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Appraisal of Wadi Tuban Agricultural Development Project People's Democratic Republic of Yemen

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Projects Department
Europe, Middle East and North Africa
Agriculture Division 1

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CURRENCY EQUIVALENTS

Currency Unit = Yemeni Dinar (YD)
YD 1 = US\$2.90

WEIGHTS AND MEASURES

<u>Metric System</u>	=	<u>British/US System</u>
1 millimeter (mm)	=	0.0394 inch
1 meter (m)	=	3.2808 foot
1 kilometer (km)	=	0.6214 mile
1 square kilometer (km^2)	=	0.3861 square mile
1 hectare (ha)	=	2.4711 acre
1 cubic meter (m^3)	=	35.3147 cubic foot
1 million cubic meter (Mm^3)	=	810.7000 acre foot
1 kilogram (kg)	=	2.2046 pound
1 metric ton (mt)	=	2,204.6000 pound
1 liter per second (l/sec)	=	0.0353 cubic foot per second

ABBREVIATIONS

PDRY	= People's Democratic Republic of Yemen
MAAR	= Ministry of Agriculture and Agrarian Reform
LADB	= Lahej Agricultural Development Board
DTDB	= Delta Tuban Development Board
NBY	= National Bank of Yemen
NCHT	= National Company for Home Trade
NCFT	= National Company for Foreign Trade
PCMVF	= Public Corporation for Marketing of Fruit and Vegetable (ex-Horticulture Cooperative Union)
PWC	= Public Water Corporation
MRS	= Machinery Renting Station
PCEP	= Public Corporation of Electric Power
NMC	= National Meat Corporation
PWD	= Public Works Department
ADF	= Agricultural Development Fund
PCLT	= Public Corporation for Land Transport

GOVERNMENT OF PDRY FISCAL YEAR

January 1 - December 31 (From 1976)

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Table of Contents

	<u>Page No.</u>
SUMMARY AND CONCLUSIONS	i-ii
I. INTRODUCTION	1
II. COUNTRY BACKGROUND	1
General Description	1
The Agricultural Sector	2
Previous Projects in the Agricultural Sector	3
III. THE PROJECT AREA	3
General	3
Climate	4
Soils and Topography	4
Land Tenure, Cooperatives and State Farms	4
Land Use and Agricultural Production	5
Agricultural Support Services	6
Research	6
Extension	6
Credit	6
Marketing	7
Transportation	8
Taxation	8
IV. THE PROJECT	8
Objectives	8
Description	9
Engineering Status	10
Cost Estimates	10
Financing	12
Implementation Schedule	12
Procurement	12
Disbursements	13
Water Supply, Quality and Requirements	14
Water Rights	14
Environmental Impact	15

Table of Contents (Continued)Page No.

V. PROJECT IMPLEMENTATION	15
Organization, Management and Technical Assistance	15
Operation and Maintenance	17
Technical Assistance and Training	18
Credit	18
Recovery of Costs	19
Accounts and Audits	20
Monitoring	20
VI. PRODUCTION, MARKETS, PRICES AND FARM INCOME	21
Cropped Area, Yields and Production	21
Livestock	23
Markets	23
Prices	24
Subsidies and Taxes	24
Producer Income	24
VII. BENEFITS AND JUSTIFICATION	26
Main Benefits and Beneficiaries	26
Economic Evaluation	27
Project Risks	27
VIII. AGREEMENTS REACHED AND RECOMMENDATIONS	28

ANNEXES:

1. Country Background and Agriculture Sector
2. Agriculture
3. Water Availability and Requirements
4. Land Tenure, Cooperatives and State Farms
5. Description of Project Works
6. Consultant's Terms of Reference
7. Outline for Agricultural Policies Study
8. Cost Estimates
9. Estimated Schedule of Disbursements
10. Organization and Management
11. Marketing of Project Output
12. Farm Models and Farm Incomes
13. Economic Rates of Return

FIGURES:

- WB 17632: Organization of Ministry of Agriculture and Agrarian Reform
WB 17755: Present Organization of Lahej Agricultural Development Board
WB 17523: New Organization of Delta Tuban Development Board
WB 17756: Proposed Cropping Pattern for Groundwater Irrigated Areas
WB 17906: Organization of Production Cooperatives
WB 17904: Implementation Schedule
WB 13013: General Map of Project Area

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

SUMMARY AND CONCLUSIONS

i. The People's Democratic Republic of Yemen has very few known resources including surface or groundwater. Only about 110,000 ha are arable or about 0.3% of the country's total land area of 338,100 km². Most of the arable land (76%) depends upon seasonal floods thus subjecting agricultural production to considerable fluctuations from year to year. About 70% of the cultivated land is in cereals consisting primarily of sorghum and millet. The other major crops are cotton (about 7% of the cultivated land), sesame (5%) and vegetables (5%). Agriculture employs about 60% of the people and generates about 23% of the GDP and from 25% to 45% of export income. Domestic production of cereals is below local demands and agricultural imports comprise about 40% of the import bill. The major export is cotton.

ii. In the current Five Year Plan (1974-1978), Government has allocated approximately 37% of its investments to the agriculture and fisheries sector. In addition, a significant portion of the transportation allocation is earmarked for road construction which will improve the transfer of agricultural goods and supplies to and from production centers. The proposed project is compatible with the national program. It will contribute towards export earning and provide food, feed and fiber for local consumption, livestock enterprises and agro-industries.

iii. The project will provide for purchase of fertilizers and plant protection chemicals (all requirements for the first year and the incremental needs for the second, third and fourth year); procurement of tractors, farm implements and pumpsets to replace obsolete and worn out equipment; a buried pipe irrigation distribution system; construction of feeder roads and a rural water supply to serve 6,000 persons; planting of shelterbelts; a water management and feasibility study to determine groundwater resources and the use of sewerage water for irrigation; a study on agricultural price, taxation and subsidy policy systems; and technical assistance. The project will be implemented in four years by the reorganized Delta Tuban Development Board (DTDB), a semi-autonomous body with a direct link to the Minister of Agriculture. Five expatriate experts, one for four years, two for three and a half years, and two for two years will be provided to assist the DTDB, one of whom will be the project manager. Each expert will have a counterpart (Yemeni graduate) except the project manager who will have two. One counterpart will serve as co-manager. In-service and short-term overseas training will also be provided for Yemeni personnel.

iv. The project cost, including physical and price contingencies, is estimated at US\$12.3 million, of which 79% will be foreign exchange. The proposed IDA credit of US\$5.2 million will finance about 52% of the foreign costs (US\$5.0 million) plus approximately 8% of local costs (US\$0.2 million) or 42% of the total project cost. It is expected that another external source will supply a loan of US\$6.1 million which will finance the remaining 48% foreign exchange (US\$4.6 million) plus 57% of local costs (US\$1.5 million). The Government of PDRY will finance about US\$1.0 million covering about 36%

of the local costs or 8% of total project costs. The civil works (feeder roads and rural water supply) included in the project do not lend themselves to international bidding and will thus be constructed by force account or under negotiated contract. All imported goods and supplies will be procured by international competitive bidding except for small items with an aggregate value of US\$200,000.

v. Farming in the project area is carried out by 7 production cooperatives in the spate area and 12 state farms in the groundwater irrigated areas. Cotton (60%), sorghum (30%), melons (5%) and sesame (5%) are the crops in the spate region. In the groundwater area, tomatoes (50%), sorghum (grain and forage) (30%) and a wide variety of vegetables (15%) are the main crops. Four of the state farms specialize in livestock production, mainly dairying, beef fattening and sheep and goat raising. Fertilizers and plant protection chemicals will be supplied under short-term credits, whereas agricultural machinery, equipment and pumpsets will be furnished under medium-term credits. Irrigation improvement investments will be recovered from state farms over a 20 year period with interest.

vi. At full development, the project in 1984 will increase the annual gross value of agricultural production (in economic prices) by about 107%. The net value added will be increased by about 218%. The net annual savings in foreign exchange will be approximately US\$1.2 million, discounting any expansion in demand induced by increased incomes. There will also be an increase in public revenues of about 134% from the area. The economic rate of return (ERR) of the project as a whole is 24%, or 27% excluding the infrastructure (roads and water supply) and the water and agricultural policy studies. The ERR is 52% in the spate irrigated area alone, and 22% for the perennially irrigated area. For the orchard development alone the ERR is 29%. Excluding the infrastructure and reducing the benefit stream by 20% and simultaneously increasing the cost stream by 20% the ERR is 12%.

vii. As a result of the project in the spate area approximately 7,000 farm families (36,000 persons) will benefit; their average income, after taxes and levies, rising from about YD 51 (US\$148) to YD 84 (US\$242) per family, an increase of 63%. A majority of these families are in the target group, defined as those whose incomes are below the Relative Poverty Level (US\$75 in 1976). The feeder roads will link about 9 villages with the main road and the village water supply will improve the health of approximately 6,000 persons. About 200,000 days of work will be created by construction during the project period and an increase of 326,000 days per annum on farms following completion of project. The water management study will determine how to maximize the use of available water and could produce information that might lead to an expansion of irrigated agriculture in the region. The agricultural policies study will result in recommendations for alternative policy instruments to improve productivity, resource mobilization and income distribution. The DTDB with its management and extension capabilities developed by technical assistance and training under the project will be a significant institution in the Wadi Tuban Delta.

viii. The necessary assurances having been obtained during negotiations, subject to the conditions of effectiveness, the project is suitable for an IDA credit of US\$5.2 million on standard terms. The Borrower will be the People's Democratic Republic of Yemen.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

I. INTRODUCTION

1.01 The Government of the People's Democratic Republic of Yemen (PDRY) has requested assistance from IDA to help finance an agricultural project in the Wadi Tuban Delta in the Second Governorate. The proposed project aims at increasing agricultural production and improving irrigation efficiency in the present spate and groundwater irrigated lands in the Wadi. The project will finance fertilizers, plant protection chemicals, irrigation improvement, farm machinery, technical assistance, as well as a rural water supply scheme and feeder roads. It will also support a water management study to determine the status of water resources in the Wadi, develop a plan for its efficient use and determine the feasibility of using waste water for irrigation. Provisions have also been made for a study of agricultural policies which will develop alternative policy instruments for improvements in productivity, resource mobilization and income distribution.

1.02 The proposed credit will be the seventh IDA credit to PDRY and the third to the agricultural sector. The first loan for agriculture was for a project in the fisheries sub-sector (Cr 370-YDR) which, although initially hampered because of various delays in project implementation, is now proceeding satisfactorily. The second credit was for agricultural development in Wadi Hadramaut (Cr 615-YDR). The latter has only recently begun to be implemented because of delays in appointing consultants.

1.03 The project evolves from an FAO/UNDP project sub-contracted by FAO to ITALCONSULT, Rome, on "Soil and Water Conservation and Utilization in the Wadi Tuban Watershed Area". The project was planned with the assistance of the FAO/IBRD Cooperative Program (CP) mission in May 1976 and prepared by another CP mission in December 1976. This appraisal report is based on the findings of an IDA mission to PDRY in April/May 1977, composed of Messrs. F. Sands (agriculturalist, mission leader); M. Mian (irrigation engineer); and G. Donovan (economist). Messrs. J. Tellez and U. Kiermayr have also contributed to this report.

II. COUNTRY BACKGROUND

General Description

2.01 PDRY, with an area of 338,100 km², is divided into six governorates for administrative purposes. It has a population of 1.7 million (Jan. 1976), which is increasing at an annual rate of 2-3%. The population density averages only five persons per km² of total land, but 1,600 per km² of arable land. The per capita GNP for 1976 was estimated to be US\$280.

2.02 PDRY has few known natural resources. Much of its territory is either mountainous and rugged or desertic, while the climate is arid, characterized by high temperatures and very little precipitation. These conditions

plus the absence of perennial surface water streams limit the scope for agricultural development. No minerals of commercial importance or oil have been discovered, although explorations are continuing along the northeastern borders.

2.03 Government is now pursuing a policy of developing the commodity-producing sectors of the economy and providing the infrastructure to integrate production areas with consumption centers. Government is emphasizing development in agriculture, fisheries, mining and manufacturing.

The Agricultural Sector

2.04 About 65% of the population of PDRY is classified as rural or nomadic, while the agricultural sector generates about 23% of the GDP and from 25% to 45% of export income. Agricultural imports comprise about 40% of the imports bill, so that the scope for substitution is considerable (Annex 11).

2.05 Only about 110,000 ha of land are arable, or about 0.3% of the country's total land area of 338,100 km². Since about 76% of the arable land depends upon irrigation by seasonal floods, agricultural production is subject to considerable fluctuations from year to year. Cereals occupy about 70% of the cultivated land, with sorghum and other millets taking up almost 80% of the cereals area. Other major crops include cotton (about 7% of the cultivated area), sesame (5%) and vegetables (5%). Stover and forage are important by-products of cereal production, since they sustain the country's livestock.

2.06 Production of most cereals is of a subsistence nature, with small farms producing little marketable surplus. There are significant imports of all major foodstuffs - wheat, rice, sugar, meat and milk. In 1975 the value of imported agricultural commodities was about fourteen times as great as the value of exported agricultural commodities (seven times if fisheries exports are included). The major export item is cotton, while in 1976, imports included 36,000 tons of rice, 55,000 tons of wheat, 26,000 tons of wheat flour, 5,000 tons of millets and 22,000 tons of sugar (Annex 11). The inflow of cereals was probably almost as great as domestic production in that year.

2.07 Most agricultural production has been organized into cooperatives and state farms since 1970, and Government sets all prices for inputs and outputs. At present, prices for sorghum and maize are set at from 60% to 75% above world market levels, but the cotton price received by farmers is well below its export level. Farmgate prices for fertilizers are from 30% to 60% above world levels, while the hire rates for agricultural machinery are considerably less than actual costs of operation and maintenance. Agriculture is also relatively heavily taxed, with flat rate levies on most commodities (Annexes 4, 12).

2.08 There is considerable scope for increasing agricultural output in the country through use of fertilizers and plant protection chemicals, adoption of improved crop varieties, and more efficient use of available irrigation water. Several studies are currently underway which may lead to expansion of irrigation by tapping currently unused sources of water. In the current Five Year Plan (1974-1978), about 37% of investment has been allocated to the agriculture and fisheries sector. In addition, a significant proportion of the

25% of investment allocated to transportation is being used to construct roads which will increase possibilities for regional specialization and intensification in agriculture. The proposed project conforms well with the country's needs by contributing towards both export earnings (cotton) and import replacement (cereals, tomatoes for paste production, forages for livestock and some increase in oilseeds output), while adding some feeder roads and providing for an additional water feasibility study.

Previous Projects in the Agricultural Sector

2.09 The Bank group has financed two projects in the agricultural sector, both of them IDA credits, one for the development of fisheries and the other for agricultural development in Wadi Hadramaut. Under the Fisheries Project (Credit 370-YDR), IDA through a credit of US\$3.5 million and a supplementary credit of US\$1.6 million to cover increased costs due to foreign and domestic inflation, provided 100% of foreign expenditure for: (a) materials, machinery, installation equipment and vehicles related to shore facilities; (b) civil works for shore facilities; (c) engines, fishing gear, office equipment and vessel hulls; (d) consultants' services relating to engineering and management studies, and emoluments of operational personnel; and (e) consultants' services relating to fisheries development, agricultural and water supply studies. The project, although initially hampered because of various delays in project implementation, is now progressing satisfactorily.

2.10 The Wadi Hadramaut Agricultural Project (Credit 615-YDR), became effective on September 16, 1976. IDA through a credit of US\$7.0 million, provided 100% of the foreign expenditures and 74% of local expenditures for: (a) agricultural equipment and supplies; (b) civil works involving equipment for and construction of feeder roads and village water supply works; (c) a date packing plant; (d) a feasibility study to determine water resources in the area; (e) an experimental program on sand dune stabilization and optimizing date palms yield; and (f) technical assistance in the form of management personnel, consultants and training of Yemeni personnel. Project implementation has been unexpectedly slow mainly because of difficulties experienced in securing suitable expatriate personnel.

III. THE PROJECT AREA

General

3.01 The project is located in the southern district of the second Governorate of the People's Democratic Republic of Yemen (Map IBRD 13013). Lahej, the capital of the Governorate and the center of the project area, is approximately 40 km north of Aden, the capital of the country and a major seaport. The project area covers the Wadi Tuban Delta and encompasses approximately 10,000 ha of arable land (about 9% of the country's total), of which 2,100 ha are suitable for well irrigation and 8,000 ha can be spate irrigated. There are 12 state farms operating on about 2,100 ha irrigated by 75 tubewells supplemented by spate water in three farms. Crop production throughout the year is possible on the farms. In the spate area there are 7 cooperatives farming about 6,500 ha of which about 5,000 ha are usually flooded annually.

Only one crop per year, with high peak period demands for labor, is possible in this area. The paved main road from Aden to the border of the Yemen Arab Republic in the north passes directly through the project area. Feeder roads linking villages in the area are mainly earth tracks and require the use of four-wheel drive vehicles. Two cobbled feeder roads, constructed by Ministry of Agriculture and Agrarian Reform (MAAR), link Jawala State farm and the tomato paste factory to the main road.

3.02 The villagers usually obtain their water for domestic and livestock use from shallow wells. These wells tend to dry up and have to be continuously deepened. The rural areas are not supplied with electricity for domestic use but each state farm has electricity. School attendance is high for the six years of compulsory education, but classroom facilities and teacher/pupil ratios are not satisfactory. Education at the intermediate and college levels is provided by Nasser Higher Institute of Agriculture at Lahej. Malaria is the major disease in the area. Although there is one hospital and health center at Lahej, health care and preventive medicine are inadequate in the rural areas outside Lahej. There is a branch of the Institute of Health Man-power Development (Aden) established in Lahej for training practical nurses.

Climate

3.03 The climate in the project area (Annex 2) is characterized by low and erratic rainfall (less than 100 mm/year), high temperatures (average 24°C daily in winter and 33°C in summer), relatively high humidity (annual average 66%) and long periods of sunshine (seven hours/day annual average). Winds of 10 to 20 km/hr. prevail throughout the year mainly during daytime. Evaporation rate has an average value of 6.6 mm/day but may go above 9 mm/day in mid-summer and as low as 2.8 mm/day in winter (Annex 2).

Soils and Topography

3.04 In the spate area the soils consist of deposits of silty materials over the original sandy or gravelly soils. The deep deposits are usually loams, silt loams or silty clay loams. In the perennial irrigated areas, where there has been little or no deposition of silty materials, the soils are generally sandy with occasional gravelly alluvial deposits.

3.05 In the heavy textured soils in the groundwater irrigated areas salinity may build up, although it can easily be reduced by leaching with high applications of water. All soils are deficient in nitrogen. Available phosphorus and potassium in the spate areas are higher than in the perennial irrigated areas (Annex 2). The soils in the spate and groundwater irrigated areas are satisfactory and present no unusual problems.

3.06 The topography in the project is relatively flat with a north-south slope of less than 1%.

Land Tenure, Cooperatives and State Farms

3.07 Under the Agrarian Reform Law of 1970, land ownership was limited to 8 ha irrigated or 16 ha non-irrigated per primary family. Land in the

project area is now organized in cooperatives and state farms (Annex 4), the latter being required by law to have a permanent source of irrigation water (from wells), while the cooperatives are mainly spate-irrigated.

3.08 In the project area there are seven cooperatives, with 7,000 farm families and a cultivable area averaging about 1.1 ha per farmer member. Most individually operated holdings are between 1 ha and 2 ha. Six of the cooperatives are of the Model 1 type, with individually operated farm holdings in the context of collective responsibility for obtaining credit, and for marketing produce. The one remaining is a Model 2 cooperative, with all means of production (including livestock) collectively operated and members remunerated on the basis of work shares. Each cooperative is administered by an elected board of 7-10 members, with an elected chairman and secretary, assisted by appointed accounting and technical staff. Tractors and farm equipment are hired from the Machinery Rental Station (MRS). There is insufficient equipment, however, to allow timely mechanized operations, and development in the cooperatives is also hindered by lack of trained staff (especially in accounting and record collection) and by inadequate technical assistance.

3.09 The twelve state farms in the project area have about 2,100 ha of cultivable land and employ about 2,600 workers (Annex 4). Each farm has a Government appointed manager responsible for supervising operations and hiring labor. Crop plans are set by Government but are sometimes modified later by consideration of the resources of a particular farm. Four of the farms in the project area specialize in livestock production - dairying, sheep and goat raising and beef fattening. The farms own most of their own machinery, but they lack equipment appropriate to the tasks to be performed. In addition, major improvements are required in the irrigation systems on state farms to increase efficiency of water use, and they also have a shortage of technically trained personnel.

Land Use and Agricultural Production

3.10 The area cultivated under spate-irrigation in the project area varies widely depending on the seasonal flood, but averages about 5,000 hectares. A program of land levelling and irrigation works being carried out under bilateral aid, projected to be completed by 1981, is expected to improve water use and allow an expansion of the average area spate-irrigated to 6,500 ha. Approximately 60% of the area is sown to cotton, 30% to sorghum and 5% each to watermelons and sesame. Practically no fertilizers are used on spate-irrigated lands, while use of plant protection chemicals is confined to cotton and, to some extent, watermelons. Yields are low, estimated at about 0.7 tons/ha for cotton, 1.0 tons/ha of red sorghum grain (0.6 tons/ha for white sorghum), 0.4 tons/ha of sesame and 10.0 tons/ha for watermelons. Livestock are fed on stover and forages from the sorghum crops. Further details of yields and production are in Annexes 2 and 11.

3.11 On the state farms, under perennial irrigation, about 2,000 ha are cultivated with an intensity of 105%. The dominant crop is tomato (for paste production) which takes up 50% of the total cultivated area, having displaced

the long staple cotton which was formerly grown. Sorghum for grain and forage occupies 30% of the cultivated area, melons and a wide variety of vegetables (mainly okra, eggplant, onion, pepper and potato) about 15%, and there are small areas of maize, forage legumes and other crops. Fertilizers are used to some extent on most crops, and a limited amount of plant protection chemicals on tomato, melons and vegetables. Yields per hectare are estimated to be as follows: sorghum forage 35 tons, legume forage 15 tons, maize grain 1.5 tons, watermelons 15 tons, tomatoes and vegetables 12 tons (Annex 2).

3.12 Also in the state farms there is a small orchard area of 105 ha, consisting mainly of bananas yielding about 15 tons/ha and old mango trees yielding about 8 tons/ha. The banana plantation is in the process of being removed because of disease problems, and this entire area would be converted into a new mango orchard under the project.

Agricultural Support Services

3.13 Research. The strongest support service in the project area is the on-going research program at the El Kod Research Center operated by Government with assistance from FAO/UNDP. Over the past ten years, package programs have been developed to increase production of cotton, sorghum, maize, tomatoes and other vegetables. Another FAO/UNDP sponsored program operating in the Wadi Tuban has demonstrated the effectiveness of improved cultural and irrigation practices in increasing yields and conserving water when raising the crops mentioned above. Project management will draw heavily upon the results of these programs to implement the proposed development project. The forestry and horticultural nurseries at El Kod will supply the seedlings for the shelterbelts and orchards (Annex 2).

3.14 Extension. At present there is no functional Extension Service in MAAR, although Government intends to develop such a service. The DTDB in the spate area has 18 persons designated as Extension Agents working with cooperatives. These agents, due to their training and technical support, are functioning mainly as data collectors. Project management will have to train and develop an effective Extension Service in order to implement the project. It has been the lack of an Extension Service that has prevented the research data on improved varieties, fertilizers and plant protection chemicals from being applied in the project area.

3.15 Training facilities for agriculture and support services are available in and near the project areas. It is expected that through retraining some of the present Extension Agents, selection of graduates from the Agricultural Training Center at Giar and/or diploma graduates from Nasser Institute at Lahej, in-service training and overseas training, an effective Extension Service will be developed for the proposed project (Annex 2).

3.16 Credit. The two major credit institutions are the National Bank of Yemen (NBY) and the MAAR Agricultural Development Fund (ADF). The NBY (Annex 1, Table 2), through its Industrial and Agricultural Advances Branch, extends both short-term and medium-term credit, at interest rates between 5%

and 6%, to cooperatives and state farms. In addition, this Branch lends for industrial purposes and to the Ministry of Fish Wealth, as well as extending overdraft facilities to various marketing and industrial organizations. There is an office of the NBY at Lahej in the center of the project area. Loans of up to YD 10,000 may be approved by the General Manager of NBY, while those greater than YD 10,000 must be decided upon by the Management Committee. To obtain a loan, a cooperative's application must be approved by MAAR after careful evaluation, and all loans are secured to NBY by the Ministry of Finance. For non-prompt repayment of loans a penalty of 2 percentage points is added to the basic interest rate. The Industrial and Agricultural Advances Branch had loans outstanding at March 31, 1977 of YD 1.6 million, of which only YD 17,000 (1%) were overdue. Facilities extended on a one-year renewable basis, mainly to public marketing entities, totalled YD 5.3 million at March 31, 1977. The ADF (Annex 1, Table 3) whose capital comes mainly from Government surpluses in the export of cotton, extends mainly medium-term credit at interest rates of 1%-2% for purchase of equipment such as pumpsets and agricultural machinery. Loans outstanding from the ADF to cooperatives and state farms in the project area total about YD 162,000 (Annex 4, Table 1).

3.17 Marketing. The former major export crop in the project area, long staple cotton, was brought by farmers to collection centers of the former Lahej Agricultural Development Board (LADB) where it was weighed and graded before passing to the Board's ginnery. From the ginnery, cotton lint passed to the National Company for Foreign Trade (NCFT). Government has recently decided to replace long staple cotton in the spate-irrigated areas with medium staple cotton in order to supply the textile factory at Dar Sa'ad. Long staple cotton in the perennially irrigated areas has been displaced by tomatoes. In the future, medium staple cotton surplus to the needs of the textile factory will be exported. A recently established edible oil and feed production plant in Aden processes cotton seed, and also sesame seed, a small amount of which is grown in the project area.

3.18 Vegetables are collected by the Public Corporation for Marketing Fruits and Vegetables (PCMFV) at two receiving stations in the Second Governorate (one in Lahej, with 500-ton capacity) and sold through the Corporation's retail outlets in Aden and other localities. The PCMFV plans to have four receiving stations and five selling stations in the Second Governorate by the end of 1978. The Corporation's storage capacity in Aden totals 5,000 tons including 1,500 tons of cold storage, and a further 1,000 tons of cold storage capacity is planned for the 1978/79 season. A fleet of about 70 trucks enables the PCMFV to operate a flexible collection and selling system. There is scope for developing the sale of fresh vegetables to ships bunkering in Aden harbor.

3.19 A tomato paste factory, about 17 km from Lahej, handles approximately two thirds of the current output from the area, with the balance being sold as vegetables through the PCMFV. The factory's capacity of 120 tons of tomatoes per day was about two thirds achieved in the Spring of 1977. During the 1976/77 season, the factory processed more than 7,000 tons of tomatoes and produced more than 6.8 million cans of paste (6 million of 150 gms and 800,000 of 450 gms). There is considerable scope for increasing the factory's efficiency and also for using it in other seasons for vegetable canning.

3.20 The majority of cereals are produced for subsistence use, but the marketed surplus is acquired and distributed by the National Company for Home Trade (NCHT). Six storage silos were recently constructed south of Lahej, in the project area.

3.21 The National Meat Corporation (NMC), with two slaughter houses in Aden and Sheikh Othman, handled about 58,000 sheep and 2,000 cattle in 1976. New cold storage facilities (440 tons capacity) are expected to be completed by the end of 1977. So far the NMC has slaughtered mainly imported livestock, but is taking output from the livestock state farms as their production expands. In addition, the NMC buys and sells live animals, some of which go to state farms for breeding, and some to households and restaurants for their own slaughter and use.

3.22 A system of official prices covers all major output from the project area (Annex 11). Many of these prices were increased in early 1977 after remaining stable since 1973. Government control of the marketing function in cooperatives, and also of most marketing institutions, allows the official prices to hold and govern the exchange of most commodities.

3.23 Transportation. The transport of goods in PDRY is also controlled by Government. There are about 360 trucks (8-12 ton capacity) owned by families and individuals, which in 1976 moved about 80%-85% (on a dry weight basis) of the total goods carried in the country. Individual operators pay a commission to the Public Corporation for Land Transport (PCLT) which has its own fleet of 110 (12 ton) trucks, as well as running the approximately 360 buses used in the country. About 75% of the Corporation's commodity transportation activities involve consumer goods (mainly foodstuffs). Standard rates are set according to the road surface, as follows: Tarmac YD 0.075/ton/km, Sandy Tracks YD 0.113/ton/km, and Rough Terrain YD 0.150/ ton/km. These rates are said to cover about 75% of actual costs, with the balance being Government subsidy.

3.24 Taxation. On both cooperatives and state farms, the Government levies a tax of 15% of the gross value of cotton, cereals, forages and tobacco, proceeds of which go to the State Treasury. A similar levy is extracted from the marketing margin of the PCMFV as a portion of the difference between its buying and selling prices for vegetables. The latter difference averages more than 50% of the buying prices, and ranges from 18% to more than 100%. A further levy of 5% of the gross value of produce goes towards meeting administrative expenses of the cooperatives.

IV. THE PROJECT

Objectives

4.01 The main objective of the project is to increase agricultural production and thereby farm income in Wadi Tuban Delta by increasing the cropping intensity in the groundwater irrigated areas and crop yields through use of

modern inputs and improved cultural practices in both the groundwater and the spate irrigated areas. Additional objectives are : (i) to construct feeder roads to connect nine villages with the Aden-Lahej paved road; (ii) to provide drinking water supply to six villages, which due to excessive depth of water table in their vicinity do not possess a potable water supply source; (iii) to maximize the use of available water by conducting a water management study for ascertaining the safe yield of the aquifer, locating an alternate source of potable water for Aden, examining the feasibility of using Aden's sewage effluent for additional irrigation and developing a comprehensive water use plan for the Wadi Tuban Delta; (iv) to recommend alternative policy instruments to improve productivity, resource mobilization and income distribution by conducting a study of agricultural prices, taxes and subsidies.

Description

4.02 The present knowledge of exploitable groundwater of the Wadi Tuban Delta does not permit groundwater extraction exceeding the current withdrawals (Annex 3). No horizontal extension of the perennial irrigation area is, therefore, contemplated at this stage. Ample scope, however, exists in the delta for raising crop production, by improving the efficiency of water use, intensifying crop rotations, providing better extension services, increasing use of inputs and improving cultural practices. The project works (Annex 5) for improving water use efficiency will include: (i) constructing buried pipe water distribution systems for an area of about 1755 ha to replace the existing unlined water courses conducting tubewell water to the fields; (ii) reorganizing basins and land-leveelling on the same area; (iii) constructing farm roads and providing wind breaks; (iv) replacing defective pumps and diesel motors with electric motors; and (v) providing earth-moving equipment for basin (levelling) improvement operations. To increase the agricultural yields on 2,100 ha of perennially irrigated and 6,500 ha of spate irrigated land will require (i) supply of about 1,515 tons of fertilizer and 49 tons of plant protection chemicals to meet full requirements of one crop year plus incremental requirements of the next three years of the project implementation (Annex 8, Table 2); (ii) supply of about 40 agricultural tractors with implements and other machinery to DTDB and state farms to replace their obsolete equipment and meet their additional needs (Annex 8, Table 6); and (iii) establishment of a mango orchard on 105 ha.

4.03 Potable water will be supplied to six villages with a population of about 6,000 (Annex 5). The works to be done in this connection will include construction of two tubewells, laying of sub-mains to connect the Lahej-Saber water supply main to the said villages and providing stand pipes at convenient points for supplying water to the population. About 22 km of feeder roads (Annex 5) will be constructed to connect 9 villages in the project area with Aden-Lahej paved roads to facilitate the movement of their farm inputs from and outputs to the market centers. Presently, these villages are served with earth tracks on which the movement of even four-wheel drive vehicles is a problem. The maintenance of water works and feeder roads will be done by PWC and PWD respectively.

4.04 Services of expatriate experts comprising an irrigation agronomist, an extension specialist, a civil (irrigation) engineer, a farm management specialist and a farm machinery expert will be provided to DTDB to help

achieve the project objectives and train its staff. Overseas, training facilities will also be provided to Yemeni project staff to improve their knowledge and efficiency (Annexes 5 and 10).

4.05 A water management study to be carried out by a firm of consultants is also included in the project. The objectives of the study will be to refine the estimates of the available surface and ground water potential of Wadi Tuban area, and to produce a long term water management plan for its optimum use for agriculture development, household and industrial uses. The study will, inter alia, include a feasibility study for utilizing Aden sewage water for irrigating coastal areas around Sheikh Othman and Beir Ahmed and a study for locating an alternative source of potable water supply for Aden city as well as a land use association (LANDSAT) study of selected areas in the territory of the Borrower, to identify areas with groundwater potential for future agricultural development (Annex 6).

4.06 A study on agricultural price, taxation and subsidy policy systems will be carried out by consultants. The objectives of the study will be to propose recommendations outlining alternative policy instruments that could be adopted and their projected effect on productivity, resource mobilization and income distribution. An outline of the proposed study is given in Annex 7.

Engineering Status

4.07 The engineering aspects of the project will involve the lay-out and hydraulic design of the buried pipe water distribution system, preparation of the field levelling plans as well as the design of the village water supply works and feeder roads. For estimating the irrigation improvement works, a 28 ha farm model was used. The work calculated using this model will approximate the final layout design, since the average farm will not materially differ from the model used. The engineering wing of the DTDB, which will be reinforced by an expatriate civil engineer and a qualified counterpart, will develop detailed plans for each farm before implementing the program. The alignments of the village water supply sub-mains and water distribution works required within the villages have been determined by the PWC. The detailed hydraulic designs will be made by the same organization before undertaking the construction. The roads will follow the existing track alignments and the standard design already developed for the area will be used.

Cost Estimates

4.08 The estimated total project cost, based on prices of mid-1977, is YD 4.2 million (US\$12.3 million), including contingencies. The foreign exchange component is estimated to be YD 3.3 million (US\$9.6 million), or 79% of total project cost. The costs of imported equipment and materials reflect international market prices; costs of civil works have been estimated for current force account practices in PDRY; and the estimates for consulting services are based on recent contracts for similar assignments in the region. Physical contingencies are 5% for most equipment (except for pipes and fittings for which 15% has been allowed) and 15% for all civil works. Price contingencies allow for annual increases in equipment costs of 7.5% in the period 1977-1979, and 7% thereafter. They allow for annual increases in costs of civil works of 9% in the period 1977-1979 and 8% thereafter. Total contingencies (physical

and price) are just over 38% of the base cost. No import duties are levied on imports for public development projects. Project costs are summarized in the table below, while detailed estimates are given in Annex 8.

Total Project Costs /1

<u>Item</u>	<u>Local</u> -----YD thousand-----	<u>Foreign</u>	<u>Total</u>	<u>Local</u> -----US\$ thousand-----	<u>Foreign</u>	<u>Total</u>	<u>%</u> <u>Foreign</u>
<u>Irrigation Improvement</u>							
Equipment							
Civil Works	-	904	904	-	2,622	2,622	100
Civil Works	333	287	620	966	832	1,798	46
<u>Fertilizer and Chemicals</u>							
Procurement Costs							
Procurement Costs	17	152	169	49	441	490	90
<u>Agricultural Machinery</u>							
Equipment Costs							
Equipment Costs	-	337	337	-	977	977	100
<u>Orchard and Shelterbelts</u>							
Establishment Costs							
Establishment Costs	40	-	40	116	-	116	-
<u>Project Management</u>							
Equipment							
Technical Assistance	4	39	43	12	113	125	91
Training	-	308	308	-	893	893	100
Operating Costs	-	54	54	-	156	156	100
Operating Costs	110	-	110	319	-	319	-
<u>Water Supply</u>							
Equipment							
Civil Works	-	50	50	-	145	145	100
Civil Works	23	24	47	67	69	136	51
<u>Feeder Roads</u>							
Civil Works							
Civil Works	57	24	81	165	70	235	30
<u>Agricultural Policies Study</u>							
Consultants							
Consultants	-	69	69	-	175	175	100
<u>Water Study</u>							
Equipment							
Consultants	-	36	36	-	104	104	100
Consultants	20	184	204	58	534	592	90
<u>Contingencies</u>							
Physical							
Price	86	281	367	249	815	1,064	77
Price	214	573	787	620	1,687	2,307	73
<u>Totals</u>							
Totals	<u>904</u>	<u>3,322</u>	<u>4,226</u>	<u>2,621</u>	<u>9,633</u>	<u>12,254</u>	<u>79</u>

/1 Discrepancies due to rounding.

Financing

4.09 An IDA credit of US\$5.2 million will finance about 52% of the foreign costs (US\$5.0 million) plus about 7% of local costs (US\$0.2 million) or 42% of the total project cost. A parallel loan of US\$6.1 million expected from an external source will finance the remaining 48% of the foreign costs (US\$4.6 million) plus about 57% of local costs (US\$1.5 million). The Government of PDRY will finance about US\$1.0 million, all local costs, representing about 36% of local costs or about 8% of total project costs. The financing plan is summarized below:

Components /1	Government		External Loan		IDA		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
-----US\$ million-----								
Irrigation Improvement	0.0	0	5.6	100	0.0	0	5.6	100
Fertilizer and Chemicals	0.1	10	0.0	0	0.5	90	0.6	100
Agricultural Machinery	0.0	0	0.0	0	1.1	100	1.1	100
Orchard/ Shelter-belts	0.1	100	0.0	0	0.0	0	0.1	100
Project Management	0.4	20	0.0	0	1.6	80	2.0	100
Water Supply	0.1	26	0.0	0	0.3	74	0.4	100
Feeder Roads	0.2	70	0.0	0	0.1	30	0.3	100
Agricultural Study	0.0	0	0.0	0	0.2	100	0.2	100
Water Study	0.0	0	0.0	0	0.9	100	0.9	100
Contingencies (physical)	0.1	7	0.5	52	0.5	41	1.1	100
Total Project Cost	1.0	8	6.1	50	5.2	42	12.3	100

/1 Price contingencies have been allocated to each component.

Implementation Schedule

4.10 The Project will be implemented in about four years in accordance with the schedule in Chart WB 17904. Project activities will commence by March 1978 and be completed by mid-1982. The estimated schedule of disbursements is in Annex 9.

Procurement

4.09 Feeder roads and village water supply works (US\$0.37 million excluding contingencies) are the only IDA-financed project elements involving civil construction. The small size and scattered nature of these works makes them

unsuitable for international bidding. Since construction contractors in PDRY are few in number and small in organization, these works will be carried out on force account or under local negotiated contracts. The equipment and imported materials required for these works, agricultural development and project management (US\$1.25 million); and fertilizers and plant protection chemicals (US\$0.49 million) will be procured through international competitive bidding. During negotiations, assurances were obtained that all the fertilizer, chemicals and equipment to be financed by IDA involving foreign exchange expenditure will be procured through international competitive bidding following "Guidelines for Procurement under World Bank Loans and Credits", except for minor items (costing less than US\$20,000 each) required for immediate use, whose aggregate value will not exceed US\$200,000, which will be procured under Government procedures, which are acceptable to IDA. Total value of goods to be procured under ICB will be US\$1.74 million (excluding contingencies) which is 25 percent of the total foreign cost of the project (excluding contingencies). Actual procurement will be performed by existing government agencies, chiefly NCHT and NCFT. For items financed by other external agencies, procurement will be in accordance with their own guidelines.

Disbursements

4.12 The proposed credit of US\$5.2 million will be disbursed over a 5-year period (Annex 9) as follows:

Agricultural Machinery and Equipment
for Water Supply
(US\$1.3 million)

- The actual foreign exchange costs of directly imported goods, or 85 percent of costs of locally procured goods.

Fertilizer and Chemicals
(US\$0.6 million)

- The actual foreign exchange costs of directly imported goods in the first year, and in any subsequent year the actual foreign exchange costs of directly imported goods over and above aggregate amounts imported in the preceding year.

Project Management
(US\$1.6 million)

- The actual foreign exchange costs of equipment, supplies, consultants, and overseas training for project staff; plus 20% of locally incurred costs.

Civil Works (Water Supply and
Feeder Roads)
(US\$0.2 million)

- 37% of total expenditures.

Water Study
(US\$0.9 million)

- 100% of total expenditures.

Agricultural Policies Study
(US\$0.2 million)

- 100% of total expenditures.

Unallocated
(US\$0.4 million)

- For contingencies.

Disbursement requests will be supported by required documentation. Any savings that remain after project completion will be cancelled.

4.13 The loan from external sources of US\$6.1 million (including all contingencies) may be disbursed as follows:

Earth Moving Machinery and Other Irrigation Equipment
(US\$3.3 million)

- The actual foreign exchange costs of directly imported goods, or 85% of costs of locally procured goods.

Civil Works (Irrigation)
(US\$2.8 million)

- 100% of total expenditures

A condition of effectiveness of the IDA credit will be the signing and ratification of a loan agreement, whose terms and conditions will be acceptable to IDA, with the other external source of financing.

Water Supply, Quality and Requirements

4.14 The average estimated annual run-off of Wadi Tuban at Al-Arais (apex of delta area) is about 135 Mm³. Electric conductivity of run-off water is low. The quantity and quality of water are both adequate for the proposed spate irrigation under the project. As regards groundwater potential, the volume of water saturated alluvium of Wadi Tuban Delta is estimated at 7300 Mm³. No precise assessment of the annual recharge is available. Studies conducted by FAO indicate that annual recharge from the Wadi bed and spate irrigated basins will lie between 40 Mm³ and 60 Mm³. The net extraction of about 28.52 Mm³ under the proposed project with its increase in crop intensity has been estimated to be practically the same as present net uses. The electric conductivity of the water in the existing irrigation wells lies in the upper range of acceptable limits. The irrigated fields, however, show no signs of salinity (Annex 3).

4.15 Apart from irrigation, 23 Mm³ is the estimated annual withdrawal from the aquifer for potable water supply in the project area. The total net withdrawals are, therefore, about 52 Mm³. The aquifer is thus taxed to its recharge limit. Mining of the aquifer would lead to salt water intrusion. It is, therefore, imperative that no additional tubewells, except for two proposed under the project to replace shallow village water supply wells, be drilled in the project area until the result of the water management study included in the project is known. An assurance to this effect was obtained during negotiations.

Riparian Rights

4.16 No riparian rights problems are anticipated in the area, although Wadi Tuban has a substantial proportion (about 70%) of its contributing catchment in the Yemen Arab Republic. This catchment is at higher elevations with an average annual rainfall of over 500 mm. The nature of the terrain and the amount of rainfall it receives is such that the risk of any significant diversion of the Wadi runoff by Yemen Arab Republic (YAR) is negligible. The project will not have any adverse effect on YAR as no work altering the wadi's surface flow regime is proposed. Thus the consent of the YAR is not necessary.

Environmental Impact

4.17 The project will have no adverse effects on the physical environment. The planting of approximately 210 km of windbreaks will assist in reducing sand encroachment on roads and arable farm lands. Through the provision of an improved water supply system in six villages, approximately 6,000 persons will benefit and have protection from the existing health hazards due to the present inadequate and unwholesome water supply system. The feeder roads to be constructed under the project will allow isolated villages easier access to the only hospital and clinic in the region. Increased production and availability of vegetables and proteins due to the project should help improve the diet and health of the human environment. Although plant protection chemicals will be used, no adverse effects are expected. However, at negotiations the Yemeni delegation was handed the Bank's guidelines indicating the precautions to be taken in the use of plant protection chemicals. In addition the extension agents, after training under the project would ensure the safe handling and use of recommended plant production chemicals used by farmers. The extension agents will, however, continue to make observations for any possible detrimental effects.

V. PROJECT IMPLEMENTATION

Organization, Management and Technical Assistance

5.01 Project implementation will be the responsibility of the Delta Tuban Development Board (DTDB), the successor of the Lahej Agricultural Development Board (LADB) (Annex 10, Chart WB 17755), which is directly responsible to the Minister of Agriculture and Agrarian Reform (MAAR). The Permanent Secretary of MAAR is Chairman of the Board. The daily control of DTDB is in the hands of a general manager appointed by the Board. The general manager is assisted by the heads of five sections, namely Agriculture, Cotton Ginnery, Accounting, MRS and the Secretariat (Annex 10 and Chart WB 17523). In order to effectively carry out the project, the DTDB will assume full control over the project staff and equipment to be employed in the Wadi Tuban Delta. The statutes enable the Board to appoint and assign project control to expatriate staff, expand and develop an extension service, design and supervise construction of civil works, plan the planting programs in cooperatives and state farms, undertake the distribution of inputs for the whole project area, and provide administrative and accounting support to and supervision of the state farms and cooperatives.

5.02 The project will be headed by an expatriate project manager who will be selected from the five expatriate specialists provided for the project, namely an irrigation agronomist (4 years), an irrigation (civil) engineer (3-1/2 years), an extensionist (3-1/2 years), a farm machinery expert (2 years) and a farm management specialist (2 years). The project manager will be employed either directly or through an international organization or a firm in consultation with and on terms and conditions acceptable to IDA. The project manager will report directly to the Chairman of the DTDB through the General Manager. The project manager will be assisted by two qualified counterparts with basic degrees in agriculture. One counterpart will serve as co-project manager. The other counterpart will assist with administrative tasks. The initial and any subsequent appointment of each counterpart will be in consultation with IDA. The appointment of the project manager and his two counterparts will be a condition of effectiveness.

5.03 The four other expatriate specialists will be employed either directly or through a firm in consultation with the project manager and IDA and will be employed by Government on terms and conditions acceptable to IDA not later than August 31, 1978. Each specialist will be assisted by at least one qualified agricultural Yemeni graduate. The initial and any subsequent appointment of each counterpart will be subject to the approval of the project manager. In addition to at least one counterpart, the extension specialist will be assigned not less than twenty-one extension agents, nine for the spate area and twelve for the perennially irrigated area. The appointment of the extension agents will be subject to the approval of the extension specialist and accomplished no later than December 31, 1978. In order to make training, organization and operation easy, however, at least 10 of the extension agents will be made available for appointment within one month of the assignment of the expatriate extension director. During negotiations, assurances were obtained in respect to the above. Details on the structure, organization and duties of the members of the DTDB are presented in Annex 10 and WB Chart 17523.

5.04 The DTDB, being responsible for project implementation, will carry out the engineering and planning of the project irrigation works, agricultural activities, budget preparation, input distribution, and after approval by the MAAR, its timely execution. The DTDB will through its extension service provide technical support and advice to the state farms and cooperatives through its extension service, carry out regular maintenance of tubewells, as well as the spate irrigation distribution system, and provide administrative and accounting support and supervision of state and cooperative farms. The DTDB will maintain liaison with El Kod Research Station and the Demonstration Farm being proposed for Wadi Tuban. The DTDB will prepare contract documents, including technical specifications, for all project procurement, but the actual procurement will be through the National Company for Foreign Trade (NCFT). Government uses NCFT as its sole importing agency. The construction of feeder roads and rural water supply schemes will be arranged by DTDB through PWD and PWC either by force account or under negotiated contract with the agencies. The DTDB will procure and install electric motors which will replace the remaining diesel engines on existing wells. An assurance was

obtained from Government that extension of the overhead power distribution lines required will be carried out by the Public Corporation for Electric Power (PCEP). Operation of the tubewells and pipe distribution will be under the control of each farm manager, who will be advised by DTDB.

5.05 The project will supply the full requirements of fertilizers and plant protection chemicals for the first year. Since the project will furnish only the incremental requirement of fertilizers and plant protection chemicals for years two, three and four, Government will have to procure the base requirements of these inputs for the three years in question. During negotiations, assurance was obtained that Government will procure from its own resources the required fertilizers and plant protection chemicals in a timely manner.

5.06 US\$1.9 million of the project funds will be channelled through the NBY which will on-lend these funds as short-term and medium-term loans (para 5.13). The remainder of the project funds will be disbursed through DTDB as direct project expenditures. The signing and ratification of a subsidiary loan agreement between Government and the NBY on terms and conditions acceptable to IDA covering funds to be on-lent by NBY will be a condition of effectiveness.

Operation and Maintenance

5.07 The continued and timely supply of fertilizers and plant protection chemicals is the most important maintenance aspect of the project. Their requirements will be determined from year to year and, in general, will approximate the quantities consumed in the last year of project implementation (present estimated value US\$0.6 million). Assurance was obtained during negotiations that after the first year of operation and throughout the life of the project, Government will procure from its own resources and annually distribute to the farmers in the project area, fertilizers and plant protection chemicals in an amount equivalent to at least those levels at which such inputs were applied in the last year of project implementation.

5.08 All agricultural equipment, whether owned by DTDB (MRS) or by the state farms, will be maintained by MRS, which is well equipped to do this. MRS will also provide tractor operators, whenever such equipment is rented out by MRS to cooperatives. The current rental rates are low and do not cover actual operation and maintenance costs. These rates will have to be approximately doubled to fully recover the actual operating and maintenance costs, and will have to be increased further if the capital cost of the equipment was to be recovered from the users. During negotiations assurances were obtained that full operation and maintenance costs will be recovered in MRS rental charges. Incremental farmers' income generated by the project, with equipment rental rates doubled will be about US\$94, with an overall cost recovery index of 61%, as shown by further cost recovery analysis (Annex 12, Tables 1 and 4). Estimated per capita income at full development will still be less than half of the Critical Consumption Level (CCL). Low levels are partly due to unfavorable cost price relations for the main cash crop--cotton. Without a change in Government's cotton price policy, further increases in machinery rental will leave insufficient incentives to project farmers (paras. 6.13-6.14).

5.09 Pumpsets are operated by the state farms, but are maintained by MRS. The present annual charge for this service is also insufficient to cover the actual maintenance costs and will have to be increased in order to recover, in full, the actual maintenance and repair costs. Irrigation distribution systems constructed under the project on state farms will be operated and maintained by state farms. The DTDB will continue to operate and maintain irrigation structures in the spate-irrigated areas. Irrigation levies in these areas, however, will remain at present levels, since raising them to recover full operation and maintenance costs will leave insufficient incentives to small farmers (cf. para 5.08). During negotiations, an assurance was obtained that MRS will increase its rates for pumpset maintenance to at least recover its actual operation and maintenance costs. Also, it was confirmed during negotiations that state farms will operate and maintain their own irrigation distribution systems; and that DTDB will continue to operate and maintain irrigation structures in the spate-irrigated areas.

5.10 The feeder roads and the rural water supply schemes will be maintained by PWD and PWC, respectively, with the assistance of some of the equipment provided under the project. The communities benefiting from the rural water supply will through payment of water charges contribute to the coverage of operation and maintenance costs of the system in proportion to volumes consumed. Assurances were obtained during negotiations that these project facilities will be properly maintained, with necessary charges being determined and collected.

Technical Assistance and Training

5.11 There is a total of 270 man-months of technical assistance (US\$2.1 million) allocated in the proposed project. The terms of reference for the specialists who will support the DTDB are presented in Annex 10, para 16. A total of 180 man-months of time will be involved. In addition, funds have been allocated for approximately 63 man-months of overseas training for the extension officers and 60 man-months for the counterparts in project related disciplines. Training will be of a practical nature and assurances were obtained at negotiations that the training program and candidates will be satisfactory to IDA and the Government.

5.12 The project provides for a water management study to be carried out by a consulting firm satisfactory to Government and IDA whose terms of reference are presented in Annex 6. Approximately 70 man-months are allocated for the study, scheduled to be completed over a 27 months period. A further allocation of 20 man-months was made for an agricultural policies study to be completed within the first year of project implementation. At negotiations, assurances were obtained that Government will appoint consultants for the studies on terms and conditions acceptable to IDA.

Credit

5.13 Of the total credit of US\$5.2 million, about US\$1.9 million (YD 649,000), or 16% of total project costs, will be on-lent by NBY as short-term and medium-term loans to cooperatives, state farms and the MRS. NBY will repay the Government over 12 years (including 2 years of grace) with an

interest rate of not less than 3% p.a. Of the total of YD 649,000, short-term lending will be about 36% (YD 236,000) and medium-term lending about 64% (YD 413,000). Short-term (seasonal) loans will be extended to the state farms and cooperatives for fertilizer and plant protection chemicals, mostly in kind, at an interest rate of 6%, in line with rates currently charged to cooperatives and state farms by NBY (para 3.16). Medium-term (5 to 7 years) loans will be made at 5-1/2 interest, to the MRS and state farms for agricultural equipment, again mostly in kind. During negotiations, assurances were obtained that short-term and medium-term loans will be extended at interest rates of not less than 6% and 5-1/2% respectively, and that any future upward adjustments in the interest rates on NBY loans will also be applied to sub-loans extended under the project.

5.14 Since the MRS does not have a depreciation fund and will be able to increase its rental rates only to levels required to cover operating and maintenance costs (para 5.08), it will not be possible for MRS to repay the subloans received under this project and to arrange equipment replacements whenever these became necessary. Government will therefore have to provide financial support to the MRS corresponding to the annuity due on subloans received from project funds. During negotiations, assurances were obtained from Government that: (a) it will give financial assistance to the MRS corresponding to the annuity due on their subloans in respect of agricultural equipment; (b) it will undertake to finance from its own resources future replacements of agricultural equipment and pumpsets for the project area, whenever such replacements became necessary; and (c) MRS rental rates will be reviewed and readjusted periodically, at intervals of not more than three years, so as to achieve the maximum practicable cost recovery. The review will cover all major cost-determining factors, including interest rates on agricultural credits, production taxes and government subsidies.

Recovery of Costs

5.15 Of the total project investment, 16% (US\$1.9 million) will be in short-term and medium-term loans. The short-term loans and about 69% of the medium-term loans will be recovered from project beneficiaries, while the remaining 31% of the medium-term loans (those to MRS) will be recovered through government support (para 5.14). Another 12% (US\$1.4 million) of project funds will be invested in rural water supply (4%) and the water study (8%). There will be no investment cost recovery for village water supply, in keeping with government policy. The water study and the agricultural policies study will not result in quantifiable benefits and therefore no direct recovery of cost would be required. Investment in feeder roads (3%) (US\$0.4 million) and in project management (18%) (US\$2.1 million) will be recovered through general taxation on increased production. Investment in irrigation improvements (51%) (US\$6.1 million) will be recovered by the Government from state farms over a 20-year period, with interest of 5% p.a. To summarize: of total project investment, 65% will be recovered from beneficiaries in full with interest, 21% will be recovered through general taxation, and the remaining 14% will not be recovered. Operation and maintenance costs of irrigation on state farms will be met in full by state farms, but irrigation levies in spate

irrigated areas will remain at present levels, since raising them to recover full O&M costs will leave insufficient incentive to small farmers (para 5.09). At negotiations, assurances were obtained that Government will recover the short-term and medium-term loans as outlined above, and will recover investments in irrigation improvements in state farms in full over 20 years with interest of 5% p.a.

Accounts and Audit

5.16 All organizations connected with project implementation, e.g. NBY, DTDB, MRS, PWD and PWC, will maintain separate accounts of all project expenditures relating to their respective agencies, and will have such accounts audited annually by the Central Organization for Audit, which has this responsibility by law. In addition, the Central Organization for Audit will examine disbursement applications for force account work under the project, to check that goods and services have been procured in member countries (where applicable), that goods have been received and work performed, that payment has been made, and that goods and services are eligible for financing and have been used in the project. Assurances were obtained at negotiations that the project and subloan accounts will be established and maintained by the organizations concerned; that these accounts will be audited annually; and that a copy of the audited annual accounts along with the auditor's opinions regarding disbursement applications for force account work will be sent to IDA within six months of the close of each PDRY fiscal year.

Monitoring

5.17 During and following project implementation, DTDB will maintain records of all inputs furnished to cooperatives and state farms, production costs, prices received and will also collect yield data and other relevant information. DTDB will also be required to prepare quarterly progress reports following a format satisfactory to Government and IDA. The quarterly progress reports will be submitted to MAAR and copied to IDA during and up to five years after project completion. Evaluation will be done by DTDB. In addition, DTDB will prepare a completion report using an outline to be agreed upon with IDA and submit this report to IDA within six months of the closing date of the project. Assurances in regard to the points mentioned above were obtained from Government at negotiations.

5.18 The MAAR will keep a continuous record of the groundwater table at state farms and PWC at potable water supply well fields in order to regulate the operation of wells to prevent mining of the aquifer and the possibility of salt water intrusion. MAAR will make the groundwater table data available to IDA for a period extending not less than 5 years after project implementation. Assurances to this effect were obtained during negotiations.

5.19 Since production records will be maintained by DTDB, it may be possible to increase production by introducing a system of recognition for specific achievements. An award could be given to the cooperative and state farm that reaches or exceeds the annual yield levels established for each year

for the major crops (Annex 2, Table 2). Another method could be the awarding of cups or ribbons each year for the cooperative and state farm with the highest average yield for specific crops.

VI. PRODUCTION, MARKETS, PRICES AND FARM INCOME

Cropped Area, Yields and Production

6.01 In the groundwater irrigated areas of the project covering 2,100 ha, intensive cultivation, use of improved inputs, and changes in the cropping pattern and new cultural practices are expected to make a significant increase in production. The projected yields are based on the results of the package programs developed by the El Kod Research Station and demonstrated in the field at the Wadi Tuban State Farm, both UNDP sponsored programs. It has been shown that the package program can more than double the average present yields with less water than is currently being used. To be on the conservative side in the economic analysis, in the groundwater irrigated area and the spate region, yields without project are present yields and assumed to remain at this level in the future. Without fertilizers, adequate pest control and no change in cultural practices, however, yields would undoubtedly decline in time. Data on the area, yields and production, with and without project in the groundwater irrigated areas, are presented in the table below. The projected yields for the major crops in the fourth year of the project are approximately 50% of current research yields. Details on yield increases and inputs are found in Annex 2.

Area, Yields and Production With and Without Project
Groundwater Irrigated Areas

Crop	Without Project			With Project			Increased Production (mt)
	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Yield (mt/ha)	Production (mt)	
<u>Annual Crops</u>							
Cotton	100	0.7	70	-	-	-	-
Tomatoes	1,000	12.0	12,000	650	27.0	17,550	5,500
Vegetables	150	12.0	1,800	400	27.0	10,800	9,000
Melon, water-melon	150	15.0	2,250	250	27.0	6,750	4,500
Maize	50	1.5	75	650	3.5	2,275	2,200
Sorghum (grain)	120	1.0	120	-	-	-	-
Sorghum (grain and forage)	130	1.0	130	-	-	-	-
Sorghum (forage)	350	3.0	390	-	-	-	-
Forage legumes	350	35.0	12,250	490	80.0	39,200	26.950
Other	12	15.0	180	450	22.0	9,900	9,720
Planted area	2,105				2,890		
Land area	2,000				2,000		
Crop intensity	105%				145%		
<u>Perennial Crops</u>							
Bananas	50	15.0	750	-	-	-	-
Mango (old)	55	8.0	440	-	-	-	-
Mango (new)	-	-	-	105	30.0	3,150	2,710

6.02 In the spate irrigated areas the land levelling program which is expected to be completed by the end of 1981 with bilateral aid will increase the area available for cultivation. The application of improved practices and use of fertilizers and plant protection chemicals under the project will bring about a substantial increase in production. The alluvial soils in the spate area are deficient apparently only in nitrogen. Thus the application of urea will stimulate root growth enabling all plants to exploit moisture and nutrients from a deeper level than they otherwise would. As a result, top growth should reflect improved root development and the larger plants with their higher yields would be protected by pesticides. Data on the area, yields and production, with and without project, are presented in the table below. Details on yield increases and inputs are found in Annex 2. Since the proposed program will only supply inputs and extension service activities

it could function even without the completion of the land levelling program. Land levelling activities are confined to the season without spate flow during which no cultivation takes place.

Area, Yields and Production With and Without Project
Spate Irrigated Areas

Crop	Without Project			With Project			Increased Production (mt)
	Area (ha)	Yield (mt/ha)	Production (mt)	Area (ha)	Yield (mt/ha)	Production (mt)	
Cotton M. S.	3,000	0.7	2,100	3,000	1.2	3,600	1,500
Red Sorghum	1,100	1.0	1,100	1,100	1.8	1,980	880
White Sorghum	400	0.6	240	400	1.2	480	240
Watermelon	250	10.0	2,500	250	19.0	4,750	2,250
Sesame	250	0.4	100	250	0.7	175	75
Planted Area	5,000			5,000			
Land Area	5,000			5,000			
Crop Intensity	100%			100%			

Livestock

6.03 In the Wadi Tuban Delta practically every farm family owns several head of livestock. All breeds are local and it is estimated that there are 10,000 head of cattle and 30,000 head of sheep and goats in the Wadi. The livestock are fed forage produced on the farm and crop residues. They also graze on crop stubble and the sheep and goats graze on the range. Since feed is limited, productivity is low.

6.04 The Government in recent years, in order to overcome to some extent its dependency on imported livestock products, has sought to upgrade the national stock and develop livestock production farms. Through bilateral assistance, approximately 2,000 Friesian and Boran cows have been imported from East Africa and an artificial insemination program has been developed. Selected breeds of Somali and Pakistani sheep and goats have also been imported. In the project area there have recently been developed state farms that specialize in livestock production such as dairy, beef fattening, sheep and goats. The change in the cropping pattern and the increase in crop production in the groundwater irrigated areas has been designed to a large extent to provide feed for the animals on these farms (Annex 2).

Markets

6.05 No marketing problems are foreseen with the project. Domestic production of vegetables, cereals and fodder crops falls short of demand. With the exception of cotton, most of the incremental production from the proposed project will be absorbed by the domestic market (Annex 11). Increased tomato production will be processed into paste or sold as fresh vegetables. Any vegetables which cannot be taken up by the local fresh market will be

canned in an existing factory at Fiyush which has surplus capacity, or will be sold to ships bunkering in Aden harbor. Increments to cereal production will represent about 4% of cereal imports in 1976 and will substitute for imports. Additional production of forage and fodder will lead to increased livestock production which will also substitute for imports. Cotton will be absorbed by the local textile factory, with any amount incremental to this factory's needs being exported.

Prices

6.06 Farm gate and consumer prices for all major agricultural commodities are fixed by Government, and a new announcement in early 1977 increased some prices which had been held constant since 1973. These prices are mostly uniform throughout the country and normally do not allow variations on account of differences in quality of produce. In the economic analysis, prices for cereals, cotton and fertilizers are based on import parity prices derived from projections provided by the Bank's Economic Analysis and Projections Department; economic prices of other commodities are estimated. Both economic and financial prices are given in Annex 13, Table 2.

Subsidies and Taxes

6.07 Subsidies. No depreciation funds have been established for replacement of equipment supplied to state farms and the MRS. Rates at which agricultural equipment is rented out by the MRS are about 47% of estimated operation and maintenance costs (varying with the operation, since actual costs vary, while the rental charge is fixed at YD 0.650 per hour for a 70 HP tractor). There is also a substantial subsidy in the annual fee charged by MRS for the maintenance of irrigation pumps and engines. During negotiations assurances were obtained that full operation and maintenance costs will be recovered in rental charges of the MRS, and that all fertilizers and plant protection chemicals will be sold at their actual cost to project beneficiaries. Subsidies thus reduced on machinery of the MRS will amount to an estimated YD 13,000 (US\$38,000) per annum. However, Government will incur responsibilities for loan repayment and machinery replacement (para 5.14).

6.08 Taxes. Government levies a 15% tax on gross value of production of cotton, cereals and forages. There is also a levy on gross value of vegetables, collected from the marketing margin of the PCMFV. A further levy of 5% on gross value of production in cooperatives covers administrative costs of a public nature incurred by these bodies. Public revenues from these sources are expected to increase from about YD 158,000 (US\$458,000) per annum to about YD 369,000 (US\$1.1 million) per annum or by 134%.

Producer Income

6.09 Two representative farm budgets have been prepared to illustrate project effects--one for a typical small farm of 1 ha in the spate irrigated area, operated as a family farm under cooperative arrangements (Model 1, Annex 12, Tables 1 and 4), the other for a 200 ha state farm in the groundwater irrigated area (Model 2, Annex 12, Tables 2 and 5).

6.10 For the spate farm area the average farm size is about 0.77 ha of cultivated land (fluctuating from year to year depending upon available water flow from the Wadi). Farm size data indicate an egalitarian agrarian structure--98% of holdings are less than 3 ha, 1.6% between 3 and 5.9 ha and only 0.4% are 6 ha or above; no holdings are larger than 16 ha. Income generated from about 6 ha will be equivalent to the Critical Consumption Level (CCL). Thus 99.6% of the 7,000 farm families (36,000 persons), the beneficiaries in spate irrigated farms, will still remain below the CCL at full development. The income projections are as follows:

	Without Project or 1976	Full Development or 1983	Percent Increase
	US\$ per capita		
Relative poverty level /a	75.0	106.1	41
Absolute poverty level /a	140.0	197.4	41
Farm income in project area after taxes and levies	29.0	47.9	65
National average income /a	280.0	393.8	41

/a Assumed to increase by 5.0% p.a. in real terms.

Practically all beneficiaries on spate irrigated farms will be in the target group, defined as those below the Relative Poverty Level.

6.11 In the groundwater irrigated area the state farms average 175 ha in size, but seven of the twelve have areas of 170 ha or more. These state farms employ approximately 2,600 workers, whose incomes will increase by 35% due to an increase in employment from 81 to 108 days annually. The income projections are as follows:

	Without Project or 1976	Full Development or 1983	Percent Increase
	US\$ per capita		
Relative poverty level /a	75.0	106.1	41
Absolute poverty level /a	140.0	197.4	41
Farm workers' income	31.8	43.0	35
National average income /a	280.0	393.8	41

/a Assumed to increase by 5.0% p.a. in real terms.

6.12 The calculated rent and cost recovery indices (Annex 12, Tables 4 and 5) are as follows:

	<u>Rent Recovery</u>	<u>Cost Recovery</u>
	-----%	-----
Spate irrigated area	49	61
Groundwater irrigated area	67	56
Overall indices	62	57

6.13 Substantial increases in cotton prices will need to be paid to farmers in order to increase their incomes to the Relative Poverty Level. Based on the spate irrigated area, the structure of returns and costs is as follows:

	<u>YD/ha</u>
Gross production:	82.2
of which:	
cotton:	42.0
other cash:	14.2
subsistence:	26.0
Production costs:	17.6
Taxes and fees:	13.4
Net farm income (family)	51.2
Relative Poverty Level (family)	133.1

Thus, at present, the price paid to farmers of YD 100/ton for medium staple unginned cotton (US\$290/ton) will have to be raised to YD 315/ton (or US\$913/ton) to increase their farm incomes to the Relative Poverty Level. This price level will be 62% above the present economic price of US\$563/ton.

6.14 At full development, the farm gate price of medium staple unginned cotton will have to be YD 252/ton (or US\$732/ton) to bring the farmers' income to the Relative Poverty Level for that period as compared with YD 100/ton (or US\$290/ton) at present levels. This price will be 34% above the world level price; however, a moderate price increase of 7% will suffice to enable farmers to repay the full capital cost of MRS equipment (para. 5.08).

VII. BENEFITS AND JUSTIFICATION

Main Benefits and Beneficiaries

7.01 The project will increase the annual gross value of agricultural production (in economic prices) by about 107% and the net value added by about 218%. There will be a net annual saving in foreign exchange of about US\$1.2 million, discounting any expansion in demand induced by increased incomes, and there will be an increase in the volume of public revenues of about 134% (para 6.08). The water study will produce data which could result in a

further expansion and intensification of irrigated agriculture in the area. The DTDB, with its extension and management capabilities built up by technical assistance and training under the project, will be an important institution in the area. The agricultural policies study will provide the Government with a choice of alternative policy instruments to improve farm incomes.

7.02 Principal beneficiaries of the project will be the 7,000 families in production cooperatives, or about 36,000 persons. On the state farms, which have about 2,600 employees, the increase in work with the project will be about 79,000 days per annum. Feeder roads will link about nine villages to the main road, and the health of some 6,000 persons will be improved in the seven villages served by the new water supply schemes. About 200,000 days of work will be created by construction during the project period, and an increase of 326,000 days per annum on farms following completion of the project, about 24% of which will be on state farms. The majority of the 36,000 principal beneficiaries are estimated to be in the target group, defined as those whose annual income is below the Relative Poverty Level of US\$75 (para 6.09).

Economic Evaluation

7.03 In performing economic analysis, the benefits arising from an expansion of cultivated area in the spate-irrigated portion of the project have been omitted, because these benefits are partially attributable to land levelling and other works being carried out under bilateral aid (see para. 3.10). In addition, no allowance has been made for benefits from the infrastructural components of feeder roads and water supply. The economic rate of return under these assumptions is estimated to be 24% (Annex 13). Economic rates of return for the project excluding infrastructure and the water and agricultural policy studies will be 27%, and for the spate-irrigated areas, perennially irrigated area and orchard development respectively would be 52%, 22% and 29% (Annex 13).

7.04 Sensitivity analysis for the whole project (excluding infrastructure) showed that a simultaneous increase in costs of 20% and decrease in benefits of 20% would reduce the economic rate of return to 12%. The combination of events which could give rise to this result is unlikely to occur in practice. For the perennially irrigated area alone, a decrease in the benefit stream by 25% would reduce the rate of return to 13%. Assuming a set of circumstances which is unlikely to occur in practice, equivalent to decreasing the benefit stream by 40%, the rate of return in the perennially irrigated area alone would fall to 8% (Annex 13).

Project Risks

7.05 There are no major risks inherent in the project. Under the project a water management study is being proposed with its major objectives being to refine the estimates of surface and groundwater potential and the recharge rate of the aquifer. The project as designed does not utilize more water than is currently being consumed for agricultural purposes (para 4.12 and Annex 3, para 8). If the proposed study indicates that there is mining of the aquifer,

this would have no effect on agricultural production in the spate region but irrigation intensity in the state farms (groundwater irrigated area) would probably be adjusted. However, if this were to result in a lowering of the benefit stream in the groundwater irrigated area even by as much as 25%, the sensitivity analysis indicates that the economic rate of return for this component would be lowered only to 13% (para 7.04). This would not, however, significantly reduce the 24% economic rate of return for the project as a whole. A possible risk could be the delay in the appointment of expatriate personnel, particularly the project manager. However, to safeguard against this, the appointment of the project manager and his two counterparts has been set down as a condition of effectiveness.

VIII. AGREEMENTS REACHED AND RECOMMENDATIONS

8.01 During negotiations, agreements were reached and assurances were obtained on the principal issues referred to in Chapters 4, 5 and 6. Subject to the conditions of effectiveness described in paras. 4.13, 5.02 and 5.06, the project is suitable for an IDA credit of US\$5.2 million on standard terms. The borrower will be the People's Democratic Republic of Yemen.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Country Background and Agriculture Sector

<u>Item</u>	<u>Unit</u>	<u>Amount</u>
Area	km ²	338,100
Population		
Total (Estimated, January 1977)	persons	1,770,000
Rural and Nomads (Estimated, January 1977)	persons	1,186,000
Growth Rate (1976)	%p.a.	2.7
Density (on total land)	persons/km ²	5.2
Density (on arable land)	persons/km ²	1,600
Income		
Total GNP (1975)	YD million	142
% GNP arising in Agriculture and Fisheries (1974)	%	19
GNP per capita (1976)	YD (US\$)	97 (280)
GDP growth rate in 197 ⁴ prices (1970-1975)	%p.a.	4.7
Growth rate of Agriculture's contribution to GDP, in 197 ⁴ prices (1970-1975)	%p.a.	3.8
Exports		
Total (1975)	US\$ million	11.4
Agricultural Products (1975) /1	US\$ million	4.8
Fishery Products (1975)	US\$ million	4.8
Imports		
Total (1975)	US\$ million	172.3
Agricultural Products (1975) /1	US\$ million	68.7
Land Areas		
Arable Area (0.3% of total land area)	hectares	110,000
Well-Irrigated Area	hectares	26,000
Spate-Irrigated Area	hectares	84,000
State Farms (number =37)	hectares	7,200
Cooperatives (number =42)	hectares	85,200

/1 For selected details, see Annex 11 , Tables 1-2.

APPRAISAL OF
HADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC OF YEMEN

Agricultural Production^{/1}
(Area in thousand acres and production in thousand tons)

Crop Year ^{/2}	Cotton Production	Sesame Production	Wheat Production	Barley Production	Sorghum and Other Millets Production	Fodders Production	Coffee Production	Tobacco Production	Vegetables Production	Potatoes Production	Cucumbers Production	Bananas Production	Papayas Production	Dates Production
	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area
1969/70	12.8	10.0	3.4	18.0	12.0	3.0	2.0	90.0	57.0	17.2	210	1.5	0.80	1.5
1970/71	15.3	10.0	3.4	18.0	12.5	3.0	2.0	90.0	57.0	17.2	210	1.5	0.80	1.5
1971/72	12.1	10.0	3.4	22.0	15.5	3.0	2.0	105.0	66.2	17.2	226	1.5	0.81	1.5
1972/73	13.2	10.2	3.4	24.0	16.8	3.0	2.0	110.0	69.4	7.5	244	1.5	0.81	1.5
1973/74	10.3	10.2	3.5	-	17.7	-	2.0	140.0 ^{/3}	70.3	17.7	264	1.5	0.81	1.5
1974/75	-	10.2	3.5	28.8	20.8	3.2	2.1	114.0	72.0	-	-	-	-	-

^{/1} - = not available; -- = zero.

^{/2} Crop year is usually July to April for cotton, October to April for wheat, barley and sesame, and February to July for sorghum.

^{/3} All cereals in 1973/74.

Source: Ministry of Agriculture and Agrarian Reform and IBRD estimates.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Consolidated Balance Sheet of National Bank of Yemen

	December						<u>September</u>	
	1969	1970	1971	1972	1973	1974	1974	1975
Liabilities	----- YD million -----							
Total deposits, of which:	13.82	13.97	15.70	16.53	20.29	23.67	24.14	29.10
Government deposits: Demand	(0.08)	(0.04)	(0.45)	(0.47)	(2.34)	(2.54)	(2.06)	(2.91)
Time	(1.71)	(0.24)	(1.22)	(1.16)	(1.31)	(1.80)	(1.69)	(1.83)
Other deposits: Demand	(5.59)	(4.57)	(5.85)	(6.03)	(7.73)	(10.29)	(11.54)	(13.61)
Time and savings	(6.45)	(8.10)	(6.96)	(7.89)	(7.46)	(7.95)	(7.41)	(9.58)
Deposits against letters of credit	(--)	(1.02)	(1.22)	(0.98)	(1.45)	(1.09)	(1.44)	(1.17)
Credit from Bank of Yemen	--	1.02	--	--	--	--	--	--
Balances due to local banks	1.58	--	--	--	--	--	--	--
Balances due to foreign banks	0.88	0.50	0.36	0.61	0.69	1.44	0.97	1.47
Bills payable in foreign currencies	--	--	1.47	1.49	2.48	3.77	3.09	2.90
Deposits in foreign currencies	--	--	--	--	0.52	0.82	0.82	2.14
Capital accounts	0.40	0.35	3.37	3.48	3.65	4.59	3.85	4.40
Other liabilities	7.21	4.47	1.60	1.49	2.22	2.74	3.15	2.91
Total liabilities = assets	23.89	20.31	22.49	23.61	29.85	37.03	36.02	42.92
Assets	-----							
Cash	0.47	0.36	0.53	0.58	0.58	1.14	1.12	1.43
Balances with Bank of Yemen	0.80	0.56	0.47	3.05	6.37	2.99	3.30	5.17
Balances with local banks	1.63	--	--	--	--	--	--	--
Balances with foreign banks	5.20	1.71	3.37	2.33	2.28	1.12	2.44	4.69
Bills receivable in foreign currencies	--	--	1.42	0.82	0.59	0.77	1.02	1.24
Bills receivable in local currencies	--	--	1.07	1.36	1.93	2.83	2.34	1.26
Treasury bills	--	--	--	2.00	2.00	--	2.00	2.00
Credit to Government	--	--	0.30	0.12	0.19	0.20	0.29	0.02
Loans and advances	9.08	9.92	9.55	7.86	8.33	16.10	16.52	18.46
Claims on the Economic Organization /1	--	--	3.47 /2	3.31	3.36	3.36	3.36	3.33
Investments: Local	0.40	0.25	0.05	0.05	0.05	--	0.05	--
Foreign	0.10	--	--	0.01	0.01	0.06	0.06	0.07
Other assets	6.22	7.52	2.26	2.12	4.16	8.46	3.52	5.25

Source: Bank of Yemen.

/1 Claims on nationalized banks.

/2 Claims on economic organization were included in other assets before 1971.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Agricultural Development Fund - Balance Sheet Dec. 31, 1976
 (Amounts in YD thousand)

<u>Item</u>	<u>Assets</u>	<u>Liabilities</u>
Loans outstanding (to State Farms and Cooperatives)	1,274	
Loans outstanding (to water projects)	16	
Stocks of Pumps, Parts, etc.	1,078	
Accounts with NBY etc.	540	
Bills receivable	684	
Furniture	4	
Other Assets	35	
 Bills payable		2,040
Deposits by MAAR Machinery Section		626
Income		34
Capital		931
 Totals	3,631	3,631
	_____	_____

Loans Outstanding - By Governorates

First Governorate	59
Second "	456
Third "	528
Fourth "	121
Fifth "	105
Sixth "	5
 Total	1,274

Source: MAAR - Agricultural Development Fund

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Agriculture

Geography

1. The Wadi Tuban Delta located in the 2nd Governorate is a major agricultural region because of its size and closeness to Aden. The Wadi Tuban drains a large catchment basin of about 5,600 km², 70% of which is in the mountainous region of the Yemen Arab Republic. The rainfall in the mountains provides annual spate irrigation in the Wadi Tuban Delta and serves as the main source of water for the underground water basin.

Climate

2. The Wadi Tuban Delta is an arid zone with an erratic rainfall which averages less than 100 mm/year, high average daily temperatures (24°C in winter and 33°C in summer), relatively high humidity (annual average 66%), and long periods of sunshine (a minimum of 7 hours a day on the annual average). Throughout the year, winds of 10 to 20 km/hr prevail mainly during the daylight hours. These high winds create shifting sand dunes, which would cover the roads and cultivable land if left unchecked. The average evaporation value is 6.6 mm/day. The climate creates two growing seasons, a hot summer period (April-September) and a warm winter season (October-March). A summary of the main climatic factors for two years at Lahej, the center of the project zone, is presented in Table 1.

Soils and Topography

3. The soils in the delta are made up of two basic groups, the desert soils and the spate irrigated soils. The topography in both cases is flat with a north-south slope of less than 1%. The desert soils located at the southern end of the Wadi consist of sandy and gravelly alluvial deposits. Profile development is lacking, but layers of sand, loamy sands and sandy loam material are found. Approximately 18,500 ha have been surveyed 1/. Spate irrigated soils located in the northern part of the Wadi are the result of a continuous slow sedimentation of silty materials carried by the flood waters annually over the centuries and deposited over the natural soil of sandy texture. These alluvial soils are 8-10 m deep and have horizons with textures that are usually loam, silt loam or silty clay loam. Approximately 16,730 ha in this group have been surveyed 1/.

1/ Italconsult, Wadi Tuban Feasibility Report, Rome 1975.

Soil Physical and Chemical Properties

4. Permeability and infiltration rates are related to soil texture. Lateral permeability is good for horizons of light texture (8-12 mm/hr). The average infiltration rates for silt loam, loam, loamy sand and sand were found to be respectively, 27, 55, 120 and 185 mm/hr. Salinity is not a problem in the spate irrigated areas because of annual flooding. These soils have an EC value not exceeding 2 mmhos/cm in the soil saturated extract. In some ground-water irrigated areas with heavy textured soil, EC values above 4 mmhos/cm have developed. However, soil salinity is not expected to be a problem in the project area. The cation exchange capacity (CEC) is adequate. The range is from 7 mg/100 g for sand and loamy sand, to 30 mg/100 g for heavier soils such as silty clay loams and clay loams.

5. Exchangeable sodium percent (ESP) is low in the spate irrigated soils (5-8 ESP). However, in some tubewell irrigated areas some saline sodic soils have developed with values from 15% up to 30% ESP. The delta soils in general are slightly alkaline with a pH of 7.6 to 8.8. In terms of fertility, both spate and desert soils are extremely low in nitrogen, but the spate soils have more available potassium and phosphorus than the desert soils as shown below.

<u>Soil Type</u>	Total Nitrogen %	K ₂ O kg/ha	P ₂ O ₅ kg/ha
Spate	0.077	1,182	2,030
Desert	0.070	249	1,824

6. In the spate area, based on suitability for spate irrigation, it is estimated that more than 75% of the land is in Class 1 and Class 2, and around 25% in Class 3. Land classification in the perennially irrigated area, shows approximately 75% of the land in the project to be in Class 1 and the balance about equally divided between Classes 2 and 3. The soils in the project area are satisfactory and present no unusual problems.

Agricultural Production - Spate Area

7. Spate irrigation is the traditional system of irrigation in the delta, and the distribution of water has been accomplished by long standing customs concerning priority rights. Government has recently established however, a new program concerning priority and distribution of water in the area. During the flood period, which usually begins in May, water is directed from the river by a system of weirs and semi-permanent off-takes (ogmas) through canals to basins. After flooding, the crops are planted in the moist soil and complete their life cycle utilizing the water stored in the soil profile. The total area flooded with a reasonable amount of water varies greatly from year to year, but ranges from an average of 5,000 ha to 6,500 ha. The land is ploughed by tractors and tilled prior to irrigation. Seeds are sown by hand after flooding with the aid of an ox drawn country plow. Replanting, a

limited amount of weeding and harvesting are performed manually. Fertilizers and plant protection chemicals are seldom used, except on the cotton crop. Yields are consequently low (see Table 2). The seven farm cooperatives are located in this region. The tractors for ploughing and bulldozers which are used for ridging and levelling the basins are rented from MRS.

8. Early floods occur in April, the peak floods in July-August and late floods of low volume in September and October. The amount of flood water determines the crops, and the cropping pattern which is practiced is shown below. All crops receive one irrigation, except red sorghum which is flooded twice, allowing two grain harvests plus a third harvest for forage. From the white sorghum, flooded once, a grain crop is obtained and the ratoon crop is harvested later for forage. Up to 1976, long staple cotton, an export crop, was grown in the area. From 1976, short staple cotton will be grown in the area to supply the raw material for the local textile mill. All crop cultivars used in the area are unimproved types. All families have livestock (10-15 head per family) which consists of sheep and goats in equal quantities. The bullocks used are owned by the cooperative, which charges each family for their use.

<u>Crop</u>	<u>Flood and Planting Period</u>	<u>Percent Crop Area</u>	<u>Harvest Period</u>
Cotton, M.S.	June	60	November and December
Red Sorghum /1	May-June	20	100 days + 50 days + 30 days
White Sorghum	July-August	10	100 days later
Watermelon and Cucumbers	Sept.-October)	5	100 days later
Sesame and others	March-April)		80-100 days later
	Sept.-October	5	100 days later

/1 After 50 days, a second spate irrigation is given; 100, 150 days from sowing two grain crops are harvested, and 180 days after sowing a forage crop is harvested.

Agricultural Production - Perennially Irrigated Areas

9. Perennially irrigated areas are irrigated solely by groundwater and in a few cases supplemented by spate flows. These areas encompass the state farms and are located in the southern end of the Wadi. For years, farmers located in some areas supplemented their spate irrigated land with water from shallow wells which also provided drinking water. Although tubewell drilling began in the early fifties, it has been only in the last four years that tube well drilling for agriculture has taken place. This has been done by the Government to extend agricultural production. Up to two years ago, cotton was the main crop grown, but this crop has been replaced gradually by tomatoes to meet the needs of the tomato paste factory. Farming practices for the most part are similar to those in the spate areas with limited use of inputs, such

as fertilizers and plant protection chemicals, and basin irrigation in uneven fields. Improved varieties are being gradually introduced, but crop yields remain relatively low (Table 2).

10. Since water is available throughout the year, the season determines the planting period for the crops grown. The present cropping intensity is 105% and the cropping pattern is presented below. Small plantations of mangos and bananas have been planted in one area, and an array of other minor fruit crops, such as custard apples, guava and young date palms, are grown on a small scale. The cotton grown is for export, the tomatoes for the canning factory, the watermelon, cucumbers, okra, eggplant, onions and peppers and others for the Aden market. The sorghum is grown for the dairy and beef herds and for the sheep and goats. The net land under cultivation is approximately 2,100 ha.

<u>Crop</u>	<u>Planting Period</u>	<u>Percent</u> <u>Crop Area</u>	<u>Harvest Period</u>
Cotton M.S.	June	5.0	December-January
Tomatoes	September-December	50.0	January-April
Vegetables	September-December	7.5	January-April
Maize (grain)	September	2.5	100 days after sowing
Sorghum (grain)	March-September	12.5	100 days after sowing
Sorghum (forage)	March-July	17.5	1st cut after 50 days 2nd cut after 90 days 3rd cut after 125 days
Watermelons	throughout year	7.5	100 days after sowing
Forage legumes and others	March-April	2.8	July-August

Livestock

11. Although the farmers in the spate areas (cooperatives) and the workers on the state farms maintain their own cattle, goats and sheep, the main livestock enterprise in Wadi Tuban is of the specialized type (dairy, beef fattening, sheep and poultry) and is confined to state farms. The live-stock population in the country is not accurately known. However, during a compulsory vaccination campaign in 1972, there were estimated to be 80-100,000 cattle and 1.5 to 2.0 million sheep and goats. Approximately 9% of the cattle and 2% of the sheep and goats were in the Wadi Tuban Delta. There are two dairy farms in the project area which are managed through a bilateral assistance program. There is a veterinarian permanently stationed at each farm. The milk produced is sold in the Aden market. The most productive dairy cows are Kenya Friesians imported from Kenya. The plan is to secure from Canada pure Friesian semen to inseminate stock on hand. Data on the dairy farms are as follows:

<u>State Farm</u>	<u>Date Established</u>	Milking Cows Capacity	Milking Cows <u>Actual</u>	Cattle Heads	Sheep and Goats
Jawala	1973	600	488	1,028	-
Fiyush	1974	600	490	800	2,000

Comparative data on breed performance are presented below.

<u>Dairy Breed</u>	Jawala Farm		Fiyush Farm	
	<u>Milk 1/day</u>	<u>Total 1/lactation</u>	<u>Milk 1/day</u>	<u>Total 1/lactation</u>
Friesian	8.0	2,400	6.7	2,100
Boran	4.5	1,350	5.0	1,500
Ayrshire	6.7	2,100	-	-
Local	2.3	690	-	-

12. Beef fattening operations are confined to the El-Jarrad State Farm. Male calves about four months old, weighing 80-90 kg, are purchased from Jawala and Fiyush at a cost of 400 fils/kg (liveweight) per animal. The farm maintains at present about 500 calves, each reportedly gaining on the average 30 kg per month. The animals are sold to the National Meat Corporation (NMC) when they attain about 400 kg liveweight, which usually requires less than one year.

13. Sheep production is restricted to the Somali breed and is conducted at two state farms, Revolution and 26 September. Breeding is the main emphasis at present with all of the milk being given to the lambs. The males, after about a year when they attain approximately 25-30 kg liveweight, are sold to the NMC. The Revolution Farm was started in 1972 with about 500 ewes and was increased to approximately 3,000 in 1976. The 26 September Farm was established in May 1976 with a stock of 2,000 ewes.

14. Goats are maintained primarily for milk. There are approximately 500 females at Fiyush State Farm, and Government is considering establishing a goat-raising state farm. The herd consists of Pakistani breed and the Baladi, a local breed. Although the former produces more milk than the latter, it only drops one kid a year, whereas the Baladi may give two. The cross between Baladi and Pakistani has been reported to be superior to the Baladi in milk production and has a higher birth rate than the Pakistani.

15. Poultry production for eggs appears to be the most efficient and well organized livestock enterprise. Begun in 1972 as a Government Corporation with bilateral assistance, this operation plans to produce 35 million eggs annually by 1978. It is a self contained unit with a breeding farm, hatchery, feed factory and layer production units. Approximately 18.5 million eggs were produced in 1976, and they expect to reach 25 million in 1977, and 35 million in 1978. Broiler production is being planned as a second phase of

the program. Locally procured fish and cotton seed meal are used in the feed ration, but grains such as wheat, maize and sorghum are imported.

16. Except for the importation of chemicals for medicinal purposes, the livestock industry (excluding poultry) in Wadi Tuban depends entirely on locally produced products. The daily feed ration for the animals is presented below. While cotton seed meal and wheat bran are readily available, sorghum forage and fodder are presently limited.

<u>Crop</u>	<u>Daily Feed Ration - kg/animal</u>			
	<u>Dairy</u>	<u>Beef</u>	<u>Sheep</u> /1	<u>Goats</u> /1
Sorghum fodder	12	7)	2.5-3.0	2.5-3.0
Sorghum forage (green)	10	7)		
Cotton seed meal	0.5	2	0.15	0.15
Wheat bran	2.5	3	0.5	0.5

/1 Allowed to graze on farm crop residues.

Agricultural Support Services

17. Research on crop and fruit production applicable to the Wadi Tuban Delta is being carried out at the El Kod Research center by the Government, with assistance from a FAO/UNDP program. El Kod, an old station developed by the British for cotton research in 1955, now has an international staff with expertise in horticulture, plant pathology, entomology, agronomy, economics and forestry. Over the past ten years, package programs to increase the production of sorghum, maize, tomatoes and other vegetables have been developed. The station has selected and also tested improved varieties of fruits, vegetables and grains. This was accomplished under the first and second phase of UNDP assisted project on "Agricultural Research and Training". The third phase, starting in 1977, is goal-oriented and is known as "Improvement of Crop Production". Unfortunately, all research efforts thus far have been confined mainly to the perennially irrigated areas, and little has been done specifically for the spate areas. Other FAO/UNDP sponsored projects which have been helpful are PDY/71/508 and PDY/75/014 "Piloting Improved Agro-nomic Practices". The latter is scheduled to terminate in August 1977. Most of the work on improvement of irrigation techniques and other cultural practices recommended were developed and successfully demonstrated at Fiyush and Wadi Tuban State Farms under these projects. It has recently been decided that under the third phase of this FAO/UNDP assisted project one of the proposed demonstration farms to be established will be in the Wadi Tuban Delta.

18. There is at present no functional Extension Service in MAAR. The Extension Service is being created as a section in MAAR (see Annex 10, Chart 17632). Government intends to strengthen and upgrade this section into a

department when it has been developed. The absence of an organized and effective Extension Service has kept the information developed at El Kod from becoming known to and practiced by the farmers and managers of the state farms. Moreover, there is little feedback from the field to the experts to bring them closer to the problems in crop production being encountered at the state farms. In the Wadi Tuban area, the Lahej Agricultural Development Board (LADB) had 18 extension agents assigned to the cooperatives under its Agricultural Extension Section (Annex 10, Chart 17755). Primarily because of their training and technical support, these agents were mainly data collectors rather than persons who are able to advise and teach improved agricultural practices to farmers and farm managers.

19. Training facilities for agriculture and support services are available in and near the project area. For clerks, accountants, cooperative officers and farm management staff the Cooperative Education and Training Center (Dar Sa'ad), established under a UNDP/ILO project, is able to provide the pre-service and in-service training needed for the cooperatives and state farms. In respect to the new accounting system to be introduced for state farms, Government intends to develop a 9-month training course to start in June and continue over a 5-year period. The Agricultural Training Center (at Giar), established in 1970 under the first phase of the FAO/UNDP project mentioned above, provides practical training in farming, such as ploughing, cultivating, sowing, fertilization and other operations. It also provides a 5-month training course for selected students from various villages. Carefully selected individuals from this group, with some additional in-service training, might be utilized as new extension agents for DTDB. Nasser Agricultural College, situated at Lahej and started in 1969, provides a 3-year post-preparatory course which grants a diploma to the successful students and also a post-secondary 4-year course which leads to a B.Sc. degree. In 1976, the first degree holding students (18) were graduated. At present, there are 158 students enrolled in the 3-year diploma course and 112 in the B.Sc. degree program; both groups include female students. The staff consisting of 15 Ph.Ds. are from Egypt. Only the Director is from PDRY. However, five Yemenis (2 Ph.Ds. and 3 M.Sc.s.) are expected back from overseas training shortly and will join the institute. Graduates with a B.Sc. could serve as counterparts to the specialists assigned to the project, and the diploma graduates would be excellent extension agents for the cooperatives and state farms.

Agricultural Development

20. In spite of the hot temperatures, limited water resources, high evaporation rates, strong hot winds and constant sand movement, it is believed that the project will bring about substantial yield increases over the first six years as presented in Table 2. Such an accomplishment will only be realized after a number of changes are introduced which will enable the project to be implemented as planned. The basic change will be the reorganization and expansion of the responsibilities of the LADB as presented in Annex 10. Anticipated yields in the groundwater irrigated area as shown in Table 2 are based on the results obtained following the procedures given in the package of

improved practices developed and demonstrated in the field by UNDP sponsored programs at El Kod and Wadi Tuban State Farm, respectively. Following the practices advocated in the package programs for the major crops, and using much less water than is currently being used, crop yields have been reported to be more than double the existing averages. The package program involves mainly field levelling, subdivision of fields into relatively small plots (1/2 ha) for affecting water economy during irrigation, efficient use of farm machinery, planting improved varieties, judicious use of fertilizers, inter-tillage of row-sown crops, irrigating crops according to their needs for water and stage of growth, and the exercise of crop protection measures. The yields for tomatoes, maize and watermelons reported for the 4th year are approximately 50% of that realized at the research station in 75/76.

21. Without the project in the spate and groundwater irrigated areas, no improvement in yield level is anticipated. Without fertilizers, adequate pest control and changes in cultural practices, yields would most likely decline in time. The increase in agricultural production in the groundwater irrigated areas will be through efficient irrigation techniques, intensification of agriculture (108% to 145%), the use of improved cultivars, fertilizers, plant protection chemicals and farm machinery. The farm machinery will increase and improve land levelling operations, improve the timeliness and increase the efficiency of all field operations such as land preparation, crop protection and harvesting. Organic manure from the livestock farms will be applied on the forage crops which will improve the physical and chemical properties of the soil as well as supplying additional soil nutrients. A schematic layout showing the proposed cropping pattern for the entire groundwater area is given in Chart 17756. A 3-year rotation will be followed to prevent the build up of nematodes in tomato production as well as other harmful organisms and chemicals. Shelter-belts will protect the arable land and roadways from the encroachment of the desert and greatly reduce the evapotranspiration rate on the farms. Judicious pruning of the shelter-belt trees will prevent them from becoming detrimental to the crops and will at the same time provide needed firewood. The increase in production in the spate area will be primarily from the adoption of improved cultural practices and the use of fertilizers and plant protection chemicals. The alluvial soils in the spate area are deficient apparently only in nitrogen. Thus the application of urea will stimulate root growth enabling all plants to exploit moisture and nutrients from a deeper level than they otherwise would. As a result, top growth should reflect improved root development and the larger plants with their higher yields will be protected by pesticides. Technical assistance, the development of an effective extension service, the training of Yemeni personnel, coupled with the factors mentioned above, will enable the project to reach the yield and production levels projected.

22. Cotton and maize seeds will be obtained from the Seed Multiplication Program at Media and Meifa Harja. The National Seed Multiplication Program will have seed production centers in Wadi Tuban, especially for maize and sorghum HYVs. The high yielding cultivars for the other crops will be imported. Fruit tree seedlings for the orchards and forest tree seedlings

for shelterbelts will be secured from the nurseries at the El Kod Research Station. Fertilizers and plant protection chemicals will be imported and utilized as recommended by the research station. Costs for all the inputs have been taken into consideration in the cost analysis. The fertilizers and pesticides to be applied are shown below. Technical backstopping for the project will be from the El Kod Research Station staff consisting of specialists in all disciplines involved in the project. The station is only 80 km from the center of the project on a paved road.

Fertilizer Application Rates With Project - Groundwater Irrigated Areas

<u>Crops</u>	<u>Urea</u>	<u>Ammonium Sulphate</u>	<u>Triple Superphosphate</u>	<u>Manure</u>
		-----kg/ha-----		
Tomatoes	125	100	150	-
Vegetables	100	100	150	-
Melons/Watermelons	100	50	75	-
Maize	100	100	75	-
Sorghum Forage	100	100	100	15 tons
Forage Legumes	50	-	100	10 tons
Mango	125	100	150	-

23. For Years 5, 6 and onwards, urea at the rate of 50 kg/ha, will be added to the above base for all crops except the forage legumes. This will increase the nitrogen available which will probably be required in order to maximize the output of new varieties expected to be available by that time. For the initial plantings of forage legumes in each plot, the seeds will be mixed with a culture of Rhizobium to assure that the soil would become inoculated with suitable nitrogen fixing bacteria. The application of urea on the legume forage crops will be discontinued after there is evidence that the soil has become inoculated. The high rate of fertilizers at the outset for the mango plantation is because the area is expected to be interplanted with tomatoes for the first four years. Thereafter, the annual application will be 100 kg/ha of both urea and ammonium sulphate. Because of the low cation exchange capacity of these soils, the fertilizers will be applied in two or more doses. In the spate area, experience has shown that only nitrogen is required. Thus only 50 kg/ha urea has been planned for all the crops in the area since moisture is the critical factor. For red sorghum, which will be given two irrigations, 100 kg/ha of ammonium sulphate will be applied just before the second irrigation.

Main Pests of Major Crops and Pesticides Used

<u>Crop</u>	<u>Main Pest</u>	<u>Pesticide /1 Used</u>	<u>Dosage per ha</u>	<u>Number Treatments</u>
Cotton	Bollworms	Nuvacron 40	2.5 l	2
	Aphids	Nuvacron 50	2.5 l	2
	Jassids	Dimethoate 40	1.5 l	1
Sorghum	Aphids	Malathion 50	1.5 l	1
	Shoot Fly	Furadon 75%	200 gms	1
Maize	Stem borer	Sevin 85%	2 kgs	2
Cucurbits	Melon Fly	Dimethoate 40	1.5 l	1
	Aphids	Dimethoate 40	1.5 l	1
	Melon beetle	Lebaycid 50%	1.5 l	3
	Melon bug	Lebaycid 50%	1.5 l	3
	Downy mildew	Captan 50	4.5 kg	1
Tomatoes	Bollworms	Gardona 75%	2.0 kg	2
	White Fly	Dimethoate 40	1.5 l	2
	Downy mildew	Captan 50	4.5 kg	1
Mangos	Fruit Fly	Supracide 40	1.5 l	2
	Scale	Supracide 40	1.5 l	2

/1 Or similar product. Method and precaution for application should be in accordance with label instructions.

24. In the spate area medium staple cotton will replace the long staple cotton. Medium staple cotton, when compared with the long staple cotton previously grown in the spate areas, has certain advantages: the maturation period of medium staple is shorter by about one month, maturity is more uniform requiring less picking periods, it is easier to pick because of its larger bolls, and there is usually less problems with pests and diseases.

25. Since production records will be maintained, it may be possible to increase production by introducing a system of recognition for specific achievements. An award could be given to the cooperative and state farm that reaches or exceeds the annual yield levels established for each year in Table 2 for the major crops. Another method could be the awarding of cups or ribbons each year for the cooperative and state farm with the highest average yield for specific crops.

APPRaisal OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN
Monthly Mean Data Lahej Meteorological Station

	Temperature °C					Relative Humidity %			Wind		Radiation		Pan Evaporation		Rainfall
	Maximum Highest	Minimum Lowest	Monthly Mean	Maximum	Minimum	Average	Direction	Reach km/day	cal/cm²/day	Sunshine hrs/day	mm/day	mm/month	mm		
1974:															
January	- /1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	33.0	29.2	22.0	16.0	25.2	96	43	69	E/NE/SE	150	407	7.0	6.17	190	2.4
April	38.0	32.4	28.9	19.0	28.2	97	35	67	SE/E/NE	119	491	9.5	6.17	185	0.0
May	40.8	31.5	26.5	20.3	29.6	96	36	66	SE/E/NE	118	445	8.6	7.84	240	4.0
June	40.0	35.1	25.7	23.7	31.5	91	41	66	SE/SW	113	455	8.7	9.27	280	0.0
July	43.0	35.8	31.5	21.0	31.1	87	33	60	VAR	112	428	7.6	9.43	290	4.4
August	40.2	34.2	28.8	25.5	32.3	89	36	63	VAR	140	432	8.1	9.44	290	0.0
September	38.1	32.0	28.5	22.5	30.3	97	45	71	VAR	86	418	7.8	6.13	185	83.0
October	38.5	31.9	24.4	17.7	27.6	96	22	64	E/NE/E	201	458	9.6	7.23	225	0.0
November	34.6	29.2	25.0	17.4	25.0	93	36	65	SE/E/N	110	429	9.2	5.63	170	0.0
December	30.7	28.3	21.2	15.8	24.4	92	47	70	E/N	109	362	7.9	4.87	150	0.0
											(2,205)			(93.0)	
1975:															
January	30.9	26.1	20.4	15.8	24.4	88	52	47	E/SE/NE	132	381	7.4	4.20	130	0.0
February	32.1	28.5	23.2	18.0	25.0	93	50	72	E/NE	120	385	7.2	4.66	130	2.3
March	33.6	29.8	23.7	18.5	25.4	92	47	68	NE	118	463	8.5	5.68	175	0.0
April	36.4	30.4	24.4	20.5	26.9	98	42	70	E/NE	106	449	9.1	6.19	185	13.4
May	39.9	34.3	27.1	19.3	28.9	97	40	68	E/SE/E	88	498	9.7	8.03	250	0.0
June	45.0	36.8	28.0	23.0	31.1	91	29	61	VAR	101	437	8.6	8.66	260	0.0
July	40.2	32.7	29.0	24.1	30.2	89	34	62	VAR	104	405	7.3	9.20	285	1.5
August	40.2	30.8	26.8	22.5	28.5	95	62	79	VAR	109	426	7.8	7.63	235	10.2
September	39.2	29.5	26.7	20.3	29.9	90	57	73	E/N/S	75	421	8.8	5.98	180	30.0
October	37.8	31.9	24.7	17.9	28.2	86	45	66	E/N/EW	81	440	9.1	7.10	220	0.0
November	37.8	29.8	22.0	15.2	25.7	88	36	62	E/N	83	431	8.8	4.33	130	3.6
December	-	-	-	-	-	-	-	-	-	-	4.25 /2	130 /2	-	0.0	
											2,310			61.5	

Source: Ministry of Agriculture

/1 No Data

/2 Estimate

July 1977

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Crop Yield Projection for Perennial and Spate Irrigated Areas
(tons/ha)

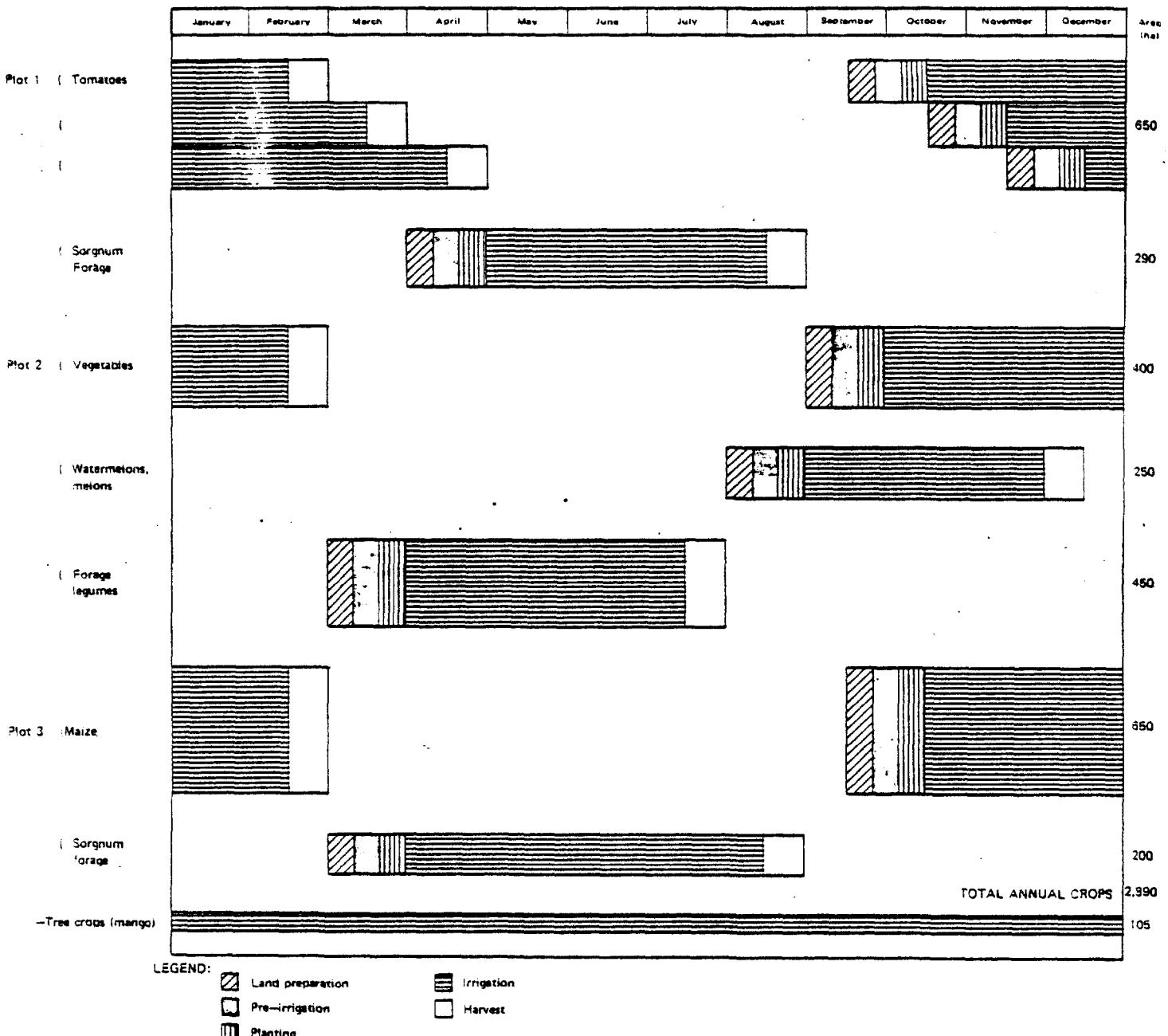
	<u>Present</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>Year 5</u>	<u>Year 6</u>
<u>Perennial Irrigation</u>							
Tomatoes /1	12.0	14.0	17.0	21.0	25.0	25.0	27.0
Vegetables	12.0	14.0	17.0	20.0	23.0	25.0	27.0
Melon - Watermelon /1	15.0	16.0	18.0	20.0	22.0	25.0	27.0
Maize (Grain) /1	1.5	2.0	2.4	2.8	3.3	3.3	3.5
Maize (Stover)	4.5	5.5	6.5	7.0	8.0	8.0	8.0
Sorghum (Forage)	35.0	42.0	50.0	57.0	65.0	75.0	80.0
Forage Legumes	15.0	16.0	17.0	19.0	20.0	21.0	22.0
<u>Spate Irrigation</u>							
Cotton (Medium Staple)	0.7	0.8	0.9	1.0	1.1	1.1	1.2
Red Sorghum (Grain)	1.0	1.1	1.2	1.4	1.6	1.7	1.8
Red Sorghum (Stover)	6.0	6.5	6.5	7.0	7.0	7.5	7.5
Red Sorghum (Forage)	3.0	3.5	4.0	4.5	5.0	5.5	6.0
White Sorghum (Grain)	0.6	0.7	0.8	0.9	1.0	1.1	1.2
White Sorghum (Stover)	3.5	3.5	4.0	4.5	4.5	5.0	5.0
White Sorghum (Forage)	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Watermelon - Melon	10.0	12.0	14.0	16.0	18.0	18.0	19.0
Sesame	0.4	0.45	0.50	0.55	0.60	0.65	0.70

/1 Yields in year 4 are approximately 50% of research yields.

July 1977

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PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Perennial Irrigation: Crop Rotation at Full Development



Crop intensity of area under annual crops 145

World Bank - 17756

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PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Water Availability and Requirement

Surface Water

1. The Wadi Tuban lies at the southern extremity of the Arabian Peninsula between latitude $12^{\circ} - 55'$ and $14^{\circ} - 10'$ N. Its catchment area excluding the delta part is about 5600 km² of which 9% (500 km) lies at an elevation of about 2000 m, about 77% (4300 km) between 1000 and 2000 m and 14% (800 km) below 1000 m. The catchment receives annual rainfall which varies on average from a few dozen millimeters in the plains to around 600 mm in the higher areas. A calculation of the annual runoff based on precipitation in the catchment is not possible due to lack of sufficient knowledge of the rainfall regime in the upper catchment. Hence, the only possible approach to estimate the Wadi's surface water potential is the use of available runoff data both for Wadi Tuban itself and the contiguous basins. Based on this approach, ITALCONSULT have tentatively estimated the Wadi's water potential within the framework of an integrated study "Soil and Water Utilization and Conservation in the Wadi Tuban Watershed Area" entrusted to them by FAO in 1972. Based on the available discharge data for the period 1957-1960 supplied by Lahej Agricultural Development Board (LADB) and the 1973 and 1974 data observed by ITALCONSULT, the following runoff values were obtained:

10% probability	229 Mm ³
50% "	153 Mm ³
75% "	99 Mm ³

Based on 21 years record of Wadi Bana which rises in the same mountains system and has a course roughly parallel to Wadi Tuban and has similar morphological and hydrological characteristics, the following runoff values were obtained for Wadi Tuban:

10% probability	210 Mm ³
50% "	135 Mm ³
75% "	105 Mm ³

From the above estimates, the average annual discharge of Wadi Tuban is assessed between 135 and 153 Mm³.

2. The available discharge data with LADB for the years 1957 to 1960 and with MAAR for the years 1973 to 1976 gives the following values of the annual runoffs.

<u>Year</u>	'57	'58	'59	'60	'73	'74	'75	'76
<u>Runoff Mm3</u>	177	138	278	312	41	57	105	40

The years 1973 and 1974 have been bad years and 1976 is called a disaster year for agriculture in the country.

3. From the study of the calculated and observed data, the mission considers that adequate supplies would be available in normal years for irrigating 6500 ha considered for surface flow irrigation under the project.

4. The electric conductivity (EC) of the surface water varies from 0.5 mmhos/cm to 0.9 mmhos/cm. The tests confirm the suitability of water for irrigation.

Groundwater

5. The aquifer of Wadi Tuban Delta is composed of alluvial deposits of alternating layers of sand and gravel. The unconfined aquifer is located in the upper layer of alluvial deposits up to a maximum thickness of 180 meters. The deeper part consists of finer sediments of poor water bearing characteristics. The piezometric surface occurs at depths varying between 5 and 30 meters. The volume of water saturated alluvium is estimated as 73000 Mm3. The major sources of recharge of the alluvium are surface inflow in Wadi Tuban and irrigation channels and the spate irrigated basins in the delta area. From the water budgets prepared for the years 1973 and 1974, the recharge was assessed as 45% of the Wadi runoff. A digital groundwater model was prepared by ITALCONSULT in order to simulate the aquifer response to alternative development strategies. As a result of their study they have assessed that the annual recharge to aquifer would lie between 40 and 60 Mm3.

6. The present net ground water extraction is estimated as 52 Mm3 and therefore leaves practically no scope for additional extraction either for Aden water supply or irrigation schemes unless a refinement of the recharge estimates presents a more optimistic picture or some alternative source is found to meet the household and industrial demands of Aden town. Irrigation of coastal areas between Shiekh Othman and Beir Ahmed using sewage effluent from Aden can help irrigation development in the Delta and provide a source of seepage to the sea. This would avert the risk of salt water intrusion in the present critical balance of the delta's water budget. A Water management study is, therefore, included in the project to examine these aspects.

7. The EC of irrigation wells in the project area generally varies from 1.0 mmhos/cm to 4.0 mmhos/cm. The conductivity is low near the axis of the Wadi and increases with the distance from the axis. No signs of salinity are, however, observed in the irrigated areas. It is, therefore, believed, that with proper field management practices the water would be suitable for irrigation.

Groundwater Requirements

8. The consumptive use requirement of the proposed crops at full project development will be about 17.41 Mm³ and the leaching requirements, field losses and conveyance losses will be about 5.75, 7.46 and 5.40 Mm³, respectively (Table I), giving gross irrigation requirement as 36.02 Mm³. This is about the same as the current gross withdrawals for irrigation. Of the quantity extracted for irrigation, about 7.50 Mm³ will be recharged into the aquifer leaving the net irrigation extraction as 28.52 Mm³. About 23 Mm³ of ground water is now being extracted for household and other uses giving a net extraction of 51.52 Mm³ from the aquifer which is about the same as the present net withdrawals.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Estimated Water Requirements

1. Climate data ¹	<u>Jan.</u>	<u>Feb.</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>			
Average temp. (°C)	24.4	25.0	25.3	27.6	29.3	31.3	30.6	30.4	30.1	27.9	25.3	24.4			
Percent daytime hours	0.21	0.24	0.27	0.30	0.33	0.35	0.34	0.31	0.28	0.25	0.22	0.20			
2. Reference crop evapotranspiration															
Daily ETO mm	2.8	3.3	4.1	5.2	6.2	7.5	6.8	6.0	5.1	4.9	3.6	2.8			
3. Crop water requirements															
Area	Cropped	<u>Jan.</u>	<u>Feb.</u>	<u>March</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Dec.</u>	Total mm ha/ha	Total Demand Mm ³	
Tomatoes	650	95	102	109	47	-	-	-	24	47	76	78	578	3.76	
Vegetables	400	125	27	-	-	-	-	15	73	128	124	125	617	2.47	
Melons	250	-	-	-	-	-	-	52	112	144	82	-	390	0.98	
Maize	650	82	-	-	-	-	-	-	68	106	123	95	479	3.08	
Sorghum (Forage)	490	-	-	16	70	120	164	147	120	80	33	-	750	3.68	
Legumes (Forage)	450	80	210	460	1150	1390	1350	760	200	-	-	-	560	2.52	
Mango	105	53	56	60	84	81	92	80	72	84	86	72	60	880	0.92
Field losses (70% field efficiency)												Sub-Total	17.41		
Leaching requirement (33% of consumptive use)												7.46	5.75		
Conveyance losses (85% distribution efficiency)												5.40	36.02		
Total															

¹ No rainfall data is used as the rainfall in the project area is very scanty.

August 1977

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

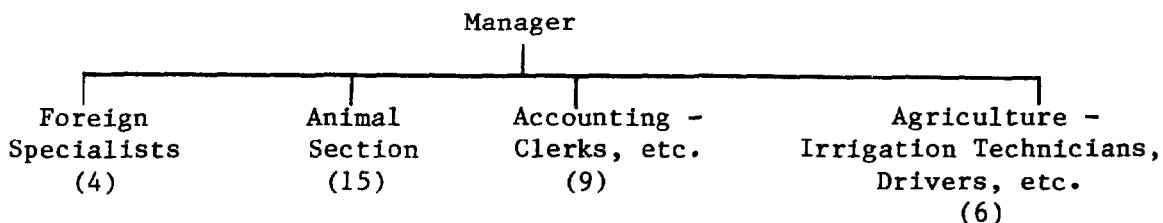
Land Tenure, Cooperatives and State Farms

1. Under the Agrarian Reform Law of 1970, which modified the earlier Land Reform Act of 1968, land ownership was limited to 8 ha irrigated or 16 ha non-irrigated per primary family. In practice, individually operated holdings remaining in the project area are considerably smaller than these ceilings. Land in the project area is now organized in cooperatives or state farms, over which a considerable amount of Government control is exercised. The state farms are required, by law, to have a permanent source of irrigation water. In Wadi Tuban, 12 state farms occupy most of the area irrigated by groundwater, while 6 cooperatives consist mainly of spate-irrigated land and 1 cooperative has irrigation tubewells.

2. Cooperatives. In the project area in Wadi Tuban there are 7 cooperatives, having a total of about 7,000 farm families, and a cultivable area averaging about 1.09 ha per farmer member. Most individually operated holdings are between 1 ha and 2 ha in size. Each cooperative is administered by a board or council consisting of 7-10 elected members, with an elected chairman and secretary. Appointed staff included accountant, storekeeper and clerks. Sometimes other staff such as plant protection technicians or extension personnel are designated by MAAR to the cooperatives. In the project area there are six cooperatives of the Model 1 type and one of the Model 2 type (Table 1). The former model has individual farm holdings, individually cultivated and operated. The overall agricultural plan is, however, the responsibility of the cooperative, within guidelines laid down each year by MAAR. The cooperative is also responsible for obtaining credit, for certain collective functions such as pest control in cotton, and for marketing produce (surplus to the 200-300 kgs. of cereals and sometimes small amounts of sesame which the farm families retain for their own use). Collective tasks may be handled by work groups. Family-owned livestock do not come under the jurisdiction of the cooperative. In the Model 2 cooperative, all means of production are owned and operated collectively, under supervision of the elected council. Members are organized into work groups to perform most tasks, with some casual labor employed at harvest times. Although members are supposed to be remunerated according to their work input, labor records were commenced only in mid-1976 and are still inadequate, covering only the hours worked each day but not the quality of work. The rate of pay is said to vary with the type of job being performed. The organization of such a model cooperative is outlined in Chart WB 17906.

3. The Model 1 cooperatives own no machinery, but hire tractors and equipment from the MRS at a fixed rate of YD 0.650 per hour for a 60-70 HP tractor, which is neither sufficient to cover actual operation and maintenance costs, nor includes any contribution for recovery of capital investment. The Model 2 cooperative owns two tractors and a pickup truck, and also hires some equipment from the MRS. The wells and pumpsets on this farm are owned by the cooperative but maintained by the MRS. Cooperatives may obtain credit from either the National Bank of Yemen or, mainly for machinery purchase in Model 2, from the Agricultural Development Fund (Table 1). Administrative expenses for the cooperatives are financed from the 5% tax which is levied on the gross value of most output. In addition there is a State tax of 15% of the gross value of cotton and cereals. Proceeds of this tax go to the Treasury.

4. State Farms. The 12 state farms in the project area (Table 1) have a cultivable area totalling 2,105 ha and employ about 2,600 workers. Government-appointed managers are responsible for purchase of capital goods, deployment of labor, and day to day running of the farms. Within Government plans for the area as a whole, however, crop areas are allocated to each farm after an assessment in consultation with each manager. Government also allocates technicians and administrative personnel in accordance with the plan. An example of organization is the Jawala Animal Farm, specializing in dairying, which employs a total of about 185 workers and has an administrative setup as follows:



Although all state farms grow crops, Jawala and Fiyush specialize in dairying (with more than 500 introduced milking cows on each), Jarrad has a beef fattening unit (with 500 head capacity), and Mujahid and 26 September have sheep and goat production units.

5. State farms own their own equipment, which is often purchased with the aid of loans from the Agricultural Development Fund (Table 1). Under the project they will receive further equipment (Annex 8) to allow intensification of cash cropping and the production of feeds for livestock. From 1978, 75% of any surplus from state farms will be allocated to general Government Funds through the Ministry of Finance, and 25% will be retained by the farm for investment uses subject to Government approval. The main problems of state farms were said to be inefficient use of irrigation water, lack of appropriate machines and equipment, and a lack of technically trained personnel. All three problems will be directly addressed under the project.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Cooperatives and State Farms in Project Area

<u>Name</u>	<u>Cultivable</u>	<u>Area Culti-</u>	<u>Number of</u>	<u>Loans Outstanding</u>	
	<u>Area</u> <u>(ha)</u>	<u>vated, 1976</u> <u>(ha)</u>	<u>Members</u>	<u>NBY</u> ^{/2}	<u>(YD)</u> <u>ADF</u> ^{/3}
<u>Cooperatives</u> ^{/1}					
El Wadi El Azam	1,219	753	960	-	4,815
El Wadi El Kabir	809	577	841	-	-
El Olia El Kabir	959	959	851	540	9,201
El Sofla El Kabir	1,295	1,066	1,370	-	13,474
El Olia El Saghir	1,619	1,043	1,200	-	23,493
El Sofla El Saghir	1,538	819	1,197	21,287	6,126
26 September	138	102	510	261	2,558
Totals	7,577	5,319	6,929	22,088	59,667

State Farms

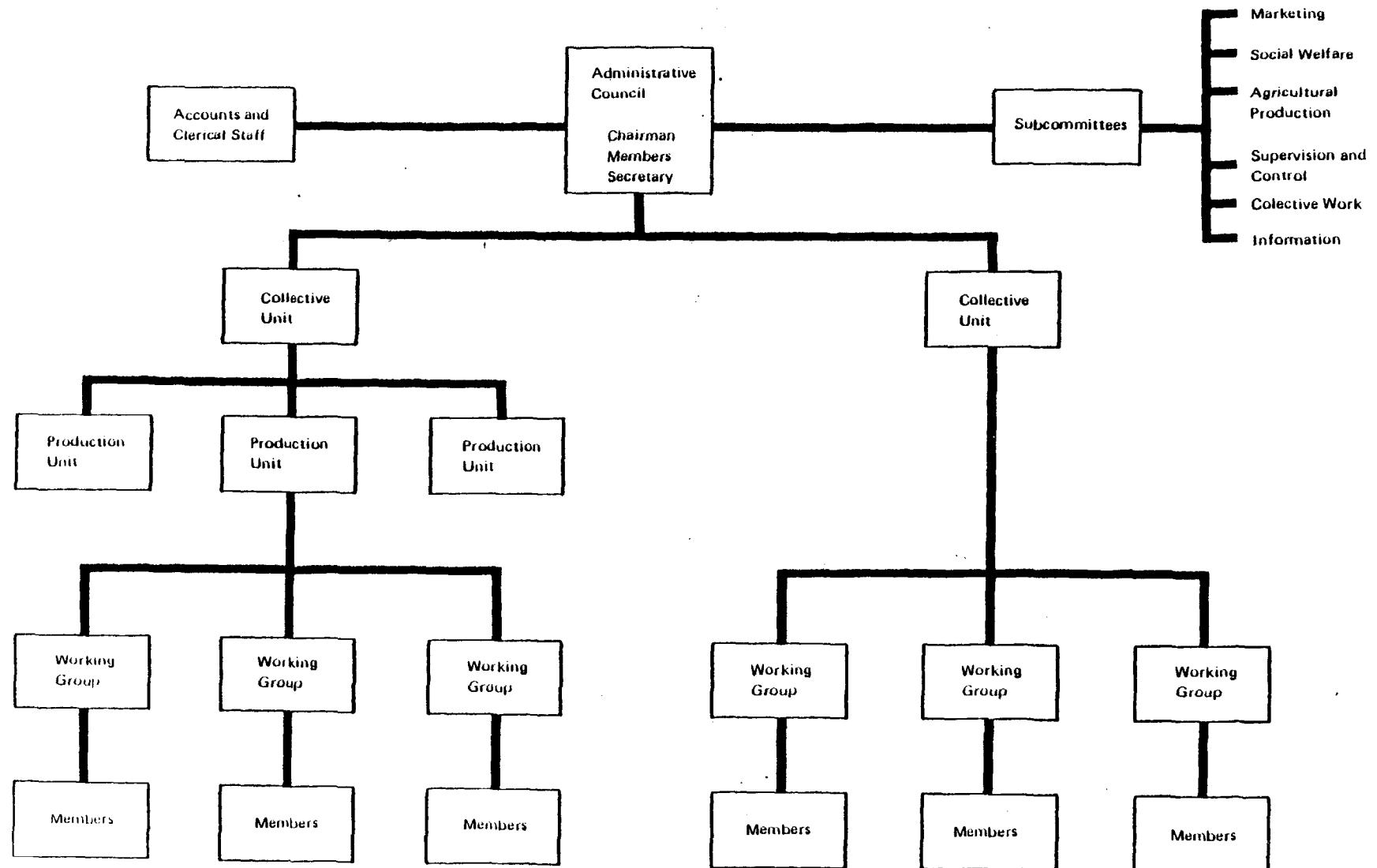
Wadi Kheir	140	120	4,422	3,818
26 September	180	160	-	13,736
Revolution	425	400	610	50,088
Fiyush	180	160	-	16,508
Wadi Tuban	140	130	-	-
Sixth Session	240	240	-	-
Obar Yacob	40	20	-	-
Nasser College	20	not known	-	584
Jawala	200	not known	-	-
Jarrad	70	not known	-	7,264
Monasrah	300	200	-	2,547
Husseini	170	160	-	7,653
Totals	2,105	1,590	5,032	102,198

^{/1} All are Model 1, except 26 September.

^{/2} National Bank of Yemen, at March 31, 1977 (mostly 5 year loans).

^{/3} Agricultural Development Fund, at December 31, 1976 (mostly 1-4 year loans).

APPRAISAL OF
WADI TUBAN AGRICULTURAL PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN
Organization of a Production Cooperative



APPRAISAL OF
WADI TUBAN AGRICULTURAL PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Description of Project Works

General

1. The Civil Works included in the Project are: (a) Irrigation improvement works; (b) Feeder roads; and (c) Rural water supply schemes. The other project elements include furnishing equipment and materials for agriculture development, providing managerial and technical experts for training of local staff, a water management study for refining estimates of available surface and ground water potential and, determining feasibility of irrigation extension and of possible alternative sources of water supply for household and industrial consumption in the project area including Aden and a study on agricultural price, taxation and subsidy policy systems. They are described hereunder:

Irrigation Improvement Works

2. The irrigation improvement works will benefit 1,755 ha of cultivable area in the following farms which are tubewell irrigated.

<u>Name of farm</u>	<u>Cultivable area (ha)</u>
Wadi Khair	140
26th September	180
Revolution	425
Sixth Session	240
Jawala	200
Jarrad	70
Monasrah	300
Hussaini	<u>200</u>
Total	<u>1,755</u>

3. The improvements will comprise:

- (i) providing buried pipe water distribution system to replace the unlined water courses;
- (ii) reorganizing and levelling the fields;
- (iii) providing farm access roads and wind breaks;

- (iv) replacing worn-out tubewell pumps;
- (v) completing tubewell electrification.

4. Buried pipe distribution systems composed of about 123,000 m of asbestos cement pipes of 15 and 20 cm diameters have been selected to distribute tubewell water in the farms. Asbestos cement pipes have been chosen as they have a history of successful use in the potable water supply systems of the Wadi. The pipes will be hot bitumen dipped to reduce friction losses and to resist sulphate attack. In each system, a convenient number of pumping units will be connected by valved-off pipes to ensure supply to the crops during periods of individual pump failures.

5. Velocities of less than 1 m/sec will be ensured in the design of the distribution system to keep the friction losses low. The present setting of pumps' discharge pipes which is generally one meter higher than the natural surface level and the natural ground slope over the farm area (3% to 4%) will provide up to three meters of water head. The balance of the head will have to be provided by the pump which, normally, it should be able to do with a slightly reduced discharge. In cases where head beyond the capacity of the existing pumps is required, either the pump and motor will be uprated or open concrete lined water courses will be used for water distribution.

6. The asbestos cement pipes will feed hydrant valves commanding about half ha each. A concrete anti-scour box and delivery pipe holder will be constructed at the head of each field ditch which will feed into small irrigation basins through plastic siphons. Each system will include non-return valves, flow control valves and circulating columns sited near the well heads. A stand pipe at the far end of each ring main will be provided to release air from the system.

7. Land Levelling and Reshaping. Experience at Fiyush Pilot Farm has shown that a field size of about half ha in the tubewell irrigation areas is an adequate farm unit being large enough for mechanical field operation, yet small enough to require only a moderate amount of land planning to achieve acceptable slope for basin or furrow irrigation. The fields will, therefore, be reorganized in half ha plots. The operation being in established farm areas, the quantity of the soil to be moved will be moderate varying between 400 to 600 m³ per hectare. The work will be done through force account using machinery (ten bulldozers and two graders) provided under the project.

8. On-farm Access Roads and Wind Breaks. Three to five meters wide earth roads surfaced with a thin gravel layer and elevated about six inches above irrigation level will be constructed to provide on-farm access. The interval between the on-farm roads will generally be between 250 to 300 meters. The wind breaks will border the farm and consist of three rows of trees. Within the farm, single tree rows matching the on-farm access road grids will be planted.

9. Pump Replacement. Ten verticle turbine pumps and 24 electric motors will be provided under the project to replace the defective and worn-out existing tubewell machinery and to replace the internal combustion propulsion with electric propulsion on the existing 69 tubewells feeding the area.

10. Tubewell Electrification. All state farms except Monasrah are partly or completely served with electric power. The project will complete this process by connecting Monasrah farm with the existing transmission lines near the tomato factory and also replacing the diesel operated motors on the other project farms.

Feeder Roads

11. The following cobbled surface roads will be included in the project to connect the outlying villages to the Aden-Lahej main road.

<u>From</u>	<u>To</u>	<u>Km.</u>
Main road	Al Waht	4.00
Al Fiyush	Harran Dayyan	5.75
Harran Dayyan	Al Majhafa	1.50
Al Majhafa	Al Hamra	2.75
Al Hamra	Lahej	2.75
Main road	Al Mahallah	1.00
Main road	Sufyan	1.25
Sufyan	Ubar Badar	1.50
Ubar Badar	At Thalab	<u>1.00</u>
 Total		<u>21.50</u>

12. The roads will be 4.5 m wide and will have cobbled surface similar to that of the existing feeder roads. This surfacing has been standardized by the Public Works Department in the region because of its low cost. It can withstand occasional flooding. For this type of construction earth work will be carried out by equipment and stones dressed and placed by hand. The interstices will then be filled with clay and sand. The MAAR Feeder Roads Section, which has already constructed two such roads in the area with engineering assistance from the PWD, will construct these roads on force account. Maintenance of the completed roads will be carried out by PWD.

Rural Water Supply

13. Due to very low water table in the following villages south of Lahej, their population is deprived of wholesome and adequate water supply. The Project will finance necessary works including two tubewells and water supply submains linking the villages with 12" to 10" water supply main connecting Lahej with the new town of Saber. The water will be distributed by a network of stand pipes located at convenient places in each village.

<u>Name of Village</u>	<u>Population (1973)</u>
Ubar as Sulum	1,430
Jawl Yamani	1,000
Muqayabirah	720
Bayt Iyad	1,410
Al Mahallah	800
Sufyan	380
Total	5,740

14. The Public Water Corporation (PWC) will prepare the designs and construct the water supply works. The distribution facilities will be designed for consumption of 10 imperial gallons per head with future extension margin in the sub-mains up to 20 imperial gallons per head. The construction will be either on force account or on local contract basis. Operation and maintenance of these schemes will be with PWC. Apart from the pumping machinery, about 5,000 m of cement asbestos sub-mains (10-15 cm in diameter) and about 7,500 m of GI distribution pipes (2 to 5 cm in diameter), some tools, one truck and one four-wheel drive vehicle will be provided under the project for construction and maintenance of the works.

15. As is customary the operations and maintenance costs will be raised from the beneficiaries and each household will share the cost depending on the number of persons in the family.

Agricultural Development

16. The agriculture development measures include:

- (i) Supply of about 1,515 tons of fertilizer and 49 tons of plant protection chemicals (Annex 8, Table 2) to cover the project needs for their first crop year plus incremental requirements for the next three years. These supplies will be distributed in kind to cooperatives and state farms.
- (ii) Supply of 40-farm tractors about 60 horsepower each with implements to augment and replace obsolete equipment with MRS and state farms. (Annex 8, Table 6).
- (iii) Establishment of about 105 ha of mangos and about 40 ha of shelter belts.

Project Management Support

17. The project will finance external technical assistance to Delta Tuban Development Board (DTDB), to improve its technical and managerial capabilities. This assistance will comprise an irrigation agronomist, an extension specialist, a civil engineer, a farm management specialist and a farm machinery expert. The farm management specialist, who will train the farm managers and the DTDB Board

officials in management and accounting techniques, will be employed for a period of two years and the other expatriates for periods ranging from four to two years. Eight 4-wheel drive vehicles and 21 motor cycles will be procured for project management and extension staff.

18. Management support will also provide for overseas training, equivalent to sixty man-months, for Yemeni counterpart staff and sixty-three man-months for extension staff.

Water Management Study

19. The project will finance a comprehensive water management study to refine the estimates of available surface and ground water potential of Wadi Tuban area and to produce a long term water management plan for Wadi Tuban Delta containing proposals for optimum use of the available water resources for agriculture, household and industrial uses. The work will, inter alia include, determining feasibility for extending ground water irrigation areas, recycling of Aden sewage water for irrigating areas around Beir Ahmed and Shiekh Othman, relocating the Aden water supply wells to prevent salt water intrusion, importing water from the adjacent Wadi Bana or desalinisation of the sea water for household and industrial uses in the project area and Aden. The terms of reference of the study are in Annex 6.

Study on Agricultural Price, Taxation and Subsidy Policy Systems

20. The project will finance a study on agricultural price, taxation and subsidy policy systems to be carried out by consultants. The objectives of the study will be to propose recommendations outlining alternative policy investments that could be adopted and their projected effect on productivity, resource mobilization and income distribution.

Land Use Association (LANDSAT) Study

21. The project will finance a land cover/land use association (LANDSAT) study of selected areas of Yemen to identify areas with groundwater potential for future agricultural development. The study will be carried out under the guidance of the Planning Resource Unit of the World Bank's Agricultural and Rural Development Department.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Consultant's Terms of Reference

Background

1. The Wadi Tuban Agricultural Development Project includes a provision for the preparation of a water management study to define the optimum future use of the water resources of the Wadi Tuban Delta and to determine the feasibility of using waste water from the Aden sewage treatment plant for irrigating arable land in the Wadi.
2. It is intended that this study could eventually lead both to a second phase Wadi Tuban Agricultural Development Project (which, depending on the study findings, would further expand the agricultural production of the delta), and to a water supply project to meet the projected domestic and industrial (including factory installations) water demand for Aden City and surrounding urban areas, and other towns and villages in Wadi Tuban Delta. A separate simultaneous study commissioned by the Public Water Corporation (PWC) will establish the water demand in Aden. The detailed engineering for the source of supply identified under the present terms of reference will be carried out by PWC's consultant.
3. The agricultural use of water resources within the wadi has recently been the subject of a study carried out by Italconsult 1/ for UNDP/FAO. The main conclusions of this report were that, in the intervening period before more hydrological data is collected and assessed, no further expansion in the groundwater irrigated area should take place, and that new town water supply wells will have to be sunk eventually in an unspecified position further north. These findings were influenced by two low flow years in the wadi and no exploratory drilling to confirm the geophysical findings in the untapped southwestern part of the aquifer.
4. A recent cycle of successive dry years and increasing abstractions from the aquifer have resulted in a progressive lowering of the water table which is allowing sea water intrusion near coastal areas. Thus, a number of wells at the Aden potable water supply well field at Sheikh Othman have been abandoned, and the major source of water now is the well field at Bir Nasir, which is experiencing operational problems due to the falling water table. There is therefore an urgent need to refine estimates of the present and

1/ Reports "Soil and Water Utilization and Conservation in the Wadi Tuban Watershed Area", Italconsult - Nov. 1975.

future groundwater balance and, with this knowledge, to specify a long-term water management policy with specific technical and managerial proposals for its implementation. In addition, a feasibility study for using the Aden sewage effluent for irrigating the coastal areas between Sheikh Othman and Beir Ahmed for increasing agricultural production and creating a source of recharge to prevent salt water intrusion is considered necessary.

Selection of Consulting Firm

5. A consulting firm experienced in the fields of groundwater exploration, waste or sewage water use, resource planning and utilization will be employed, in consultation with the Government and IDA, to carry out the proposed study.

6. On the basis of the TOR's presented below, the interested firms will make detailed proposals for consulting services and for the provision of the scientific devices which they consider necessary to carry out the work. The proposals will include experience and background of the firm, computer facilities, staffing program (field and headquarters) and curricula vitae of proposed staff.

7. The consultants will cooperate fully with the Government, which will provide the existing data, facilities and services outlined below. However, the consultants will be solely responsible for the analysis and interpretation of all data received and for the findings, conclusions and recommendations made in their reports. The project manager, in conjunction with Government departments concerned, will supervise the various phases of the study and will ensure that it complies with the following terms of reference.

Terms of Reference

Objectives

8. A. The consultants will produce a long-term water management plan for the Wadi Tuban delta with proposals for meeting the irrigation requirements and increased water supply needs of the non-agricultural sector. This could involve, inter alia, the recycling of sewage effluent, desalination of sea or brackish water, importing water from the adjacent Wadi Banna, or any other economic alternative. This long-term management plan will be discussed and agreed upon with the Government and IDA.
- B. Within the agreed long-term plan, the consultants will have to demonstrate the technical and economic feasibility of:
- (i) the alternative water supply source for non-agricultural uses proposed in (A) above;

- (ii) the expansion of agriculture within the delta, if the findings of the water management plan indicate availability of water for this purpose;
- (iii) the use of sewage waste water for irrigation purposes.

Part A - The Water Management Plan

9. The work for the plan will be in three parts:

(i) The Water Resources Study

10. The work to be done by the consulting firm under this part will be to assess the water resources of the Wadi Tuban Delta and will include:

- (a) collection of existing geophysical and hydrogeological data, its verification, analysis and re-interpretation;
- (b) collection, reduction and review of all existing hydrological and meteorological data, its analysis and re-interpretations;
- (c) estimation of the historic change of water storage in the aquifer by reviewing piezometric records;
- (d) estimate the rate of recharge to the aquifer both directly from the river beds and from spate irrigated areas;
- (e) confirm the validity of the tentative rating curve for Dukeim gauging station by direct current metering of high flows. This will require the installation of a cableway across the gorge at Dukeim to be installed under the consultants' supervision;
- (f) establish and monitor a gauging station on the Wadi Abrayn (NW of Wadi Tuban) in order to estimate this wadi's contribution to the aquifer's resources. This station, and the cableway described in (e) will allow measurement during the consultants site surveys and will then be incorporated into the Wadi's hydrological observation network, run by the Government;
- (g) drill with a Government rig, two exploratory boreholes to confirm the geophysical findings in the untapped SW part of the aquifer and as necessary, install piezometers in parts of the delta not having shallow wells. It is suggested that these piezometers could take the form of hand dug shallow wells;

- (h) update and refine the mathematical aquifer model used in the Wadi Tuban study, using the latest estimation of field parameters.

11. Production of a landuse/landcover image based on computer categorization with a map overlay and a computer processed edge enhanced false color rendition for hydrologic and geologic evaluation from satellite imagery, accompanied by a report to facilitate the evaluation of water resource potential of selected areas in the territory of the Borrower, will be undertaken by consultant directly under the Planning Resource Unit of the Agricultural and Rural Development Unit of the Agricultural and Rural Development Department of the World Bank.

(ii) Techno-economic Study

12. The work to be carried out under this part will be to consider the existing and future demand, alternative supply of water and develop an optimized plan of aquifer water use, and will include:

- (a) a survey of all tubewells and pumped shallow wells to establish an updated well inventory for the delta. All details such as discharge, hours run per year, construction of the well, type of pump set and age, water quality and commanded area should be logged.
- (b) establish the optimum area for spate irrigation both in terms of agricultural production and maximum average aquifer recharge;
- (c) using the projected potable and industrial water supply demand for Aden established by the consultants to PWC (para 2), investigate the economics of providing alternative supplies by importing water from the adjacent Wadi Banna 1/, by flash distillation, reverse osmosis of brackish/sea water, or any other method;
- (d) examine the advisability and estimate the effect and cost of displacing the main potable supply well field, now at Bir Nasir, further north or to the untapped SW part of the aquifer;
- (e) review the latest sewerage improvement schemes proposed for Aden and surrounding towns. Estimate the effect on water consumption and determine the economics of the extension in the water-born sewerage system and consider the role to be played by recycled sewage effluent.

1/ On the basis of present knowledge of the potential of this wadi.

- (f) determine the feasibility of using waste water from the Aden sewage plant for irrigating arable land north of Aden and creating a source of recharge to prevent salt water intrusion.

(iii) Agreement on Water Management Study

13. The recommended water management plan will be submitted to Government for review. Following acceptance of the report and its recommendations, the consultants will commence work on Part B hereunder.

Part B - The Feasibility Study

14. This study will be based on the findings of Part A. It will put forward costed feasibility level designs of sufficient detail to demonstrate the physical and economic viability of any new source of potable and industrial water supply. Should the findings of the water management plan indicate availability of additional water resources for agriculture, the feasibility study will also examine the technical and economic feasibility of expanding groundwater irrigated agriculture in the delta. In particular it will make recommendations on the location of any such expansion and on cropping patterns maximizing the return from pumped waters. Should it be found that it is possible to use waste waters from the sewage treatment plant, the feasibility study will estimate the cost involved in irrigating a specified area of land in the delta, along with technical details of the proposed works.

Reports

15. The consulting firm shall submit the following sets of reports, in English, to Government and copied to IDA as follows:

- (a) an inception report (10 copies) within three months of appointment, summarizing initial findings after review of existing data and describing the proposed program of data collection, field work and explorations;
- (b) brief progress reports (20 copies) at quarterly intervals, describing all work performed during the quarter and a summary of findings, and the work proposed to be done during the next quarter;
- (c) an interim report (20 copies) covering Part A of the study, after completion of field works and completion and verification of the mathematical model (estimated to be within 14 months of appointment), summarizing all work performed, and identifying the most promising alternative sources of water supply. This interim report will be the basis for discussion for the approval of the proposed water management plan by the Government and IDA;

- (d) an interim report (20 copies) covering Part B of the study after completion of field work, preliminary designs and costing;
- (e) a final report (50 copies) at the conclusion of all data collection (assumed to be 23 months after appointment) and after discussion and approval of the interim report on Part B by Government and IDA, summarize all work done and recommend the optimum water management plan and its method and timing of implementation. The final report will also incorporate the feasibility of the identified water supply source and a possible second-stage agricultural development project.

Facilities to be Provided by Government

16. All available relevant data, reports, maps, air photographs, and other information available on topography, meteorology, hydrology, geology, land use, etc. will be supplied to the consulting firm, which is not entitled to publish or disclose any of the information so obtained without the written consent of the Government.

17. Government will second suitable technicians to the consulting firms, which will provide these technicians with in-service training in various study disciplines. Government will also dig necessary observation wells and drill the two exploration boreholes (para 10 g).

18. The consulting firm will recommend to Government a list of suitable equipment and materials, e.g. vehicles and cableway equipment (for Dukiem gorge) and gauging equipment (for Wadi Abrayn) with estimated cost, to carry out the studies mentioned in paras. 8, 9 and 10 above. The equipment and materials will be procured by the consulting firm after agreement by the Government and IDA and, the consulting firm will finance the cost of these items on a non-profit reimbursable basis. Such equipment will be allowed by Government to be imported free of duties and taxes and will be retained by Government following completion of the study.

Facilities to be Provided by the Firm

19. The consulting firm will provide all specialized equipment required, e.g. survey equipment, drafting equipment, calculators and the like which will be allowed by Government to be imported and subsequently exported free of duties and taxes. The firm will be reimbursed for the cost of such services on a per month basis.

Manpower Requirement

20. The total manpower requirement for the study is estimated at 70 man months as set out in Table 1. If consultants prefer to present other time estimates, they must justify them.

Government Decision

21. Government will have to approve any staff substitution in place of those mentioned in the consultants' proposals.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Manpower and Phasing of the Water Management Study

Specialist	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total Man-months
Hydrologist	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12		
Hydrogeologist	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14		
Water resources planner/economist	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Period for Government	—	—	—	—	—	—	—	—	—	—	8		
Water supply and sewerage engineer	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	and IDA	—	—	—	—	—	—	—	—	—	—	18		
Agronomist	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	approval of	—	—	—	—	—	—	—	—	—	—	6		
Digital model studies	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	water manage-	—	—	—	—	—	—	—	—	—	—	5		
Report writing	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	ment plan	—	—	—	—	—	—	—	—	—	—	7		
																		Total	—	—	—	—	—	—	—	—	—	—	70		

August 1977

APPRAISAL OF
WADI TUBAN AGRICULTURAL PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Preliminary Outline of a Proposed Study on Agricultural Price,
Taxation and Subsidy ^{1/} Policy Systems in PDRY

1. A historical description of the original objectives, of the price, taxation and subsidy policy systems prevalent in the agricultural sector (including cooperative and state farms)--how they work and what recent major changes have occurred;
2. An analysis of the importance of the various policy tools with respect to agricultural production, the Government's budget, and public savings;
3. An analysis of the impact of price, taxation and subsidy policies on incentives and economic efficiency;
4. An analysis of the incidence of the burdens and benefits of the administrative price, taxation and subsidy systems on incomes between agriculture and industry, between urban and rural areas, and between high- and low-income groups; and
5. A set of recommendations outlining alternative policy instruments that could be adopted and their projected effect on productivity, resource mobilization and income distribution.

1/ Including interest rate policy.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Irrigation Development - Cost Estimates
(Amounts in YD thousand)

<u>Item</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>TOTAL</u>	<u>Foreign Exchange</u>	
						<u>YD thousand</u>	<u>US\$ thousand</u>
A. Civil Works							
Land Levelling	-	127.7	138.0	138.0	403.7	242.2	702.4
Farm Roads	-	16.7	18.0	18.0	52.7	15.8	45.8
Laying Pipe Lines	8.6	46.9	44.1	44.1	143.7	28.7	83.2
Installing Replacement Pumpsets	2.7	3.0	-	-	5.7	-	-
Installing Electrical Connections	6.7	6.7	-	-	13.4	-	-
Total Civil Works	18.0	201.0	200.1	200.1	619.2	286.7	831.4
Physical Contingencies (15%)	2.7	30.2	30.0	30.0	92.9	43.0	124.7
<u>Total A</u>	<u>20.7</u>	<u>231.2</u>	<u>230.1</u>	<u>230.1</u>	<u>712.1</u>	<u>329.7</u>	<u>956.1</u>
B. Equipment							
Earth Moving Equipment	170.2	113.4	-	-	283.6	283.6	822.5
Pipes, Hydrants, Valves	309.5	206.3	-	-	515.8	515.8	1,495.8
Pump Sets	37.8	-	-	-	37.8	37.8	109.6
Electrical Equipment	33.6	33.6	-	-	67.2	67.2	194.9
Total Equipment /1	551.1	353.3	-	-	904.4	904.4	2,622.8
Physical Contingencies	58.5	38.3	-	-	96.8	96.8	280.7
<u>Total B</u>	<u>609.6</u>	<u>391.6</u>	<u>-</u>	<u>-</u>	<u>1,001.2</u>	<u>1,001.2</u>	<u>2,903.5</u>
<u>Grand Total (A+B)</u>	<u>630.3</u>	<u>622.8</u>	<u>230.1</u>	<u>230.1</u>	<u>1,713.3</u>	<u>1,330.9</u>	<u>3,859.6</u>

/1 Physical Contingencies are 15% for Pipes etc., 5% for other equipment.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Agricultural Development - Cost Estimates
(Amounts in YD thousand)/1

<u>Item</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>TOTAL</u>	<u>Foreign Exchange</u>	
						<u>YD thousand</u>	<u>US\$ thousand</u>
<u>A. Fertilizers and Chemicals</u> /2							
Urea - metric tons	259	180	178	170	787		
Ammonium Sulphate - metric tons	100	99	98	91	388		
Triple Superphosphate - metric tons	90	88	86	76	340		
Fertilizer Costs - YD thousand	25.2	19.9	19.7	18.3	83.1	74.8	216.9
Chemicals - YD thousand	43.2	14.6	14.3	13.8	85.9	77.3	224.2
Total	68.4	34.5	34.0	32.1	169.0	152.1	441.1
Physical Contingencies (15%)	10.2	5.2	5.1	4.8	25.3	22.8	66.1
<u>Total A</u>	<u>78.6</u>	<u>39.7</u>	<u>39.1</u>	<u>36.9</u>	<u>194.3</u>	<u>174.9</u>	<u>507.2</u>
<u>B. Farm Machinery</u> /3							
	134.9	202.3	-	-	337.2	337.2	977.9
Physical Contingencies (5%)	6.7	10.1	-	-	16.8	16.8	48.7
<u>Total B</u>	<u>141.6</u>	<u>212.4</u>	<u>-</u>	<u>-</u>	<u>354.0</u>	<u>354.0</u>	<u>1,026.6</u>
<u>C. Orchard and Shelterbelts</u>							
Mango establishment	9.6	9.6	9.6	-	28.8	-	-
Shelterbelts (total 210 km)	2.8	2.8	2.8	2.6	11.0	-	-
Total	12.4	12.4	12.4	2.6	39.8	-	-
Physical Contingencies (15%)	1.8	1.8	1.8	0.4	5.8	-	-
<u>Total C</u>	<u>14.2</u>	<u>14.2</u>	<u>14.2</u>	<u>3.0</u>	<u>45.6</u>	<u>-</u>	<u>-</u>
<u>Grand Total (A+B+C)</u>	<u>234.4</u>	<u>266.3</u>	<u>53.3</u>	<u>39.9</u>	<u>593.9</u>	<u>528.9</u>	<u>1,533.8</u>

/1 Quantities of fertilizer are in metric tons.

/2 Incremental costs from year to year. In Year 1, total costs are included; thereafter, only costs incremental to the previous year.

/3 Details in the equipment list (Table 6).

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Project Management - Cost Estimates
 (Amounts in YD thousand)

<u>Item</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>TOTAL</u>	<u>Foreign Exchange</u>	
						<u>YD thousand</u>	<u>US\$ thousand</u>
A. Staff							
Technical Assistance(Expatriates)(5)	82.0	82.0	82.0	61.5	307.5	307.5	891.7
Counterparts(5) and Co-Manager	4.6	4.6	4.6	4.6	18.4	-	-
Extension Agents(21)	5.5	10.5	10.5	10.5	37.0	-	-
Site Engineers(3)	2.2	2.2	2.3	2.3	9.0	-	-
Accountancy(1)	0.6	0.7	0.7	0.7	2.7	-	-
Other(11)	4.0	4.0	4.0	4.0	16.0	-	-
Total Staff Costs	98.9	104.0	104.1	83.6	390.6	307.5	891.7
Contingencies(15%)	14.8	15.6	15.6	12.6	58.6	46.1	133.7
<u>Total A</u>	<u>113.7</u>	<u>119.6</u>	<u>119.7</u>	<u>96.2</u>	<u>449.2</u>	<u>353.6</u>	<u>1,025.4</u>
B. Training							
Contingencies(15%)	-	18.0	18.0	18.0	54.0	54.0	156.6
<u>Total B</u>	<u>-</u>	<u>2.7</u>	<u>2.7</u>	<u>2.7</u>	<u>8.1</u>	<u>8.1</u>	<u>23.5</u>
C. Equipment							
Vehicles	34.9	-	-	-	34.9	34.9	101.2
Extension Training Equipment	1.6	0.3	0.3	0.3	2.5	2.5	7.3
Office Equipment	6.0	-	-	-	6.0	2.0	5.8
Total Equipment	42.5	0.3	0.3	0.3	43.4	39.4	114.3
Physical Contingencies(5%)	2.1	-	-	-	2.2	2.0	5.8
<u>Total C</u>	<u>44.6</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>45.6</u>	<u>41.4</u>	<u>120.1</u>
D. Operating Costs (Total D)	3.9	7.7	7.7	7.7	27.0	-	-
Grand Total (A+B+C+D)	162.2	148.3	148.4	124.9	583.9	457.1	1,325.6

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Social Infrastructure and Water Study - Cost Estimates
(Amounts in YD thousand)

<u>Item</u>	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>TOTAL</u>	<u>Foreign Exchange</u>	
						<u>YD thousand</u>	<u>US\$ thousand</u>
A. Civil Works							
Installing Pipes and Tubewells	-	11.8	17.6	17.6	47.0	23.5	68.1
Feeder Roads Construction	-	25.4	27.6	27.6	80.6	24.2	70.2
Total Civil Works	-	37.2	45.2	45.2	127.6	47.7	138.3
Physical Contingencies(15%)	-	5.6	6.8	6.8	19.2	7.2	20.9
<u>Total A</u>	-	42.8	52.0	52.0	146.8	54.9	159.2
B. Equipment - Water Supply							
Water Pipes, Hydrants, etc.	-	25.5	-	-	25.5	25.5	73.9
Pumps and Motors	8.6	3.7	-	-	12.3	12.3	35.7
Transport Vehicles	6.0	6.0	-	-	12.0	12.0	34.8
Total Equipment	14.6	35.2	-	-	49.8	49.8	144.4
Physical Contingencies	0.7	4.3	-	-	5.0	5.0	14.5
<u>Total B</u>	15.3	39.5	-	-	54.8	54.8	158.9
C. Water Study							
Consultants' Costs	51.1	102.2	51.2	-	204.5	184.0	533.6
Equipment	-	36.1	-	-	36.1	36.1	104.7
Total Water Study	51.1	138.3	51.2	-	240.6	220.1	638.3
Physical Contingencies	7.7	20.7	7.7	-	36.1	33.0	95.7
<u>Total C</u>	58.8	159.0	58.9	-	276.7	253.1	734.0
D. Agricultural Policies Study							
Consultants' Costs	68.9	-	-	-	68.9	68.9	200.0
Grand Total (A+B+C+D)	<u>143.0</u>	<u>241.3</u>	<u>110.9</u>	<u>52.0</u>	<u>547.2</u>	<u>431.7</u>	<u>1,252.1</u>

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Consultants - Cost Summary

<u>Item</u>	<u>Months</u>	<u>Estimated Cost</u>		
		Foreign	Local	Total
		----- US\$ thousand -----		
<u>Project Management</u>				
A. Extension Service				
Irrigation Agronomist (Manager)	48	237.8	-	237.8
Irrigation Engineer	42	208.1	-	208.1
Extension Specialist	42	208.1	-	208.1
Farm Management Specialist	24	118.9	-	118.9
Farm Machinery Expert	24	118.9	-	118.9
Total Extension Service	180	891.8	-	891.8
Contingencies (15%)		133.7		133.7
<u>Total A /1</u>	<u>180</u>	<u>1,025.5</u>		<u>1,025.5</u>
B. Water Study /2				
Hydrologist	10	76.5	8.5	85.0
Hydrogeologist	14	107.1	11.9	119.0
Economist (Water Resources Planner)	8	61.2	6.8	68.0
Engineer (Water Supply/Sewage)	20	153.0	17.0	170.0
Agronomist	6	45.9	5.1	51.0
Studies and Reports	12	91.8	10.2	102.0
Total Water Study	70	535.5	59.5	595.0
Contingencies (15%)		80.3	8.9	89.2
<u>Total B</u>	<u>70</u>	<u>615.8</u>	<u>68.4</u>	<u>684.2</u>
C. Agricultural Policies Study				
Consultants' Cost	40	200.0	-	200.0
<u>Total C</u>	<u>40</u>	<u>200.0</u>	<u>-</u>	<u>200.0</u>
<u>Grand Total (A+B+C)</u>	<u>290</u>	<u>1,841.3</u>	<u>68.4</u>	<u>1,909.7</u>

-
- /1 With price contingencies, the total cost of these consultants is estimated to be US\$1.32 million or about US\$88,000 per year. Local costs for vehicle running expenses of the consultants have been included in the general budget of the extension service.
- /2 Costs for these consultants are inclusive of all costs related to the water study, except equipment, i.e., they include overhead of a consulting firm, transport, accommodation, etc. With price contingencies, the total cost of the study will be about US\$991,000.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Equipment Lists

<u>Item</u>	<u>Number</u>	<u>Estimated Cost</u>	
		YD thousand	US\$ thousand
<u>A.</u> <u>Irrigation Development</u>			
Pumps (vertical shaft turbine)	10	21.0	60.9
Motors - 30 HP	16	9.6	27.8
- 60 HP	8	7.2	20.9
Transformers	24	31.2	90.5
Electrical fittings		36.0	104.4
Pipes (cement asbestos)		430.5	1,248.4
Pipe fittings		85.3	247.4
Crawler Tractors - 70-90 HP	5	81.0	234.9
- 140 HP	5	107.5	311.8
Motor Graders (130 HP)	2	47.8	138.6
Spare Parts (earthmoving equipment)(20%)		47.3	137.2
Subtotal		904.4	2,622.8
Contingencies		96.8	280.7
<u>Total A</u>		1,001.2	2,903.5
<u>B.</u> <u>Agricultural Development</u>			
Wheel Tractors (60-70 HP)	40	138.0	400.2
Ploughs (moldboard)	30	10.5	30.4
Cultivators (tyné)	20	6.0	17.4
Chisel Ploughs	10	4.0	11.6
Land Planers	10	14.5	42.1
Ridgers	6	2.1	6.1
Border Disc	6	5.1	14.8
Ditchers	6	4.2	12.2
Seed Drills	6	8.4	24.4
Planters (cotton/maize)	6	9.9	28.7
Fertilizer Spinner Broadcaster	6	2.4	7.0
Mower/Conditioner	6	9.9	28.7
Baler (pick-up)	3	5.6	16.2
Forage Harvester	6	7.5	21.7
Forage Wagon	6	4.8	13.9
Trailer (tipping)	10	7.0	20.3
Sprayers (tractor mounted)	60	36.0	104.4
Stalk Shredder	6	5.1	14.8
Spare Parts (20%)		56.2	163.0
Subtotal		337.2	977.9
Contingencies		16.8	48.7
<u>Total B</u>		354.0	1,026.6

<u>Item</u>	<u>Number</u>	<u>Estimated Cost</u>	
		<u>YD thousand</u>	<u>US\$ thousand</u>
C. Project Management			
Transportation Vehicles (4WD) - LWB	4	14.0	40.6
- SWB	4	8.8	25.5
Motor Cycles	21	6.3	18.3
Spare Parts (20%)		5.8	16.8
Extension Equipment		2.5	7.2
Office Equipment		6.0	<u>17.4</u>
Subtotal		<u>43.4</u>	<u>125.8</u>
Contingencies		<u>2.2</u>	<u>6.4</u>
Total C		<u>45.6</u>	<u>132.2</u>
D. Rural Water Supply			
Transportation Vehicles (4WD) - LWB	1	3.5	10.1
Trucks (6 ton)	1	6.5	18.9
Spare Parts (20%)		2.0	5.8
Pumps(electric, submersible, with motors)	2	10.0	29.0
Chlorination Plant	1	0.5	1.5
Tools		1.8	5.2
Pipes (cement asbestos) and fittings		15.0	43.5
Pipes (GI) and fittings		<u>10.5</u>	<u>30.4</u>
Subtotal		<u>49.8</u>	<u>144.4</u>
Contingencies		<u>5.0</u>	<u>14.5</u>
Total D		<u>54.8</u>	<u>158.9</u>
Grand Total (A+B+C+D)		<u>1,455.6</u>	<u>4,221.2</u>

APPRAISAL OF

WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT

PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Cost Breakdown /1

Land Levelling

Earth-moving equipment-Hourly operation rates

D4 bulldozer

Depreciation: YD 16,200/9,000 hours life	1.800
Spares, repairs and maintenance: 1.1 x depreciation	1.980
Fuel cost: 75 HP x 0.1 1/hour/HP x YD 0.350/4.54	0.578
Lubrication: Fuel cost x 0.2	
Interest: capital cost/2 x annual interest 6% x 1/1800 hours run/year	.112 <u>0.270</u>
Sub-total	4.740
Overhead costs: 12% of sub-total	0.569
Driver + mate (8 hours a day)	<u>0.320</u>
Total cost per hour	<u>5.629</u>

D6 bulldozer

Depreciation: YD 21,400/9,000 hours life	2.378
Spares, repairs and maintenance: 1.1 x depreciation	2.616
Fuel cost: 140 HP x 0.1 1/hour/HP x YD 0.350/4.54	1.079
Lubrication: Fuel cost x 0.2	0.216
Interest: capital cost/2 x annual interest 6% x 1/1800 hours run/year	<u>0.357</u>
Sub-total	6.646
Overhead costs: 12% of sub-total	0.798
Driver + mate (8 hours a day)	<u>0.320</u>
Total cost per hour	<u>7.764</u>

/1 For the purpose of estimate only

120 G Motor grader

Depreciation: YD 23,900/9,000 hours life	2.655
Spares, repairs and maintenance: 1.1 x depreciation	2.920
Fuel cost: 125 HP x 0.1 l/hour/HP x YD 0.350/4.54	1.000
Lubrication: Fuel cost x 0.2	0.200
Interest:	
capital cost/2 x annual interest 6% x 1/1800 hours run/year	<u>0.398</u>
Sub-total	7.173
Overhead costs: 12% of sub-total	0.861
Driver + mate (8 hours a day)	<u>0.320</u>
Total cost per hour	<u>8.354</u>

Assuming efficiency of machinery use as 50% under project management, the earth moving costs will be:

Machine type	Output over average hour	Cost/hour YD	Cost/m ³ YD	Cost/ha YD
D6 Caterpillar type bladed bulldozer	20 m ³ /h	7.764	0.39	
D4 Caterpillar type bladed bulldozer	14 m ³ /h	5.629	0.40	
Motor Grader	3 h/ha	8.354		25.062

Land Levelling - Cost per hectare

The average amount of earth moving is estimated to be 500 m³/ha. YD

Cost per hectare is therefore:

D4/D6 bulldozer - 500 m ³ x YD 0.40	200.00
Motor grader - 3 hrs x YD 8.647	25.06
Surveyor & assistant 1 day x YD 1.850	<u>1.85</u>
Total cost per hectare	<u>226.91</u>
say	230 YD/ha

Estimate of earth-moving equipment requirement

Total earth work: 500 x 1755	=	877,500 m ³
Average hourly progress per machine	=	17 m ³
Number of machine hours	=	<u>877,500</u> 17
	=	51,618
Number of machine days	=	<u>51,618</u> 6
	=	8603

For completing work in about 3 years with 900 working days:

No. of machines requires	=	<u>8610</u> 900 = 10
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Use 5 D6 and 5 D4 types

Water distribution works

Cement - asbestos pipe (Bitumen-dipped)

Quantity at 70 meters/ha = 1755 x 70	=	122850 say 123000 meters
20 cm dia pipe = 30,000 m		
15 cm dia pipe = 93,000 m		
93000 meters pipe @ 3.10 YD/m	=	288300 YD
30000 " " @ 4.74 YD/m	=	<u>142200</u> YD
Sub-total	=	<u>430500</u> YD

Hydrant valves including connections 1755 number x 42 YD	=	736000 YD
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Flow control valves, non-return Valves, additional pipe fittings 69 wells x 170 YD/well	=	<u>11700</u>
Sub-total	=	<u>85,300</u> YD

Civil Works

123,000 m laying of pipes @ 0.75 YD/m	=	92200 YD
Handling and transport of materials @ 10% of cost of materials	=	<u>51500</u>
Sub-total	=	<u>143,700</u>

Village Water Supply

<u>Works</u>	4.12
Installing, developing and testing of tubewells up to 130 meter depth @ 100 YD/meter	26,000
Laying 16000' of cement - asbestos pipes @ 0.20 YD/foot	3,200
Laying 24000' of G.I. pipes @ 0.2 YD/foot	4,500
Electrification of pumps	8,000
Handling and transport of drilling machines and materials	4,000
Construction of pump houses	<u>1,000</u>
Sub-total	<u>47,000</u>

Pipes including fittings

6,000' cement asbestos pipe 6" dia @1.200 YD/ft	7,200
10,000' cement asbestos pipe 4" dia @0.800 YD/ft	8,000
6,000' G.I. pipe 2" dia @0.600 YD/ft	3,600
9,000' G.I. pipe 1.5" dia @0.500 YD/ft	4,500
5,000' G.I. pipe 1" dia @0.300 YD/ft	1,500
4,000' G.I. pipe 0.75" dia @0.200 YD/ft	<u>800</u>
Sub-total	<u>25,600</u>

Pumping sets

2 submersible electric pumping sets including internal electrical installation YD5000 each	10,000
Tools and test equipment	<u>2,300</u>
Sub-total	<u>12,300</u>

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Phasing of Project Costs
(Amounts in YD thousand)

	Year 1		Year 2		Year 3		Year 4		TOTAL		TOTAL
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	(US\$'000)
<u>Irrigation Improvement</u>											
Base cost	9	560	109	445	107	93	107	93	332	1,191	1,523
Physical contingencies	1	60	16	52	16	14	16	14	50	140	190
Price contingencies	2	71	30	104	43	37	56	49	131	261	392
Subtotal	12	691	155	601	166	144	179	156	513	1,592	2,105
<u>Fertilizers and Chemicals</u>											
Base cost	7	62	3	31	3	31	3	29	17	152	169
Physical contingencies	1	9	1	5	1	4	1	4	3	23	25
Price contingencies	1	8	1	7	1	10	1	13	4	38	42
Subtotal	9	79	5	43	5	45	5	46	24	213	236
<u>Agricultural Machinery</u>											
Base cost		135		202						337	337
Physical contingencies		7		10						17	17
Price contingencies		16		42						59	59
Subtotal		158		254						413	413
<u>Orchard and Shelterbelts</u>											
Base cost	12		12		12		3		40		40
Physical contingencies	2		2		2		-		6		6
Price contingencies	2		3		5		1		11		11
Subtotal	16		17		19		4		57		57
<u>Project Management</u>											
Base cost	25	121	30	100	30	100	30	80	114	401	515
Physical contingencies	3	14	3	15	3	15	3	12	13	56	69
Price contingencies	3	18	6	28	9	40	12	41	30	127	157
Subtotal	31	153	39	143	42	155	45	133	157	584	741
<u>Water Supply</u>											
Base cost	14	6	41	9	9	9	9	9	23	73	97
Physical contingencies	1	1	5	1	1	1	1	1	4	9	12
Price contingencies	2	2	10	4	4	5	5	5	10	19	29
Subtotal	17	9	56	14	14	15	15	15	37	101	138
<u>Feeder Roads</u>											
Base cost		18	8	19	8	19	8	8	56	24	81
Physical contingencies		3	1	3	1	3	1	1	8	4	12
Price contingencies		5	2	8	4	10	5	5	23	10	32
Subtotal		26	11	30	13	32	14	14	87	38	125
<u>Water Study</u>											
Base cost	5	46	10	128	5	46			20	220	240
Physical contingencies	1	7	2	19	1	7			3	33	36
Price contingencies	1	7	3	34	2	18			6	60	66
Subtotal	7	60	15	181	8	71			29	313	342
TOTALS^{/1}											
Base cost	59	937	189	956	186	287	171	219	604	2,399	3,003
Physical contingencies	8	98	27	107	27	43	24	33	86	281	367
Price contingencies	8	123	50	226	71	112	85	111	214	573	787
TOTAL	75	1,158	266	1,289	284	442	280	363	904	3,253	4,157
											12,055

^{/1} Individual items may not total to these figures because of rounding. Items less than YD 500 are indicated by '-' in the table.
A cell left blank indicates that the item is zero.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Estimated Schedule of Disbursements

<u>IDA Fiscal Year and Quarter</u>	<u>Cumulative Disbursements at end of Quarter</u> (US\$ thousand)
1977/78: June 30, 1978	150
1978/79: September 30, 1978	400
December 31, 1978	650
March 31, 1979	1,070
June 30, 1979	1,450
1979/80: September 30, 1979	1,950
December 31, 1979	1,430
March 31, 1980	2,900
June 31, 1980	3,375
1980/81: September 30, 1980	3,500
December 31, 1980	3,700
March 31, 1981	3,900
June 30, 1981	4,200
1981/82: September 30, 1981	4,450
December 31, 1981	4,700
March 31, 1982	4,950
June 30, 1982	5,200

APPRAISAL OF
WADI TUBAN AGRICULTURAL PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Organization and Management

Policy

1. The policy for agriculture in PDRY is determined by the Higher Political Committee for Agriculture which is chaired by the President of the Republic. This Committee approves the annual cropping plans submitted through MAAR by the cooperatives and state farms. Plans must conform with the five-year development plans specifically designed to meet the national food production requirements and provide agricultural raw materials for the agroindustries. The Director of the Department of Cooperatives of the MAAR is the Committee secretary.

Operation

2. The MAAR is responsible for implementing agricultural policy. The MAAR has a Minister, a Permanent Secretary, six departments and two sections. The Ministry Corporations such as the Delta Tuban Development Board (DTDB), the Agricultural Development Boards, the Public Corporation for Marketing Fruit and Vegetables and the Public Fish Wealth Corporation are directly linked to the Minister's Office (Chart WB 17632).

Former Organization (LADB)

3. The Lahej Agricultural Development Board (LADB) was a semi-autonomous body answerable directly to the Minister of Agriculture. It was the only established organization that was operating in the delta and familiar with the situation and problems. It had a seven member Board of Directors and the Permanent Secretary of MAAR is the Chairman. There was representation from the state farms and the cooperatives on the Board. The organization and management of the state farms and cooperatives were presented in Annex 4. The daily control was in the hands of a manager appointed by the Board. The manager was assisted by the heads of the four sections, namely Agriculture, Cotton Ginnery, Accounting and the Machinery Renting Section (MRS) (Chart WB 17755).

4. The agricultural section was responsible for the control of spate irrigation, supervision of the extension service, land reclamation, plant protection and fertilizer distribution. Through an internal Irrigation Council there was equitable distribution of the spate water during each flood on the basis of agreed cropping patterns. The extension service had 18 extension agents permanently stationed in the seven cooperatives. They were not functioning, however, as true extension agents. The land reclamation section

handled the annual repairs required to maintain the spate irrigation system. Fertilizers and pesticides were distributed to the cooperatives. The cotton ginnery section collected, graded, ginned and marketed the cotton grown in the area. The accounting section maintains records related to the cotton program. It also served as the imprest office for the disbursements in regard to the MRS and extension officers whose payment was the responsibility of other departments in MAAR. The MRS rented agricultural machinery to cooperatives, occasionally to state farms and recently to other organizations in the Second Governorate.

New Organization and Management

5. The project will be implemented by the successor of LADB, the Delta Tuban Development Board (DTDB), within the framework of the existing policy making bodies. DTDB is an autonomous body answerable directly to the Minister of Agriculture. Its eleven member board of directors, with representation from both the cooperative and state farms, is headed by the Permanent Secretary of MAAR. In order for the DTDB to carry out the project it will have expanded responsibilities and its management will be strengthened by the recruitment of five expatriates for periods of up to four years. The specialists are an Irrigation Agronomist, an Irrigation (civil) Engineer, an Extension Expert, a Farm Management Expert and a Farm Machinery Expert. To further support the DTDB and to enable it to continue to carry out its new responsibilities, counterparts for the specialists will also be provided. They will receive in-service training during the period the expatriates are involved. Details on the costing for the proposed organization and management of the project by DTDB are presented in Annex 8, Table 3.

6. The new responsibilities of DTDB will be to:

- provide extension services to state farms and cooperatives. An effective extension service will be established, whose responsibility will be to advise and train cooperative farmers on improved agricultural and irrigation practices. Technical officers will also be stationed on the State farms and will be responsible for advising the manager on proper agricultural techniques recommended by the project extension service, and the execution of the cropping plan proposed for the particular farm;
- design and supervise construction of civil works to be implemented by the project in the groundwater irrigated areas;
- conduct routine maintenance of tubewells and the groundwater irrigation distribution system. The tubewells are less than 10 years old, and previously no single body has had the regular servicing responsibility for them. The Public Corporation for Electric Power has installed and wired the electric motors used for pumping. It is also servicing motors, starter gear and overload devices. The diesel units have been serviced by local staff. The installation and replacement of pumps has been the responsibility of the Department of Irrigation and Mechanical Engineering;

- undertake the distribution of inputs for the whole project area. At present, the state farms order their inputs from the Department of Agricultural Production. In the future, the DTDB will be expected to provide summary totals of all inputs required within the Wadi Taban Delta. It will therefore be much simpler and easier to implement production programs if the DTDB has the overall responsibility for issuing commodity inputs such as fertilizer and plant protection products;
- provide administrative and accounting support to, and supervision of the state farms and cooperatives.

7. The reorganized DTDB, illustrated in Chart WB 17523, will give the expatriate project manager, assisted by a co-project manager, a direct link with the Accounts Section, the Machinery Rental Station and the Agricultural Section. The irrigation works, extension service and farm management units of the Agricultural Section will be headed by expatriates, and each will have a counterpart. It is expected that the counterparts will hold at least a basic degree in their specialty. With short, practical overseas training (see paras. 12 and 13) added to their in-service training, these counterparts should be able to assume the full responsibilities of the units they are attached to by the time the expatriate contracts terminate.

Extension Service

8. The expatriate director of the Extension Service will prepare the overall extension program, provide guidance and assistance in the training of agents, develop a technically competent staff and supervise staff performance. He and his counterpart for, backstopping purposes, will maintain direct contact through biweekly or monthly meetings with the specialists at the El Kod Research Station, and weekly meetings with the supervisor of the Demonstration Farm planned for the Wadi Tuban Delta under a UNDP project. It will be the responsibility of the expatriate director and his counterpart to become knowledgeable about adaptive research results from the El Kod Research Station and to use the information for program building. They will also keep the scientists at the station informed on problems and difficulties experienced in the field that should be given attention by the station. This information will help the El Kod Research Station plan its annual research program. In addition, a close liaison will be established with the training institutes (Annex 2, para 17) in order to have some influence on the offering of courses that will be relevant to the needs of the Extension Agents.

9. The Extension Service will be expected to significantly effect an increase in agricultural production by working directly with farm managers, farmers and field personnel in the introduction of improved cultivars and new cultural practices, the efficient use of water, crop fertilization, plant protection techniques and the adoption of other improved practices. Emphasis will be placed on teaching those with whom they have contact. Since agricultural chemicals will be used extensively, the agents will be given special

training in such areas as pesticide use, storage, health care and disposal of pesticide containers. The agents will be made aware of the need to constantly look out for any detrimental effects that might be created by applying pesticides. The concentration of effort by each agent at first will be on introducing improved cultivars, fertilization and pest control. The agents in order to reach and effectively communicate with their clients, will be well trained in working with individuals and groups, demonstration techniques, the preparation and use of visual aids and the operation of audio visual equipment.

10. The staff required to carry out the extension program in the co-operatives will be based on having one agent responsible for 750 families. For the seven cooperatives, a total of nine extension agents will be required. On each state farm one technical officer will be assigned under the general management of the farm manager. He will be responsible for the implementation of the approved cropping plan and will receive his technical backstopping from the project management. The project management will maintain direct and frequent contact with the state farm managers to review program progress and to assist in the resolution of any technical problems that may arise. The overall supervision of the extension and technical officers will be carried out by the expatriate extension director and his counterpart. The project manager, expatriate irrigation engineer and farm management consultant, however, will provide additional support in this respect, particularly in the areas of their expertise.

11. The DTDB has sufficient space to accommodate the headquarters for the project and the main Extension Office. The project will supply funds for the office equipment required. The extension and technical officers will be expected to reside in the farm facilities now available and receive the housing allowances normally provided for officers when they are in the field. The extension staff will have to be mobile and the project will provide a four-wheel drive vehicle for the senior extension officer (counterpart to the Director of Extension) and lightweight motorcycles for each extension officer. Funds under the project will also be provided for the training supplies and equipment needed by the Extension Service to conduct its work such as slide projectors, 35 mm cameras, portable screens, 16 mm film projectors, overhead projectors, flip cards, as well as costs for renting educational films. Field demonstrations in farmers' plots and on the state farms have proven to be an effective way to transfer technology, and break through the conservatism and overcome the skepticism of the farmers and farm managers. Funds will be provided under the project to continue and expand this approach.

Training and Selection of Local Staff

12. The extension personnel, agents and technical officers, will require some in-service training which will be provided by the extension director and others he may call upon. The resource persons for in-service training could come from the El Kod Research Station, staff members of the Nassar Agricultural College at Lahej and the Cooperative Education and Training Center at (Dar Sa'ad) as well as selected personnel from the MAAR. Support will also come from the expatriate (3) staff. In-service training will be on a continuing

basis but confined mainly to the summer period in the perennially irrigated area, when only forage crop production will be taking place, and the winter for the spate area when there is no spate water. The equipment listed in para 11 will also be used for this program.

13. It is expected that the extension and technical officers will be selected from among those that have been trained at Dar Sa'ad or Giar institute or their equivalent. They should be graduates of a secondary school and have some farming experience. It should be possible to select from among the agents now working for the Board a few persons for retraining at Giar. The five months practical course offered at Giar should be beneficial to those selected. To improve the agents proficiency and broaden their view on agriculture, each agent will be sent to a suitable neighboring country for a three-months course in Agriculture Extension. Funds for this program will be provided for under the project.

14. The six counterparts for the expatriates will be holders of basic degrees either from Nasser Institute at Lahej or a school of equivalent level. After serving with their respective expatriate officers for at least one year, those who have proven their ability would be sent for overseas training for 6 to 12 months. The training will be of a practical nature, specific for the area of work he is engaged in and at a place which has a reputation for competence in the respective fields. Funds for 60 man-months of training will be provided for under the project. It will be possible under this allocation to send ten persons (counterparts) for six months each. Each person given overseas training will be reassigned to his former assignment with DTDB.

Accounting and Recording

15. Along with the expanded responsibilities of the LADB there will be a corresponding increase in the accounting activities of the Board. This will involve:

- accounting for extra staff;
- interpretation and summation of farming data received from the state farms, cooperatives and the extension service;
- the creation of a budget for each of the farms in the project area, and the subsequent financial and enterprise comparisons and evaluation;
- supplying the DTDB and MAAR with technical and/or financial performance reports;
- liaison with the Audit Department, MAAR, on audit procedures affecting the state and cooperative farms.

16. Based on current journal entries, the present clerical staff could handle the additional load with the adoption of the new unified (double entry) system modified to meet DTDB's particular needs. It is expected that the farm management specialist will assist the Accounts Section Head in streamlining the account operations and in implementing the new accounting system. The farm manager specialist will also summarize and interpret the farm data obtained from all the farms and the Extension Service and teach the Accounts Section Head how to perform this task.

17. The DTDB audit staff should be expanded to conduct audits of the state and cooperative farms, and these staff should be responsible to the Central Audit Section, Department of Cooperatives. The farm management specialist will establish a simple format to be used by the state farms and cooperatives to record all essential data and maintain suitable records that will be in accord with the new unified accounting system and still provide vital data for evaluating performances. Sufficient funds are provided in the project for recruiting a short-term consultant, should the need arise, to assist in the retraining of the accountants in the new unified system that Government wants to introduce in 1978, and to help reorganize and streamline operations in the accounting section.

Terms of Reference - Expatriate Specialists

18. The supporting staff required to implement the project and to be assigned to the DTDB are: an Irrigation Agronomist, Irrigation (civil) Engineer, Extension Specialist, a Farm Management Specialist and a Farm Machinery Expert. The expatriate specialist with the best management qualifications will be selected to become Project Manager. Funds for these expatriate specialists as well as counterparts and extension personnel will be provided for under this project and are presented in detail in Annex 8, Table 3.

Qualifications and Responsibilities

19. The qualifications and responsibilities of the Expatriate Specialists are presented below:

A. Irrigation Agronomist

1. Qualifications. The candidate should have at least a MSc. degree or equivalent in Agronomy with a minor in Irrigation or vice versa from a recognized institution, and a minimum of 10 years experience in the field of agronomy and irrigation in a tropical, arid region involved with the production of cotton, sorghum, maize and vegetables. Some ability to communicate in Arabic will be desirable.

2. Responsibilities. The irrigation agronomist will be responsible for: (i) the irrigation and agronomic aspect associated with crop production; (ii) preparing the guidelines and improved recommended irrigation practices to be undertaken in the project area; (iii) arranging the cropping pattern for each state farm so that each one will fit into the overall project production schedule and still conform with the 4-year rotation. Duration of assignment: 4 years.

B. Irrigation (Civil) Engineer

1. Qualifications. The candidate should have preferably an MSc. degree in Civil Engineering with emphasis on irrigation, water pumps, water control and distribution systems; he should have at least 12 years experience in the design and installation of various forms of irrigation equipment in a desert or tropical belt of the world. Experience in land levelling operations would be an additional asset.
2. Responsibilities. The Irrigation (Civil) Engineer will be responsible for: (i) the design and execution of all civil works, including land levelling, to be directly undertaken by the project; (ii) establishing and maintaining the required liaison with government agencies responsible for implementing the rural water supply and feeder road program; (iii) providing in-service training for his counterpart and the training of the three assistant engineers in the field of surveying, setting out, pipe fitting and routine maintenance of pipework, fittings and tubewell pumps; and (iv) he will follow-up the work carried out under the Water Management Study and will advise the Government on the progress made. Duration of assignment: 3-1/2 years.

C. Extension Specialist

1. Qualifications. The candidate should at least have a MSc. degree in Agriculture with a minor in Extension or vice versa; he should be fluent in English and Arabic and have a minimum of 10 years experience in developing extension programs in arid regions and working with small farmers; he should be familiar with the production of cotton, tomatoes, sorghum, maize and should have a knowledge of livestock; he should have experience with training extension agents and farmers and be familiar with all audio and visual systems of communication.

2. Responsibilities. The Extension Specialist will: (i) train and supervise the extension agents assigned to the Wadi Tuban area; he will be assisted by his counterpart; (ii) organize and develop an effective extension service and implement a practical program; (iii) establish and maintain liaison with research personnel and supervisors of the demonstration farm for the dissemination of technical recommendations to farmers and farm managers. Duration of assignment: 3-1/2 years.

D. Farm Management Specialist

1. Qualifications. The candidate should have at least a MSc. degree covering Agronomy and Agricultural Economics. He should have a minimum of five years farm management experience in tropical and arid farming regions. He should also have accounting experience and a full understanding of single and double entry accounting, record design and statistics.
2. Responsibilities. The Farm Management Specialist will: (i) train project and extension staff in farm management techniques; (ii) assist the Accounts Section Head in streamlining the account operations and in implementing the new unified accounting system; (iii) cooperate with the expatriate extension officer to provide the format to be used for record keeping on the state and cooperative farms (this format would be compatible with the new unified system of accounting to be introduced by Government); (iv) organize the collection and processing of crop production data; (v) prepare analytical reports on crop performance; (vi) develop simple on-farm budgeting, including cash flows; (vii) collaborate with the central authority to provide an acceptable form of data presentation for the use of management, the Board of Directors and MAAR departments. Duration of assignment: 2 years.

E. Farm Machinery Expert

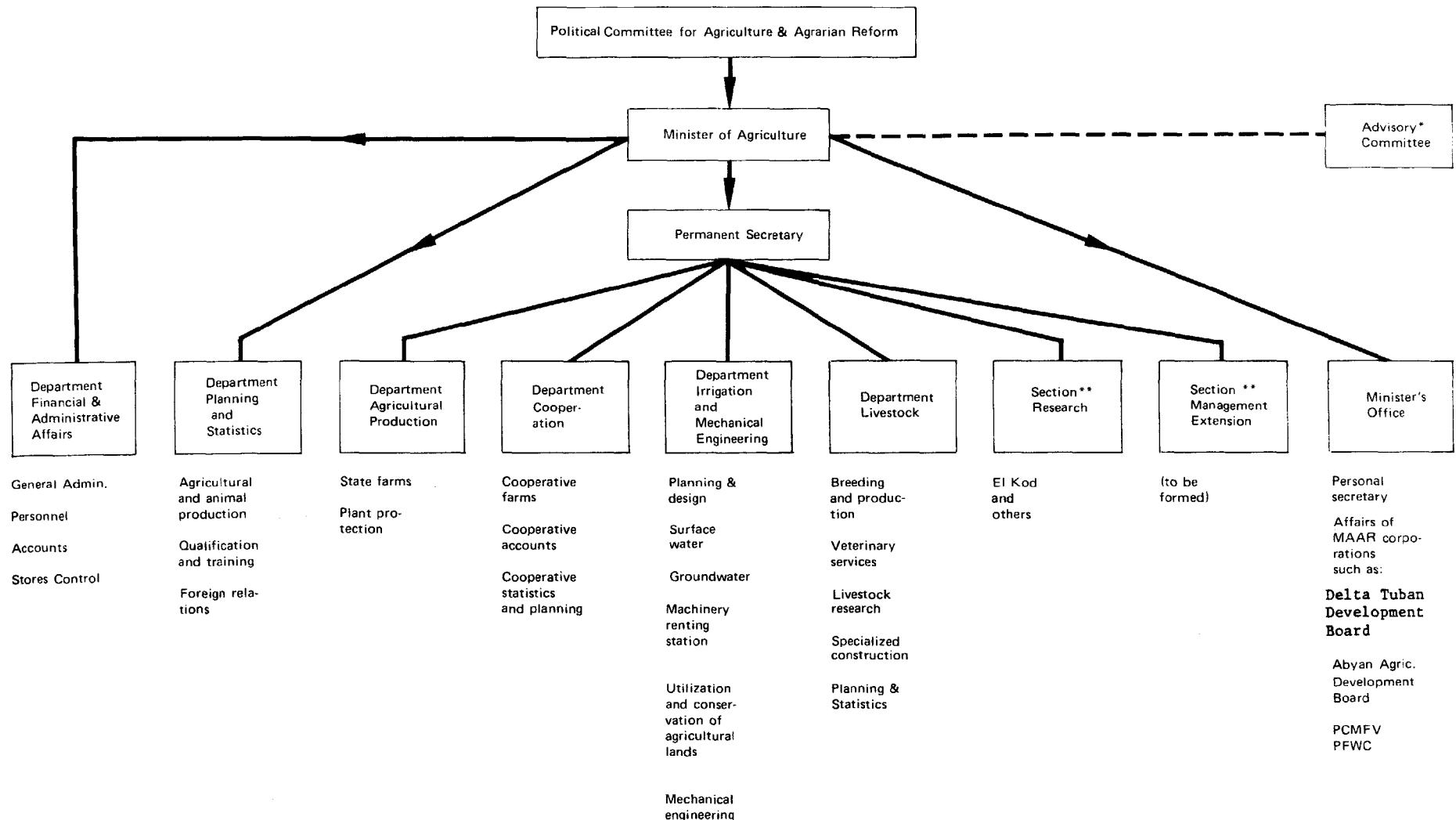
1. Qualifications. The candidate should have a degree in Mechanical or Agricultural Engineering with emphasis on maintenance and repairs of agricultural and earthmoving machinery. He should have at least ten years' experience of running a workshop dealing with the testing, overhauling, repairing and maintaining of such machines.

2. **Responsibilities.** The farm machinery expert will be responsible for: (i) supervising the maintenance and repair shops of the DTDB and training the local staff in the repair and maintenance jobs of the agricultural, earthmoving and transport machinery; (ii) assessing the requirements of the spare parts for proper upkeep of the machinery under the charge of DTDB, assisting in their procurement and supervising their storage and use; (iii) inspecting the machines while at work in the field to ensure their proper and efficient use by the operators; (iv) assisting the organization in determining the per hour operating costs of different machines and revise the prevailing MRS rates; and (v) introduce new farm machinery practices at farm level and train local operators. Duration of assignment: 2 years.

F. **Project Manager**

1. **Qualifications.** The expatriate expert with the most experience in planning, management and supervision will become project manager.
2. **Responsibilities.** The project manager will be responsible for: (i) all detailed planning within the established policy and project implementation; (ii) all operating decisions to be taken on a day-to-day basis, training his co-manager counterpart in the managerial and planning aspects of the project; (iii) training his technical counterpart; (iv) timely preparation of the quarterly and annual progress reports. The expatriate project manager will be an ex-officio member of DTDB and serves it in an advisory capacity. He will report directly to the Chairman of DTDB, who is Permanent Secretary of MAAR, through the General Manager. The project manager will prepare the Project Completion Report. Duration of his assignment will be 4 years.

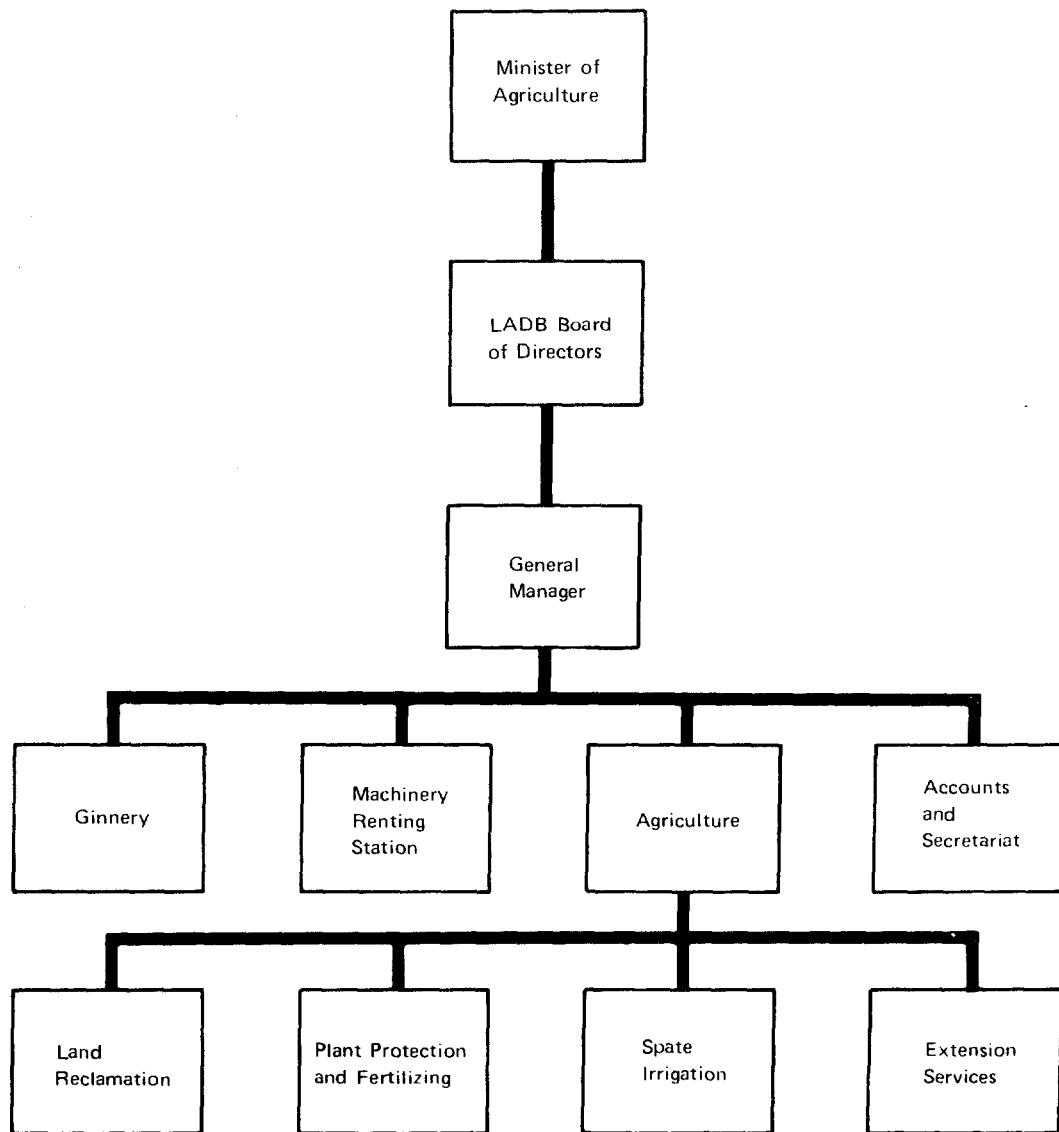
APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN
Organization Chart for Ministry of Agriculture and Agrarian Reform



* Composed of Heads of Departments & Permanent Secretary with Minister as Chairman.

** Sections report directly to the Permanent Secretary. As they develop they will become Departments.

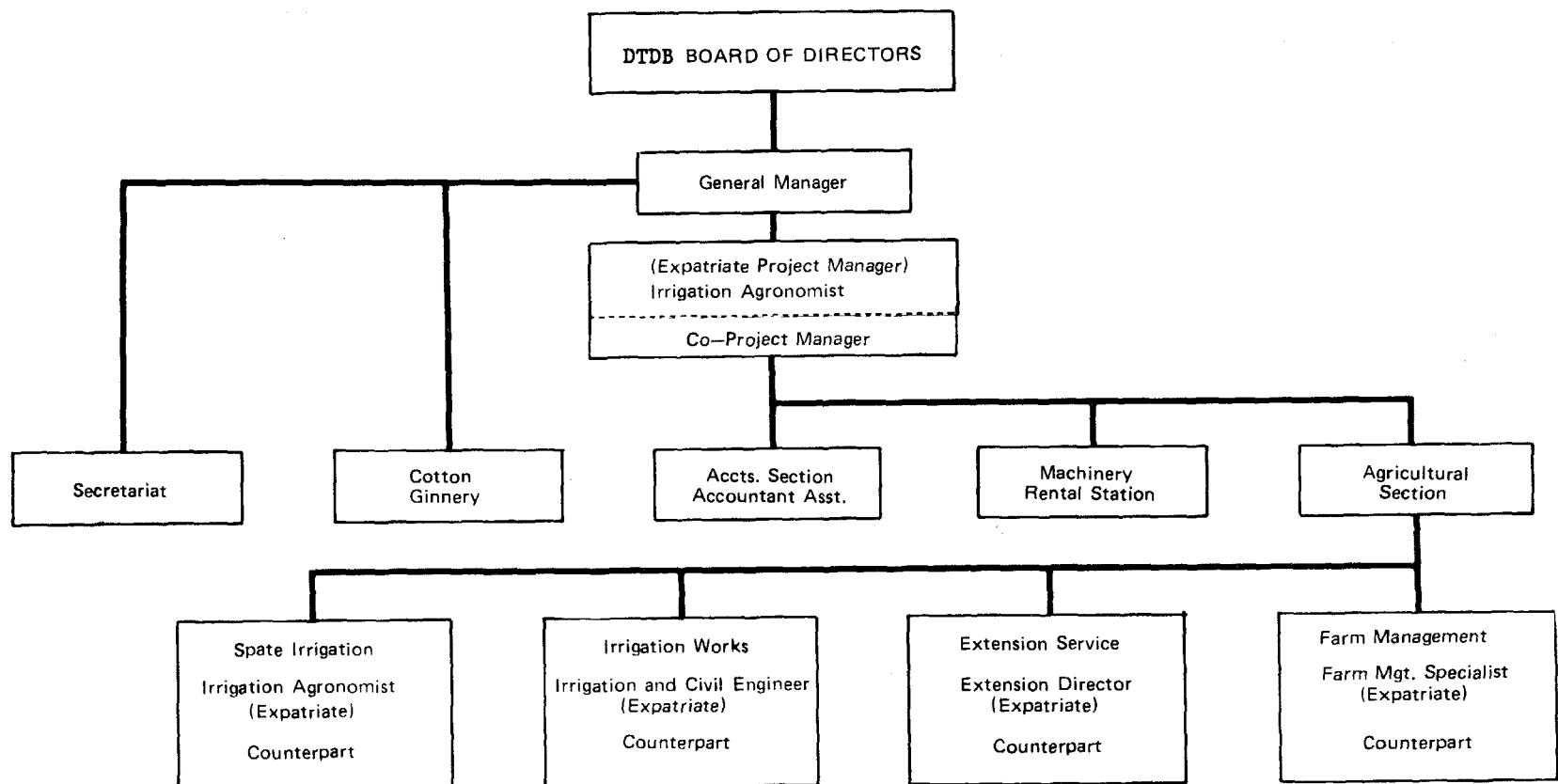
APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN
Lahej Agricultural Development Board
(Former Organization)



The Ginnery and the Machinery Renting Station have Managers.
The Ginnery Manager is responsible to the General Manager LADB,
and the Manager of the Machinery Renting Station to the MAAR,
Department of Irrigation and Mechanical Engineering; he
communicates with the LADB Manager so that there is good liaison.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Organization Chart for the Delta Tuban Development Board



APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Marketing of Project Output

1. The major marketed products whose output will be increased significantly by the project are cotton, vegetables, tomatoes, watermelon, sorghum and maize. In addition, there will be significant increases in production of legume forage, and of byproducts (stover and forage) from sorghum which would be used in livestock enterprises. The following briefly describes the market outlook for these products, the local marketing arrangements, and prices adopted for project evaluation. No marketing problems are foreseen in the project.

Cotton

2. For many years the project area produced mainly long staple cotton, which was processed by a ginnery run by the Lahej Board, and marketed through the National Company for Foreign Trade (NCFT). Between 1965 and 1975, production of unginned cotton from the project area averaged about 3,360 metric tons per annum, ranging from as little as 234 tons to about 6,350 tons (in the 1968/69 season). In order to meet the needs of a textile factory established in 1975 at Dar Sa'ad (capacity 500 tons lint, equivalent to about 1,400 tons unginned cotton) Government replaced long staple cotton with a medium staple variety in the spate irrigated areas during 1976. Simultaneously, most of the cotton formerly grown in perennially irrigated areas was displaced by the more profitable tomato crop. Government policy is to continue growing medium staple cotton in the spate areas, and to export any lint over and above requirements of the domestic textile industry. Although PDRY has exported cotton seed in the past, this appears to have been dwindling, and it is likely that much of the seed will be processed in an edible oil and feed production plant recently established in Aden. Between 1971 and 1976 a total of about 20,000 tons of cotton lint (mainly long staple) was exported from the country, with annual quantities averaging 4,000 tons but fluctuating quite markedly because of seasonal carryover. Weighted average f.o.b. prices ranged from US\$39.6/lb (YD 299.7/ton) in 1971/72 to US\$121.9/lb (YD 923.5/ton) in the 1975/76 season. It is estimated that production of unginned cotton with the project will increase by about 2,500 tons to reach an average of 4,680 tons per annum in the project area by 1984. This will yield approximately 1,660 tons of lint and 2,970 tons of cotton seed per annum, or incremental production of 890 tons and 1,587 tons respectively. Assuming costs of YD 25/ton of unginned cotton (to cover transportation, ginning, seed processing and marketing costs), and based on IBRD price projections for medium staple cotton,

an economic price is derived of YD 194/ton of unginned cotton at the farm gate. Based on indications of Government policy, the financial price (received by farmers) is estimated to be YD 100/ton of unginned cotton (Annex 13, Table 2).

Vegetables

3. A wide variety of vegetables is grown in the project area (Annex 2), many of which are collected by the Public Corporation for Marketing of Fruits and Vegetables (PCMFV) and sold through the Corporation's retail outlets in Aden and other localities. The PCMFV has two receiving stations in the Second Governorate (one station, with 500 ton capacity, in Lahej itself) and three selling stations. By the end of 1978 it is planned to have four receiving stations and five selling stations in the Second Governorate. A total storage capacity of 5,000 tons exists in Aden, including 1,500 tons of cold storage capacity. A further 1,000 tons of cold storage capacity is planned for the 1978/79 season. The PCMFV has its own trucks (a fleet of about 70) and employs a total of about 2,000 persons. Official prices for a large range of vegetables and fruits were announced in February 1977. In most cases prices remained unchanged from those of the previous announcement in 1973, but there were some increases. These latest official prices have been used for valuing additional project production. For estimating effects of the project, the vegetable component is assumed to comprise, by percentage of area sown: - Eggplant 35%, Okra 35%, Onion 15%, Pepper 10% and Sweet Potato 5%. The latest official prices for these vegetables are (per metric ton) YD 20, YD 40, YD 50, YD 200 and YD 80 respectively. An average price (weighted by percentage of area grown and by yield) is adopted of YD 44.7/ton for vegetables. It is estimated that an additional 9,000 tons of these vegetables will result from the project, bringing production in the project area by 1984 to about 10,800 tons per annum. The canning of some vegetables in the tomato paste factory is under study as a possible future extension of the factory's capability, and there is some potential for sale of fresh vegetables to ships bunkering in Aden harbor.

4. There will also be an expansion of output of watermelon under the project, estimated at about 6,940 tons, bringing total output in the project area up to about 11,700 tons. A price of YD 15/ton is adopted for analysis.

Tomatoes

5. During 1976, most of the areas in the state farms previously planted to cotton were switched to production of tomatoes for the newly established paste factory at Fiyush, about 17 km south east of Lahej and 6 km from the main highway. When visited in April 1977, the factory was achieving about two thirds of its capacity to handle 120 tons of tomatoes per day. With a staff numbering about 180 persons, the factory processed approximately 4,000 tons of tomatoes in the 1975/76 season, producing 4.76 million cans (each 150 gms)

of 28%-30% double concentration paste which retail at YD 0.165 per can. During the 1976/77 season up to April 21, 1977 the factory had received 7,128 tons of tomatoes and produced 6.07 million cans (each of 150 gms) together with 788,000 cans (each of 450 gms). On average about 5.6 tons of tomatoes were used to produce 1 ton of paste, although somewhat less tomatoes are needed at the beginning of the season and somewhat more towards the end. There is considerable scope for increasing the efficiency of the factory, and it is also envisaged that some canning of vegetables will be attempted. For economic analysis, a price of YD 35/ton has been adopted. It is estimated that under the project, production of tomatoes will increase from the present 12,000 tons to about 17,550 tons, an increase over six years of 5,550 tons.

Cereals

6. During the three year period 1974 to 1976 more than 90,000 tons of cereals per year (including more than 5,000 tons of millet) have flowed into the country, either as imports or as commodity assistance of the United Nations (Table 2). This is approximately equal to annual cereal production in the country. In addition, between 16,000 tons and 35,000 tons of wheat flour have been imported or donated each year (Table 2). Clearly, increases in domestic cereal production within the range envisaged in the project will be easily absorbed within the country, substituting for imports. It is estimated that an additional 1,600 tons of sorghum grain and 2,200 tons of maize will be forthcoming from the project, bringing total production of these in the project area to about 3,200 tons and 2,300 tons per annum respectively by 1984. Cereals are acquired and marketed by the National Company for Home Trade. Six silos were recently erected south of Lahej. The official 1977 price for sorghum and maize is set at YD 75/ton, and this has been adopted for financial analysis in the project. Based on IBRD projections for the two cereals, prices of YD 43/ton and YD 49/ton for economic analysis are adopted for sorghum and maize respectively.

Sesame

7. Over the past several years the country has been importing around US\$2 million worth of sesame seeds per annum (Table 1) and in addition, considerable quantities of vegetable oils for cooking and other purposes have been imported or donated (Table 2). It is estimated that the project will raise production of sesame seeds by about 173 tons which will be readily absorbed domestically, and probably processed in the edible oil and feed production plant in Aden. Total production in the project area will rise to about 273 tons by 1984. The official price of YD 175/ton has been adopted for financial analysis, and a price of YD 140/ton for economic analysis, based on the IBRD projections for Soybeans and various assumptions about comparative extraction rates of oil and meal of the two commodities.

Forages

8. The stover which is a byproduct of sorghum grain production in the project area is an important feed for livestock. In addition, sorghum is grown specifically for forage, with the whole plant being cut up for use as green or semi-dried livestock feed. The latter is used mainly by the producers themselves, to feed their own animals. For stover, however, there is a developed system of trade among farmers, and between cooperatives and state farms. One cooperative visited sold approximately one third of its output of stover to state farms. Under the project, stover and forage production will increase as output of sorghum and maize expanded. In addition, on state farms engaging in livestock production (Jawala - dairying, Fiyush - sheep and goats, and El Jarrad - beef fattening), the project will include areas of sorghum and legumes specifically for forage. It is estimated that additional output from the project will be approximately 8,800 tons of sorghum and maize stover, 33,400 tons (green matter) of sorghum forage, and 9,700 tons of legume forage. The official price for stover is a little more than YD 4/ton, although there was an indication that prices higher than this were being realized in private trading between farmers. Prices adopted for analysis are YD 4/ton for stover, YD 3/ton for sorghum forage and YD 7/ton for legume storage. Total output of these products in the project area is estimated to reach 18,500 tons, 51,000 tons and 9,900 tons respectively by 1984.

APPRAISAL OFWADI TUBAN AGRICULTURAL DEVELOPMENT PROJECTPEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

PDRY-Selected Agricultural Imports and Exports ^{/1}
 (US\$ millions)

	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
<u>IMPORTS</u>					
Rice	3.30	7.00	16.90	13.60	na
Wheat and Wheat Flour	5.00	10.30	21.00	10.50	na
Live Animals	2.70	2.30	1.60	2.40	na
Ghee	2.10	2.30	5.20	5.60	na
Sesame seeds	2.10	2.40	3.70	1.90	na
Animal and Vegetable Oils	0.80	1.00	2.60	2.00	na
Refined Sugar	6.70	7.80	12.40	13.80	na
<u>UN COMMODITY ASSISTANCE</u> ^{/2}					
Rice	-	-	0.03	1.82	2.30
Wheat	-	-	-	1.00	2.11
Wheat Flour	0.18	0.33	1.82	2.28	1.18
Pulses	-	-	0.06	0.14	0.08
Butter Oil	0.05	0.01	0.05	0.10	0.10
Vegetable Oils	0.04	0.06	0.12	0.31	0.24
Sugar	-	-	-	0.01	0.03
Powdered Milk	0.03	0.04	0.07	0.09	0.17
Cheese	0.01	0.05	0.06	-	-
<u>EXPORTS</u>					
Cotton	3.14	8.14	1.42	8.57	7.22

/1 na = not available; - = nil or negligible.

/2 UN assistance in 1976 valued at 1975 prices.

Sources: Central Statistical Office; UNDP Office; NCFT Cotton Marketing Section; mission estimates.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

PDRY - Imports of Foodstuff Items
(metric tons)

	<u>1974</u>	<u>1975</u>	<u>1976</u>
<u>IMPORTS</u>			
Rice	49,300	26,000	29,720
Wheat	46,000	50,250	52,800
Wheat Flour	27,500	3,000	21,000
Millets	7,000	5,000	5,000
Cooking Oil	2,000	1,200	2,500
Sugar	22,000	18,000	21,500

UN COMMODITY ASSISTANCE

Rice	61	4,546	6,082
Wheat	-	4,568	1,860
Wheat Flour	7,282	13,112	4,738
Pulses	255	598	335
Vegetable Oils	181	680	538
Sugar	5	20	67
Dried Fruits	135	102	270

Sources: NCFT; UNDP Office.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Farm Models and Farm Incomes

1. The project area is divided into seven cooperatives and twelve state farms. The cooperatives include about 7,000 farm families, and the state farms employ approximately 2,600 workers. The average family size is estimated to be 5.1 persons. Data from the cooperatives indicate that the average cultivable area per member is 1.09 hectares. The area actually cultivated varies from year to year, depending on available flow in the Wadi for spate irrigation, and it is likely to be less than 1 hectare per family in drought years. The variation in farm size is not great in cooperatives. ^{1/} Most farmers have a small number of livestock. The state farms average 175 hectares in size, but seven of the twelve have areas of 170 hectares or more. Commercial dairy-ing, sheep fattening and beef fattening operations are being developed on three of these farms.

2. Farm Model 1 (Tables 1 and 4), of one hectare, represents an average farm in the spate-irrigated area of the project. The farm modelled here is assumed to be growing 0.60 ha of Cotton (medium staple variety), 0.22 ha of Red Sorghum, 0.08 ha of White Sorghum, 0.05 ha of Watermelon, and 0.05 ha of Sesame. Livestock are fed mainly on stover and green forage from the Sorghum crops, and the values of these feed materials are assumed to be equal to prices established for them in the project area. All labor for the farm is supplied by the operator and family. Without the project, most of the Sorghum grain is retained for domestic use, while Cotton, Watermelon and Sesame are cash crops. A portion of the stover is sold to state farms producing live-stock. Cultivation is performed partly by bullocks, partly by tractors without the project, and with the project entirely by machines. Tractors and implements are currently hired out by the MRS at prices considerably below costs of operation and maintenance. Under the project, the MRS will raise charges to recover operation and maintenance, and charges in line with this policy have been included here. Fertilizers have been priced at currently estimated landed cost (including transport to the project area), on the assumption that Government will recover fully the costs of procurement of fertilizers and chemicals. Labor has been included at YD 0.550 per day, but since all of this will be family labor on the 1 hectare farm, this will not represent a cash outflow for the farm family. It is assumed that short-term credit is advanced by the NBY to cover the costs of cultivation, seeds, fertilizers and chemicals, with an interest rate of 6% per annum. Water charges

^{1/} In one major cooperative with 950 farmer members the largest farm was reported to be 2 hectares.

are levied currently by the LADB at rates of YD 0.500 per acre for forage and YD 1.000 per acre for melons and vegetables. As can be seen from the model, there is very limited scope for raising these charges for a small farm, especially in view of the fact that taxation is already rather high. The Government levies taxes of 15% of the gross value of cotton and cereals. In addition, there is a 5% overall tax whose proceeds are used to meet administrative expenses of the cooperative. After taxes and levies, the net income of this 1 hectare farm will rise from about YD 51 (US\$148) to YD 84 (US\$242) with the project. For an average family of 5.1 members this will represent an increase in per capita income from YD 10 (US\$29) to YD 16 (US\$48). In practice, for a individual farm under the project, income will probably rise at a faster rate than depicted here, since the average phasing for the whole project area has been used in the model.

3. The second model (Table 2) represents a 200 hectare state farm whose cropping pattern with the project will include Sorghum and Legume Forage, Maize, Watermelons, Tomato and a variety of Vegetables. The live-stock feeds have been valued at prices established for them in the project area. It is assumed that the farm purchases a package of machinery consisting of two tractors, cultivation and land levelling equipment and harvesting equipment to deal with forages and crop residues. These will add to machinery already used on the farm. For this purpose a loan of YD 20,800 would be taken from the NBY for a term of 6 years at an interest rate of 5-1/2% per annum. Short-term credit at 6% per annum will again cover costs of cultivation, seed, fertilizers and chemicals. Irrigation water is charged at rates which will allow full recovery of operation and maintenance costs of the pumping and distribution system. The cost recovery index for all on-farm irrigation and machinery investments is 56%, after allowing for a projected annual 6% inflation rate during the repayment period. The state farms' incentives include, besides the operating surpluses, a 20% allowance for management and risk on net farm income and a 10% return on owned capital. Labor is costed at YD 0.700 per day, the current wage for hired labor of this type on the state farms. After meeting all charges, the operating surplus on the farm will rise from about YD 20,900 (US\$60,610) to YD 82,800 (US\$240,120). From 1978 it is intended that about 75% of surpluses such as this should go into general Government funds, and 25% should be retained in the farm's bank account. Government plans are to distribute further the 25% share as follows: 10% directly paid to farm workers and 15% for a replenishment fund within the individual state farm.

4. For the project area as a whole, the following production increases are estimated (Table 3 presents total flows):

<u>Item</u>	<u>Incremental Output</u> ----metric tons---
Cotton (medium staple) (unginned)	2,510
Grains - Sorghum	1,608
- Maize	2,200
Stover - Sorghum	3,825
- Maize	4,975
Forages - Sorghum	33,400
- Legumes	9,720
Sesame	173
Watermelons	6,940
Tomato	5,550
Vegetables	9,000
Mango	2,710

APPRAISAL OF

WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Farm Model 1 (1 ha) - Income and Expenditure Flows
(Amounts in YD)

	Without Project	1	2	3	Development Years	4	5	6
<u>Inflow</u>								
Gross Value of Production-Subsistence ^{/1}	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
- Cash ^{/2}	56.2	67.3	78.1	90.7	103.3	107.0	116.9	
Subtotal	82.2	93.3	104.1	116.7	129.3	133.0	142.9	
Short-term Credit	12.5	16.2	19.8	23.5	27.2	27.2	27.2	
Total Inflow	94.7	109.5	123.9	140.2	156.5	160.2	170.1	
<u>Outflow</u> ^{/3}								
Cultivation	7.7	8.3	8.9	9.5	10.1	10.1	10.1	
Seeds	3.4	3.4	3.3	3.3	3.2	3.2	3.2	
Fertilizer	-	1.4	2.8	4.2	5.6	5.6	5.6	
Chemicals	1.4	3.1	4.8	6.5	8.3	8.3	8.3	
Subtotal	12.5	16.2	19.8	23.5	27.2	27.2	27.2	
Other Crop Expenses	3.5	4.0	4.6	5.1	5.7	5.9	6.2	
Short-term Credit - Interest	0.8	1.0	1.2	1.4	1.6	1.6	1.6	
- Principal	12.5	16.2	19.8	23.5	27.2	27.2	27.2	
Water Charges	0.8	0.8	0.8	0.8	0.8	0.8	0.8	
Labor ^{/4}	36.7	39.8	42.9	46.1	49.2	50.5	51.9	
Balance	27.9	31.5	34.8	39.8	44.8	47.0	55.2	
Total Outflow	94.7	109.5	123.9	140.2	156.5	160.2	170.1	
<u>Net Income</u>								
Cash Production (Net)	38.6	45.3	51.7	59.9	68.0	71.5	81.1	
Subsistence Production	26.0	26.0	26.0	26.0	26.0	26.0	26.0	
Less Taxes ^{/5}	13.4	15.2	17.0	19.1	21.2	21.8	23.5	
Net Income	51.2	56.1	60.7	66.8	72.8	75.7	83.6	

^{/1} Approx. 270 kgs. sorghum grain, plus stover and forage for livestock.

^{/2} Cotton, watermelon and sesame, plus a portion of sorghum stover and forage.

^{/3} Machinery charges set to cover operation and maintenance expenses. Full charges would be approx. 50% higher than this.

^{/4} Family labor valued at YD 0.550 per day.

^{/5} 15% gross value of cotton and cereals, plus 5% co-op fee on gross output.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Farm Model 2 (200 ha) - Income and Expenditure Flows
(Amounts in YD thousand)

	Without Project	Development Years							
		1	2	3	4	5	6	7	8
<u>Inflow</u>									
Gross Value of Production	65.8	84.7	101.2	120.1	139.1	147.7	156.4	156.4	156.4
Short-Term Credit	6.6	8.4	10.2	12.0	14.0	14.4	14.8	14.8	14.8
Medium-Term Credit	-	20.8	-	-	-	-	-	-	-
Total Inflow	<u>72.4</u>	<u>113.9</u>	<u>111.4</u>	<u>132.1</u>	<u>153.1</u>	<u>162.1</u>	<u>171.2</u>	<u>171.2</u>	<u>171.2</u>
<u>Outflow</u>									
Cultivation ^{/1}	2.5	3.0	3.5	4.0	4.6	4.6	4.6	4.6	4.6
Seeds	1.2	1.4	1.6	1.7	1.9	1.9	1.9	1.9	1.9
Fertilizer	0.6	1.5	2.4	3.4	4.3	4.7	5.1	5.1	5.1
Chemicals	2.3	2.5	2.7	2.9	3.2	3.2	3.2	3.2	3.2
Subtotal	<u>6.6</u>	<u>8.4</u>	<u>10.2</u>	<u>12.0</u>	<u>14.0</u>	<u>14.4</u>	<u>14.8</u>	<u>14.8</u>	<u>14.8</u>
Other Crop Expenses	3.8	5.5	7.2	8.9	10.6	11.3	12.0	12.0	12.0
Short-Term Credit - Interest	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.9	0.9
- Principal	6.6	8.4	10.2	12.0	14.0	14.4	14.8	14.8	14.8
Medium-Term Credit - Interest	-	1.1	1.0	0.8	0.6	0.4	0.2	-	-
- Principal	-	-	3.5	3.5	3.5	3.5	3.4	3.4	-
Investment in Machinery	20.8								
Water Charges ^{/2}	20.1	21.8	23.6	25.3	27.1	27.1	27.1	27.1	27.1
Labor ^{/3}	14.0	14.9	15.9	16.8	17.8	18.3	18.8	18.8	18.8
Balance ^{/4}	<u>20.9</u>	<u>32.5</u>	<u>39.2</u>	<u>52.1</u>	<u>64.7</u>	<u>71.8</u>	<u>79.2</u>	<u>79.4</u>	<u>82.8</u>
Total Outflow	<u>72.4</u>	<u>113.9</u>	<u>111.4</u>	<u>132.1</u>	<u>153.1</u>	<u>162.1</u>	<u>171.2</u>	<u>171.2</u>	<u>171.2</u>

^{/1} Machinery charges set to recover full costs of depreciation, operation and maintenance.

^{/2} Water charges set to recover full costs of operating and maintaining the pumping and distribution system.

^{/3} Labor valued at YD 0.700 per day.

^{/4} Government would retain its desired level of taxation from this balance, as well as recovering the full investment costs of irrigation improvements over 20 years with interest, which could, for this 200 ha farm, imply an annual charge of YD 17,000 with the project.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Project Area - Estimates of Output and Input Flows

	<u>Without Project</u>	<u>Project Years</u>					
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
<u>Outputs (metric tons)</u>							
Cotton (medium staple, unginned)	2,170	2,400	2,970	3,600	4,290	4,290	4,680
Sorghum grain	1,590	1,770	1,804	2,280	2,808	3,003	3,198
Maize grain	75	300	900	1,442	2,145	2,145	2,275
Sorghum - stover	9,500	10,208	9,625	11,400	12,350	13,325	13,325
- forage	17,500	22,943	31,100	36,030	41,600	47,475	50,900
Maize stover	225	825	2,438	3,605	5,200	5,200	5,200
Legume forage	180	2,000	4,250	6,650	9,000	9,450	9,900
Sesame	100	112	145	181	234	253	273
Watermelon	4,750	5,400	6,740	8,280	10,180	10,930	11,690
Tomato	12,000	13,342	14,824	16,422	17,075	16,600	17,658
Vegetables	1,800	2,100	3,910	6,200	9,200	10,000	10,800
Mango ^{/1}	440	400	280	-	-	-	315
							735
<u>Inputs</u>							
Fertilizers - Urea (metric tons) - Amm. Sulphate	78	259	439	618	788	834	882
- T.S.P.	-	100	199	297	388	386	385
Labor (thousand days)	532	612	691	769	843	850	857
							859

^{/1} Mango output would first decline, as old trees are replaced with new seedlings. Production from the new trees would reach its full level of about 3,150 tons by Year 14.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Farm Model 1: Rent and Cost Recovery Indices /a
(Incremental discounted values in constant 1977 YD)

	<u>YD</u>
1. Gross value of production <u>/b</u>	455.2
2. Cash production costs <u>/c</u>	147.2
3. Net income	308.0
4. Depreciation and return on own capital	16.1
5. Imputed value of family labor <u>/d</u>	114.3
6. Allowance for management and risk <u>/e</u>	35.6
7. General taxes <u>/f</u>	51.0
8. Rent	91.0
9. Rent as a percent of net income (8:3)	29.5
10. Machinery charges	19.1
11. Rent recovery index [(10+7):(8+7)] <u>/g</u>	49.4
12. Public sector outlays (capital + O.M.)	64.3
13. Cost recovery index [(10+7):(12+7)] <u>/g</u>	60.8
14. Estimated critical consumption level <u>/h</u>	36.6
15. Estimated per capita income in the project area at full development <u>/h</u>	16.5
16. Estimated national per capita income at full development <u>/h</u>	135.8

Source: Annex 12, Table 1

November 16, 1977

FOOTNOTES

- /a All values in lines 1-13 discounted at 10% p.a.; all values in lines 1-12 represent the repayment period of years 1-20.
- /b Includes on-farm consumption (see Annex 12, Table 1, footnote 1).
- /c Excludes machine rental charges (see item 10), includes water charges of YD 0.8/p.a., and includes 5% co-op fee on gross output.
- /d Imputed at prevailing wage rates.
- /e Imputed at 20% of net income minus charges for depreciation, return on capital and labor.
- /f 15% on gross value of cotton and cereals.
- /g On a gross basis.
- /h Year 6 or 1983. Items 14 and 16 assumed to increase in real terms by 5% p.a.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Farm Model 2 (200 ha): Rent and Cost Recovery Indices /a
(Incremental discounted values in constant 1977 YD thousands)

	<u>YD</u>
1. Gross value of production	677.6
2. Cash production costs /b	186.2
3. Net income	491.4
4. Depreciation and return on own capital /c	208.8
5. Allowance for management and risk /d	56.6
6. General taxes /e	0
7. Rent	226.0
8. Rent as a percent of net income (7:3)	46.0
9. Water charges	55.6
10. Recovery of irrigation improvements /f	95.7
11. Total direct charges	151.3
12. Rent recovery index (11:7)	67.0
13. Public sector outlays	272.1
Investment	190.3
O&M machinery	26.2
O&M irrigation	55.6
14. Cost recovery index (11:13)	56.0

Source: Annex 12, Table 2

November 16, 1977

FOOTNOTES

- /a All values in lines 1-14 discounted at 10% p.a.; all values in lines 1-13 represent the repayment period of years 1-20.
- /b Includes cash expenditures on labor employed in the state farm (groundwater irrigation).
- /c Imputed at 10% return on own capital.
- /d Imputed at 20% on net income after depreciation and return on capital.
- /e No allowance for general taxes in state farms.
- /f Assuming 6% inflation rate.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Economic Rates of Return

1. Economic rates of return for the project as a whole, and for several of its components, were calculated on the basis of data displayed in Table 1. The following assumptions underlie these calculations:

- (a) the rate of exchange is YD 1.000=US\$2.90;
- (b) agricultural labor is priced at YD 0.700 per manday, equal to the current daily wage for laborers on state farms;
- (c) project costs include physical contingency allowances as outlined in Annex 8, Table 7;
- (d) prices for economic analysis (Table 2) are at the farmgate, based where possible on IBRD projections;
- (e) as far as possible, transfer payments have been eliminated;
- (f) no allowance is made for benefits of the infrastructural elements of feeder roads or water supply, or of the water study included in the project;
- (g) additions to areas irrigated by spate methods are excluded. Through a program of land levelling and irrigation works being carried out under bilateral aid, it is estimated that improved water use will allow an expansion of the average area irrigated by spate methods from the current 5,000 ha to about 6,500 ha each year (see para 3.10). This expanded area has been assumed for all projections elsewhere in this report. For economic analysis, however, the spate irrigated area is maintained at 5,000 ha, with incremental project benefits arising from increased productivity in this area; and
- (h) project life is 35 years.

2. Based on these assumptions, economic rates of return are estimated to be as follows:

- | | |
|--|-----|
| (a) Project as a whole | 24% |
| (b) Project without infrastructure (roads and water
water supply) and without the water study | 27% |

(c) Spate irrigated area alone	52%
(d) Perennially irrigated area alone	22%
(e) Orchard (mango) development alone	29%

3. Sensitivity of the above results was tested as follows:

Assumption 1: Project as in (a) above, with all benefits attributed to livestock feeds excluded from the benefit stream.

Assumption 2: Project excluding infrastructure as in (b) above, but with the benefit stream deferred by one year.

Assumption 3: Project excluding infrastructure as in (b) above but with the benefit stream reduced by 20% simultaneously with an increase of 20% in the cost stream. This would be a more severe blow to the economic rate of return than the following four events happening simultaneously: cotton price decreased by 30%, tomato price decreased by 43%, vegetables prices decreased by 33%, and fertilizer prices increased by 170%. It is unlikely that such a combination of events would take place.

Assumption 4: For the perennially irrigated area alone, with the benefit stream decreased by 25%. This would be equivalent to assuming a 20% shortfall in expected yields of tomato and vegetables, or it would be more severe than assuming no incremental benefits from livestock feeds.

Assumption 5: For the perennially irrigated area alone, with the benefit stream decreased by 40%. This would be equivalent to assuming no incremental benefits from livestock feeds, and a 20% shortfall in expected yields of tomato and vegetables.

Assumption 6: As for Assumption 5, except that the cost stream is also increased equivalent to a rise in fertilizer prices of 170%. This would be a very unlikely combination of events.

4. The sensitivity analysis resulted in economic rates of return as follows:

Assumption 1 (whole project)	19%
Assumption 2 (whole project)	20%
Assumption 3 (whole project)	12%
Assumption 4 (perennial area alone)	13%
Assumption 5 (perennial area alone)	8%
Assumption 6 (perennial area alone)	4%

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Economic Rate of Return
(Amounts in YD thousand)

	1	2	3	4	Project Years 5	6	7	8-
<u>Incremental Economic Benefits</u>								
1. Cotton	45	104	162	219	219	278	278	278
2. Sorghum grain	8	2	14	24	32	37	37	37
3. Maize grain	11	40	67	101	101	108	108	108
4. Stover and forages	34	74	110	147	171	182	182	182
5. Sesame	2	4	7	12	13	15	15	15
6. Watermelon	10	25	43	65	76	87	87	87
7. Tomato	47	99	155	178	161	198	194	194
8. Vegetables	13	91	197	331	366	402	402	402
9. Mango ^{/1}	(4)	(16)	(44)	(44)	(44)	(13)	30	82
Total Incremental Economic Benefits	<u>166</u>	<u>426</u>	<u>711</u>	<u>1,033</u>	<u>1,095</u>	<u>1,294</u>	<u>1,333</u>	<u>1,385</u>
<u>Project Investments</u>								
1. Irrigation Improvement	569	555	200	200	-	-	-	-
2. Fertilizers & chemicals	69	34	34	32	-	-	-	-
3. Agricultural machinery	135	202	-	-	-	-	-	-
4. Orchard & shelterbelts	12	12	12	3	-	-	-	-
5. Project Management	142	122	122	102	-	-	-	-
6. Water Supply	14	47	18	18	-	-	-	-
7. Feeder Roads	-	26	27	27	-	-	-	-
8. Water Study	51	138	51	-	-	-	-	-
9. Contingencies(physical)	106	134	70	57	-	-	-	-
Total Project Investments	<u>1,098</u>	<u>1,270</u>	<u>534</u>	<u>439</u>				
<u>Incremental Operating Costs</u>								
1. On project investments	24	47	67	88	120	124	126	128
2. On farms	63	183	262	330	375	390	391	396
Total Incremental Operating Costs	<u>87</u>	<u>230</u>	<u>329</u>	<u>418</u>	<u>495</u>	<u>514</u>	<u>517</u>	<u>524</u>
Total Incremental Costs	<u>1,185</u>	<u>1,500</u>	<u>863</u>	<u>857</u>	<u>495</u>	<u>514</u>	<u>517</u>	<u>524</u>

^{/1} Incremental benefits from Mango rise to YD 271,000 by year 14.

APPRAISAL OF
WADI TUBAN AGRICULTURAL DEVELOPMENT PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN

Prices for Farm Outputs and Inputs

<u>Item</u>	<u>Unit</u>	<u>Price for Financial Analysis</u>		<u>Price for Economic Analysis</u>	
		<u>YD</u>	<u>US\$</u>	<u>YD</u>	<u>US\$</u>
Cotton (M.S.-unginned)	metric ton	100	290	194	563
Sorghum	"	75	218	43	125
Maize	"	75	218	49	142
Sesame	"	175	507	140	406
Watermelon	"	15	43	15	43
Tomato	"	35	101	35	101
Eggplant	"	20	58	20	58
Okra	"	40	116	40	116
Onion (red)	"	50	145	50	145
Pepper (red)	"	200	580	200	580
Sweet Potato	"	80	232	80	232
Banana	"	30	87	30	87
Mango	"	100	290	100	290
Crop Stover	"	4	12	4	12
Sorghum Forage	"	3	9	3	9
Legume Forage	"	7	20	7	20
Farm Labor	day	0.55-0.70	1.60-2.03	0.7	2.03
<u>Fertilizers</u>					
Urea (46:0:0)	metric ton	65	188	66	191
Ammonium Sulphate (21:0:0)	"	35	101	33	96
Triple Super phosphate(0:46:0)"		54	157	56	162
<u>Machine Operations</u>					
Plough (moldboard)	ha	5.6	16.2	8.4	24.4
Cultivate	"	0.6	1.7	1.0	2.9
Border Disc	"	0.3	0.9	0.6	1.7
Ridge	"	0.7	2.0	1.0	2.9
Drill Seed	"	3.0	8.7	5.0	14.5
Fertilizer Application	"	0.2	0.6	0.3	0.9
Forage Harvesting	"	5.2	15.1	9.6	27.8
Mowing and Baling	"	13.9	40.3	21.8	63.2

APPRAISAL OF
WADI TUBAN AGRICULTURAL PROJECT
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN
Implementation Schedule

IDA Fiscal Year	1978	1979		1980		1981		1982		
Calendar Year	1978	1978	1979	1979	1980	1980	1981	1981	1982	
IRRIGATION IMPROVEMENT										
Water Distribution Works										
Procurement										
Construction										
Replacing and Electrifying Pumps										
Procurement										
Installation										
Land Improvement Works										
Equipment Procurement										
Land Improvement										
AGRICULTURE IMPROVEMENT										
Fertilizers and Insecticides										
Procurement										
Distribution										
Machinery Procurement										
Permanent Crop										
RURAL INFRASTRUCTURE										
Feeder Roads										
Water Supply										
Procurement										
Construction										
MANAGEMENT SUPPORT										
WATER MANAGEMENT STUDY										
Bids and Award										
Study and Report										

Legend

■ ■ ■ ■ Intermittent Activity.

PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN
WADI TUBAN
AGRICULTURAL DEVELOPMENT PROJECT

State Farms with Groundwater Irrigation:

- To be Supplied with New Irrigation Works
- No New Irrigation Works to be Supplied

Spathe Irrigated Areas

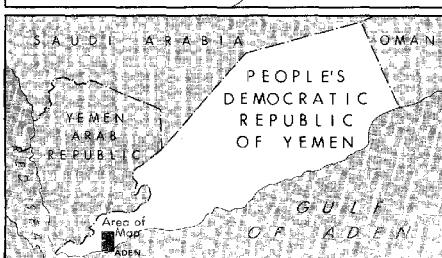
- Cooperative Farm Centers
- Sufyan Villages to be Provided with Water Supply
- Proposed Water Mains
- Existing Water Mains
- Proposed Overhead Electricity Transmission Lines
- Existing Overhead Electricity Transmission Lines
- Roads to be Constructed
- Existing Surfaced Roads
- Bir Ahmed Water Works
- Existing Diversion Weirs
- Rivers
- Bir Nasir Well Field
- Tomato Paste Factory
- Cities, Towns and Villages

Contours in Meters

0 1 2 3 4 5 6 7 8 9 10
KILOMETERS



The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.



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