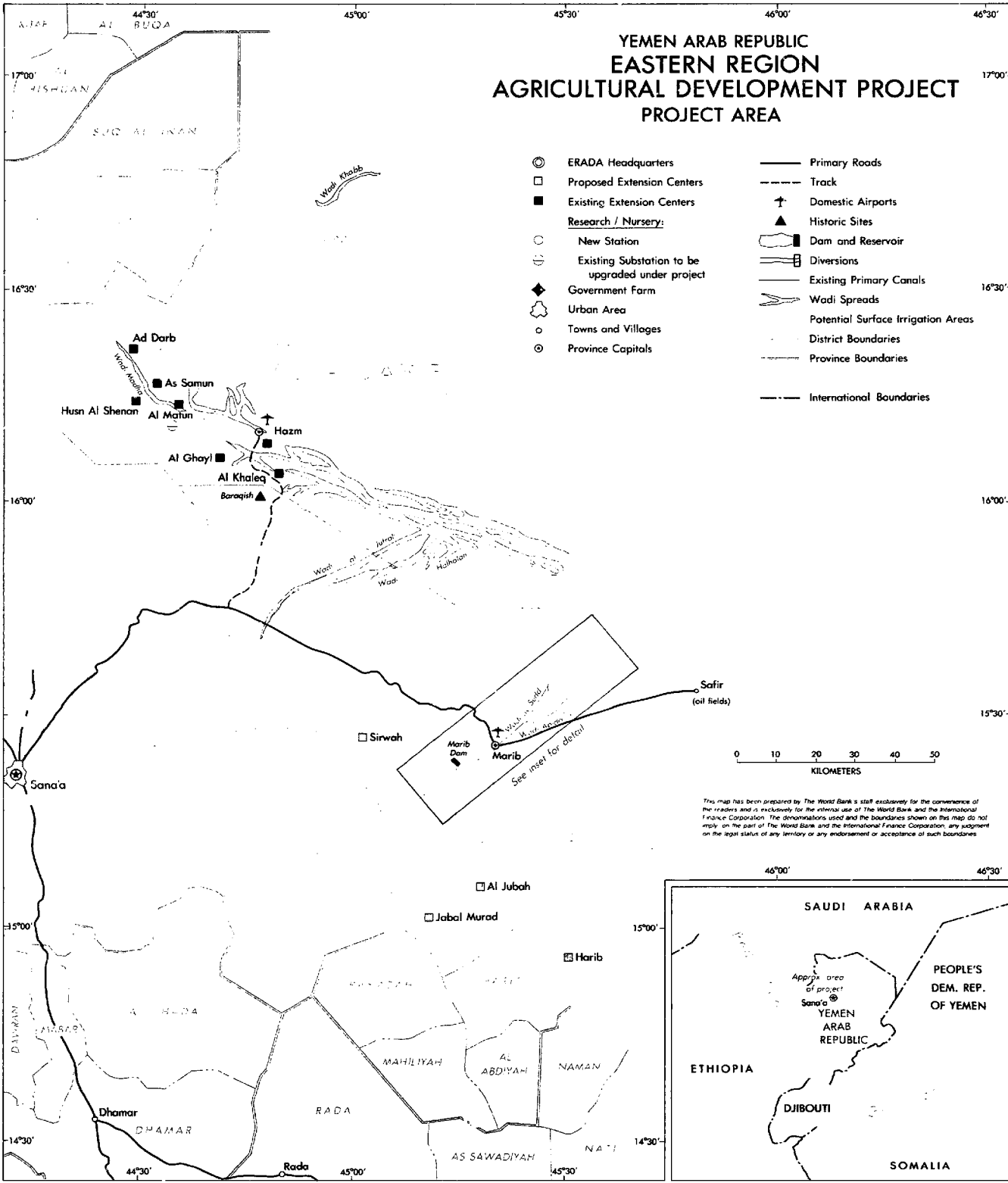


- Current Project
- Prior Projects
- Primary Roads
- Secondary Roads
- Track
- Wadis
- ⊗ National Capital
- ⊙ Province Capitals
- Cities, Towns, and Villages
- ▲ Historic Site
- ⚓ Main Ports
- ✈ International Airports
- Province Boundaries
- International Boundaries

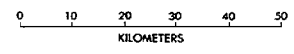


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YEMEN ARAB REPUBLIC EASTERN REGION AGRICULTURAL DEVELOPMENT PROJECT PROJECT AREA



- | | | | |
|----------------------------|--|-------|------------------------------------|
| ⊙ | ERADA Headquarters | — | Primary Roads |
| □ | Proposed Extension Centers | - - - | Track |
| ■ | Existing Extension Centers | + | Domestic Airports |
| <u>Research / Nursery:</u> | | ▲ | Historic Sites |
| ○ | New Station | ▭ | Dam and Reservoir |
| ⊙ | Existing Substation to be upgraded under project | — | Diversions |
| ◆ | Government Farm | — | Existing Primary Canals |
| ⊕ | Urban Area | — | Wadi Spreads |
| ○ | Towns and Villages | — | Potential Surface Irrigation Areas |
| ⊙ | Province Capitals | - - - | District Boundaries |
| | | - - - | Province Boundaries |
| | | - - - | International Boundaries |



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