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Oman: Transformation of an Economy

(In Three Volumes)

Volume II: Major Sectoral Developments

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CURRENCY EQUIVALENTS
(Official Exchange Rate)

Prior to August 15, 1971

O.R. 1	=	U.S. \$2.40
U.S.\$1	=	O.R. 0.417

August 15, 1971 to January 1973

O.R. 1	=	U.S. \$2.60
U.S.\$1	=	O.R. 0.385

February 1973 to May 1976

O.R. 1	=	U.S. \$2.895
U.S.\$1	=	O.R. 0.346

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CHAPTER NINE

AGRICULTURE AND FISHERIES

I. INTRODUCTION

1. For many years farming, livestock production, and fishing were the mainstays of the Omani economy. Their importance in terms of national income began to decline in the 1960s with the discovery of oil and subsequent expansion of petroleum production and exports but it was hastened by lagging growth of output from agriculture and fisheries. These activities now account for only about 3% of GDP (down from nearly 34% in 1967), while agricultural exports are an even smaller portion of total exports (less than 1%). However, despite a substantial outflow of labor from rural areas in recent years, agriculture and fishing continue to be the most important means of livelihood for most of the Omani population. At present, two-thirds of the Omani and nearly half of the total work force are employed in these activities. Labor productivity, incomes and welfare lag far behind levels achieved in the non-farm economy and agriculture is increasingly viewed by rural Omanis as an economic activity of secondary importance. The outflow of workers from rural areas and resultant scarcities of agricultural labor were probably important factors in explaining an apparent overall decline, or at best, stagnation, in agricultural and fisheries output in recent years. The country's dependence on agricultural imports has increased.

II. THE RESOURCE ENDOWMENT

2. The Sultanate of Oman extends over some 300,000 km² of which only about 37,000 ha (0.12%) are cropped. Most of the area consists of desert, sparsely populated by nomadic herdsmen. The agricultural areas are located where suitable water has been found and developed, either through the aflaj system of man-made underground channels, as in much of the Interior, or, increasingly, from wells equipped with motorized pumpsets.

The Cropping Pattern

3. More than a third of the cropped area is located in the Batinah coastal plain located north and west of Muscat. The Interior of Northern Oman accounts for much of the remainder, although small areas are cultivated in the Sharkiya area southeast of Muscat, in the Musandam Peninsula and in Dhofar Province in the South. With water a severe constraint, expansion of the cropped area in recent years has been small. New areas developed in some interior valleys with excess water and in the Batinah Coast appear to have been largely offset by land abandonment elsewhere.

4. Dates and citrus account for nearly half of the cropped area. Alfalfa may occupy about 15% and onions another 10%. The balance is made up of various vegetables, fruits and field crops, of which wheat is the most

important. Estimates of cropped area, by district and crop, based on fieldwork in 1971, are: 1/

Table 14. DISTRIBUTION OF CULTIVATED AREA BY DISTRICT AND CROP

District	Area (ha)	Percent of Total	Crop	Area (ha)	Percent of Total
Batinah	14,700	39	Dates	13,600	37
Jan and Buraimi	600	2	Citrus	3,600	10
Dhahira	3,600	10	Mangoes	400	1
Western Hojar	3,800	10	Bananas	900	2
Eastern Hojar	3,400	9	Alfalfa	5,600	15
Nizwo	6,900	19	Onions	3,700	10
Sharkiya	2,800	8	Wheat	1,200	3
Musandam	400	1	Others	8,000	22
Dhofar	<u>800</u>	<u>2</u>			
Total	37,000	100		37,000	100

Soil and Water Availability

5. Availability of water, and to a lesser extent suitable soil, is the major technical constraint to expansion of cropped area. No systematic studies of Oman's soils have been undertaken, although information based on limited surveys suggests that cultivable lands are restricted in extent and widely scattered. Unusually great contrasts in soil quality exist within short distances in presently-cropped areas. In these locations, deep medium-textured soils with considerable potential for irrigated agriculture are closely associated with sandy or stoney soils which offer little or no potential for crop production.

6. With yearly rainfall averaging less than 150 mm in most areas with suitable soils, all crop production requires irrigation. Greater rainfall at higher elevations results in some runoff and percolation to underground aquifers. Until recently, little was known of the extent of potentially arable new lands and the amount of surface and underground water available for agriculture and livestock production. In 1973-75, a series of land and water resource studies were carried out which covered nearly all potential development areas. While of varying quality and coverage, these studies strongly suggest that the country has little unexploited water supply. The current estimate of soil experts in Oman is that from the viewpoint of soil

1/ These figures are approximations. No agricultural census has been taken in Oman. Initial fieldwork for a 5% sample survey of holdings got underway in 1976.

characteristics, i.e., excluding considerations of water availability and the economics of development, up to 10,000 additional ha are suitable for crop production. More than 9000 ha of this total were in Northern Oman (2,000 in Sharkiya; 2,000 in Wadi Quryat; 5,000 in the Batinah Coast); and less than 1,000 in Dhofar. In some areas limited unused quantities of water exist and its coincidence with suitable soil would permit some increase in cropped area. The Sharkiya was identified as one of the most promising areas for expansion, with more restricted possibilities in the Interior, in Dhofar and, with improved management of the existing water resources, in the Batinah Coast. The studies suggest that even with favorable economic conditions for development, an expansion in cropped area by something considerably less than the 10,000 ha indicated by soil considerations would be possible. Given the high costs of developing relatively small scattered areas which appear to be suitable, opportunities for economically-viable expansion are likely to be limited. More efficient use of existing water would permit additional expansion, although this would require considerable expenditure on field reorganization, introduction of new methods of irrigation and agricultural extension work. (See Appendix I for a summary of the water resource studies.)

7. Overexploitation of available water is a growing phenomenon in several areas, e.g., parts of the Batinah Coast, the Sur area and Buraimi in the Interior. This is resulting in falling fresh-water tables and deterioration in water quality through saltwater intrusion. The major effect until now has been to reduce crop yields, particularly for saline-sensitive crops such as citrus and some vegetables. Some abandonment of land has occurred. Continued deterioration of water supplies would lead to more serious, lasting effects on soil productivity.

Land Tenure and Size of Holding

8. In the allocation of land and water rights, Moslem law and traditional authority vested in tribal and local leaders continue to play important roles. However, that authority has been reduced in recent years with greater administrative control by the Central Government. The Ministry of Land Affairs and Municipalities is charged with the registration of privately-owned lands, based upon proof of occupancy or purchase from government. To date, the major thrust of this registration has been toward urban lands. Most agricultural land is individually owned, although public grazing lands are important. Owner-operatorship appears to be the dominant form of tenure in Northern Oman, although in some interior areas tenancy is high. On rented farms, crop sharing, frequently with 50% of the crop committed to the landowner, is practiced.

9. Size of agricultural holdings vary widely among regions. The larger holdings tend to be located in the newer areas of the Batinah Coast with smaller, more fragmented farms in the Interior. Water resource studies for North-West Oman (1973) suggest that farm size in that region averaged about 4.2 ha. The size of holdings is typically small relative to the size required for efficient use of irrigation and modern agricultural machinery.

Livestock

10. Livestock, which may account for as much as one-third of gross domestic product from agriculture and fisheries, play an important role in the rural economy as a source of draft power, transportation services, food and cash income to herdsmen and farmers. In the country's arid and semi-arid rangeland, livestock utilize a forage resource which is exploitable only through grazing. While estimates of livestock numbers vary, plausible figures are: 10,000 camels, 30,000 sheep, 70,000 cattle and 140,000 goats. The nomadic Bedu tribes may account for 20,000 head, mainly sheep, goats and camels. The Central Government owns dairy production farms at Sohar and Salalah stocked with exotic breeds. The Dhofar provincial government operates a beef-fattening farm on the Salalah plain.

11. Livestock management systems are simple. Animal and poultry rearing in settled agriculture is almost always the responsibility of women and children. Sheep and goats typically are grazed in communal village pastures. Cattle owned by the farm population are confined to stalls and fed largely on freshly-cut forage (frequently alfalfa) and other locally available feed-stuffs such as dates. Poultry flocks generally are small and run unconfined in house lots. Recently, however, modern large-scale broiler and egg operations, based on imported birds and feed, have been established in the Muscat-Mutrah area.

12. Among the richest livestock resources in the country are the Jebeli herds on the Qara mountain range in Dhofar. These cattle, a small, hardy type, number 30-40,000 head and are efficient users of the grass produced by the 500-700 mm of moisture from annual monsoonal rains which fall in the mid-June to September period. Supplemental feeding, largely dried sardines purchased from Dhofari fishermen, is provided during the dry season. These herds produce ghee and live animals for sale in the area. In recent years young animals have been sold to the provincial government's beef-fattening farm on the Salalah plain.

13. Until recently, little effort has been made by government to improve the productivity of Oman's livestock. The veterinary service, staffed by 10 expatriate professional veterinarians and additional technicians, began operating in rural areas in 1975. Animal research farms at Wadi Quryat and Rumais carry out performance and cross-breeding trials with imported breeds. Fortunately, the country is free of the most troublesome epizootic and enzootic diseases, although the risk of infection remains large from the increasing number of live animal imports and the absence of effective quarantine facilities.

14. Roughly estimated, domestic production accounts for two-thirds of total national consumption of meat and dairy products and about one-third of the eggs. Prices for livestock products are high by international standards and a general view is that production of milk and meat (including beef and

mutton) is declining. 1/ Production declines may be partly due to the migration of labor from rural areas and its adverse impact on feed supplies. Shortage of feed is probably the most important explanation for low livestock productivity levels. 2/

The Fisheries Resource

15. With more than 2,000 km of coastline and rich fishing waters, the fisheries resource is one of Oman's best prospects for non-oil, income-generating activities. Information on the fisheries industry is limited, although a study completed in 1975 has confirmed the high potential for development. 3/ The study concluded that fish production in Omani waters is as high as or higher than in any other part of the Arabian Sea/Bay of Bengal/Indian Ocean area. Surveys in 1973-74 suggest a standing crop of demersal fish along the Omani coast of slightly less than 750,000 metric tons (mt), with a potential annual yield of 300,000 mt. Among pelagic fish, annual yield estimates for sardines within 12 miles of Oman's coastline run as high as 1.5 million mt. The tuna reserves in Omani waters, of which the yellowfin is the most important, is estimated at 10-60,000 mt per year. Valuable stocks of abalone, lobster and cuttlefish also have been identified.

16. Fisheries output appears to have declined in recent years prior to 1976, largely as a result of the continued outflow of fishermen to more attractive employment in urban areas or neighboring Gulf states. In the mid-1950s the annual catch in Northern Oman was estimated to be 100,000 tons. Annual national output in recent years appears to be about half as high, with a significant portion accounted for by the sardine catch in the South (Dhofar Province). Most of the Dhofari catch - a small fraction of potential annual yield - is sundried and fed to local livestock. At present 7-10,000 Omani families may depend on fishing as a primary source of income. Fisheries production in 1976 appears to have increased from 1975 as a result of expanded trawler operations.

17. Low earnings in fisheries reflect the poorly-developed state of the industry. Prior to 1974, when the Directorate of Fisheries was established, almost no government assistance was provided to traditional fishermen.

1/ In 1976 the selling price of a 30-kg goat or sheep was about OR 50 (US\$145). Ghee in the Salalah area sold for approximately OR 0.18/litre. Retail prices per kg for mutton and beef in Muscat were OR 2.5 and OR 2.0, respectively.

2/ Recent surveys by animal production experts in Oman suggest that the typical daily ration per animal unit of 3-4 kg of freshly-cut alfalfa provides only half the nutrients required for body maintenance and production of one litre of milk.

3/ Mardela International, Ltd., Marine Resources Development Program: Sultanate of Oman, Final Report (April 1975).

Fishing villages are widely-scattered and in many cases poorly served by either road or sea transport. Boats and gear are primitive and annual output per crew is low. In most fishing centers landing facilities and marketing infrastructure are either non-existent or adequate to meet only the immediate needs of the nearby population. Large quantities of canned fish are imported at reasonable prices to supply the bigger population centers and, increasingly, inland consumers without ready access to fresh fish.

18. Recently the government began development of modern commercial fishing in Oman through joint ventures with foreign firms. Under a one-year agreement with the Taiyo Fishery Company of Japan, four stern trawlers of 1,500 gross tons each began fishing in a restricted area between the Kuria Muria and Masira Islands. The immediate objectives are to increase fish production from Omani waters and, through associated surveys, provide additional information on the country's fisheries resource. Under the agreement, only demersal fish can be exploited. These are to be marketed abroad until cold store and market facilities in Mutrah are constructed. Total catch by these trawlers in April-September 1976 was about 3,500 tons. The agreement provides for the training of 10 Omani fishermen aboard each trawler and deployment of 6 Omanis to a regional fisheries center in Kuwait for training as assistant captains and marine engineers.

19. Under another recent agreement with ARABCO Traders, Ltd. of New Zealand, the government purchased an ice plant and cold store equipment for the Mutrah-Muscat area, refrigerated trucks and three small trawlers of 380 gross tons capacity. The agreement provided for ARABCO to erect the shore facilities and operate the trawlers and shore installations for one year. Seventy-seven man-years of expatriate services are to be provided in management, refrigeration engineering, fishing and fish marketing. Each trawler, with an expatriate captain and a crew of 4 Omanis, is expected to catch 450 tons of demersal fish per year.

20. Because of the poorly-developed marketing infrastructure, the domestic market for local fish is limited. Throughout the country fish prices are high relative to those in neighboring countries. Domestic demand for fresh or chilled fish would increase significantly if prices were lowered and supplies made available more widely. Incomes of traditional fishermen can be improved by expansion of the market and upgrading the product. Better landing facilities, ice plants, cold stores and refrigerated trucks are needed.

21. The government has begun to provide this infrastructure. In Sohar an ice plant and fish sorting hall were constructed in recent years, but no fish landing facilities exist. At Mutrah a large cold store and municipal market facilities are under construction. However, in the important boat-building and fishing center of Sur landing and shore facilities do not exist. In the south at Salalah a cold store, ice plant and fish sorting hall are under construction. No landing facilities are available. At nearby Reyzut a good port, with accommodation for traditional fishing craft, is being built.

III. RECENT PERFORMANCE

Output Growth

22. Because of the extremely weak data base with respect to both production and prices, all figures have to be taken to represent broad orders of magnitude only. 1/ The average annual growth rate of value added from agriculture and fisheries from 1970-74 was estimated at less than 2% in current value terms. Average price increases during the period almost certainly exceeded that figure; hence a negative growth rate in real terms is implied. Impressions, based on travel by the mission and discussions with knowledgeable individuals in Oman, confirmed that agricultural production has at best stagnated, if not fallen, during the last few years. During 1975, production of some commodities rose while output of other commodities continued to fall. Among those products with declining production were dates, citrus, milk and meat. Together these comprise more than half of gross value of production from these sectors. (See Table 15.) Output of fisheries, which accounts for more than a quarter of total agriculture and fisheries production, also apparently continued to fall in 1975, although it is likely to have risen in 1976. Production of wheat, some vegetables and fruits appears to have increased in response to growing use of modern inputs and production from recently developed private farms in the Batinah Coast. Overall, a gain in value added (current terms) for agriculture and fisheries of 4% over 1974 levels is estimated.

23. The sluggish performance of Omani agriculture and fisheries reflects several factors, including labor shortages, a deteriorating physical resource base in some areas and continuing problems with plant pests and diseases. One of the important factors is the shortage of agricultural workers, particularly near urban areas where non-farm employment is readily available. The urban wage pull is strong. In 1976, urban wage levels for unskilled workers were about twice those in rural areas. Outflow of workers from agriculture and fisheries has been large in recent years and is continuing. In consequence, less labor-intensive agricultural production systems are practiced and, in many cases, the quality of crop and animal husbandry is declining. A widely-reported example is the labor shortage in date production which prevent timely weeding, pruning and pollination of the palms.

1/ No regularly-collected data on agricultural (and fisheries) production and prices exist in Oman. The absence of an agricultural census has been noted. Even agricultural trade figures are incomplete and suspect because of unreported trade and smuggling over both land and sea routes. All published data on agricultural production are based on qualitative judgments and ad hoc surveys with limited coverage. Margins for error in these figures obviously are large.

Table 15. INDICATIVE ESTIMATES OF AGRICULTURAL AND FISHERIES OUTPUT, 1975

<u>Commodity</u>	<u>Volume</u> (<u>'000 tons</u>)	<u>Farmgate price</u> (<u>OR/ton</u>)	<u>Gross value</u> (<u>'000 OR</u>)
Dates	49.0	110.0	5,390
Limes (fresh)	3.0 <u>/1</u>	375.0	1,125
Other fruits	5.0	75.0	375
Tomatoes	5.0	100.0	500
Onions	7.0	100.0	700
Other Vegetables	4.0	75.0	300
Wheat	4.0	130.0	520
Tobacco	0.9	256.0	225
Other Crops	1.0	130.0	130
Meat	4.7	1,275.0	5,990
Milk, ghee, etc.	13.4	180.0	2,430
Wool, hides, etc.	0.2	500.0	100
Fisheries	45.0	150.0	6,750
Total gross value			24,535
Less purchased inputs			
Irrigation services <u>/2</u>			3,700
Fertilizers, agricultural chemicals <u>/3</u>			300
Tractor, machinery services <u>/4</u>			100
Fuel and supplies for fisheries <u>/5</u>			<u>2,300</u>
			6,400
Equals gross value added in agriculture and fisheries			18,135

/1 Assumed roughly equivalent to 1,500 tons of dry limes.

/2 Costs of well irrigation only. Assumed to be OR 200/ha on half of total irrigated area, i.e., 18,500 ha.

/3 2,100 tons at OR 65/ton plus a similar expenditure for insecticides.

/4 Includes 30,000 hours of tractor services at OR 2.5/hr.

/5 Assumed to be about one-third the gross value of fisheries output.

Source: Directorate of Agriculture, consultant studies and mission estimates. There are no regularly collected series of agricultural price and production data in Oman.

In Shinas District, located in the Batinah Coast where non-farm employment opportunities are greater than in the Interior, only about one-half of the date palms were reported in production in 1975.

24. Despite government efforts at control, Dubas bug infestation in 1975 reduced date yields. The citrus black fly caused considerable damage in lime orchards. 1/ In some areas, e.g., at Al-Khabura in the Batinah, insect pests reduced the 1975-76 lime harvests to a small proportion of previous crops. Deficiencies in water management and supplies also constrain agricultural production. Although the number of motorized pumpsets has expanded steadily, these irrigation systems frequently are not managed properly. Over- or under-irrigation is common. Irrigation efficiency is relatively low, estimated at less than 50%. In several areas increased water abstraction has drawn down the freshwater table and led to increased pumping costs and/or saltwater intrusion. In some areas irrigated by aflaj, labor shortages have resulted in deterioration of the aflaj system and reduced water supplies.

Agricultural Trade

25. Once the major items of Oman's trade, dates and dried limes today account for a small fraction of total exports but represent three-quarters of all non-oil exports. Published trade data, which must be interpreted cautiously, suggest that the value and volume of dates and lime shipments moved erratically in recent years with no distinct trend apparent. Official figures indicate that date exports in 1975 were down about 15% from 1974 levels while lime exports were up by 23%. 2/ Recent import curbs by India, the major traditional buyer of Oman's relatively low-quality exports of unprocessed dates, threatens the export market for this product.

26. Imports of agricultural products (food, live animals, beverages, tobacco) grew by more than 50% p.a. (current value terms) in the last five years and by some 80% in 1975. The value of cereals and preparations, fruits and vegetables and dairy products and eggs rose by 51%, 106% and 56%, respectively, in 1975 from year-earlier levels. Data on price movements are not available. However, the sharp moderation of world prices in 1975 for most products, and price declines for the important cereals group, suggest that nearly all of the 1975 increase in import value reflected a similar increase in import volume.

1/ In 1973 yield losses from the Dubas bug of up to 70% of normal production were reported in Central Oman. Government control efforts were more effective in 1975, although losses continued, especially in narrow valleys which were inaccessible to aerial spray crews.

2/ Lime exports in 1975 represent production in 1974. Private trade data suggest 1976 export volumes (reflecting 1975 production) were down from 1975 levels. The consistency problems with official trade data are exemplified by the case of dates. While the reported volume of date exports in 1975 was 15% below the 1974 level, the value of date exports in 1975 is reported to be more than 4 times year-earlier levels.

27. Imports make up a growing proportion of total domestic consumption of agricultural products. Reflecting lagging domestic production and rapidly-growing urban food demand, the latter influenced in part by a large expatriate community and affluent Omanis, the proportion of consumption provided by imports increased from about 10% in 1970 to more than 50% in 1975. A recent study concluded that more than 90% of the cereals consumed in Oman in 1975 were imported, while imports supplied more than half of the vegetables, two-thirds of the eggs and about a third of the meat and dairy products.

Table 16. INDICATIVE ESTIMATES OF IMPORTS, DOMESTIC PRODUCTION, AND CONSUMPTION OF BASIC FOOD ITEMS, 1975

	<u>Domestic production</u>	<u>Imports</u>	<u>Consumption</u> (^{'000 tons})	<u>Imports as Percent of Consumption</u>
Wheat	3.0	27.0	30.0	90.0
Rice	-	25.0	25.0	100.0
Vegetables	8.5	9.5	18.0	53.0
Dates	50.0	-	16.0	-
Other fruits	8.5	2.5	11.0	23.0
Meat	4.7	2.6	7.3	36.0
Eggs	0.3	0.5	0.8	63.0
Milk/dairy products	13.5	6.5	20.0	33.0

Source: Renardet-Saudi-ICE, Water Resources Survey, Northeast Oman: Interim Report (March 1975).

Institutional Development

28. Government support of agricultural and fisheries development is of recent origin. In 1970, prior to the existence of a ministry, administrative sections for agriculture, irrigation and fisheries were established within the General Development Organization. (However, crop and livestock experimental work under government auspices was initiated some 10 years earlier - at Nizwa in 1959-60 and at Sohar in 1962-63). In 1974, the Ministry of Agriculture, Fisheries, Petroleum and Minerals (MAFPM) was formed. Reorganization within the MAFPM in 1975 resulted in the creation of separate Directorates for Agriculture and Fisheries, the first with 13 departments, the latter with 4.

29. Since 1970 steady progress has been made by the government in increasing the scope and quality of supporting services to agriculture and fisheries. However, many of these remain weak and all are hampered by the severe shortage of qualified Omani manpower. The government has relied

extensively on expatriate technicians and professionals, particularly in agricultural research, extension and veterinary services. Main features of the present system of agricultural services are discussed below.

30. Agricultural research. Steady progress has been achieved in several research areas, although a comprehensive national research effort which meets the full range of technical problems facing Omani agriculture remains to be developed. Four experimental stations (Rumais, Wadi Quryat, Sohar, Salalah) are in operation, generally with severe manpower constraints in terms of professional staff numbers and research qualifications. Other experimental stations at Nizwa, Sohar and Rumais were converted to commercially-oriented production farms in 1971 but remain the responsibility of the Department of Agricultural Research. Financial performance of these operations has been poor, and all reportedly continue to operate at a loss. High operating costs, resulting from the acquisition of a large number of field workers formerly used in the research operations, is a major reason for their unsatisfactory performance. The government now operates 7 production farms totalling about 135 ha. Good research with useful results has been done on varietal and fertilizer trials for vegetables and wheat. Work on plant protection is less advanced. Valuable work on forages and legumes has been started, some of it under the Bank-supported project of technical assistance to the MAFPM. Little research has been done on the important date and citrus crops. Soil and water management and irrigation practices are other important areas where past work has been inadequate.

31. Agricultural extension. This activity dates back only to 1971 when the government established 17 local extension centers, primarily to distribute seeds, fertilizers and insecticides and provide tractor services, generally at subsidized prices. By 1976 the number of local extension centers had increased to 23 (plus 7 "sub-centers"), supported by 6 regional centers at Nizwa, Rumais, Sohar, Salalah, Dhahira and the Sharkiya. Each center is staffed by an Omani administrator, generally with primary school training, together with 1-3 expatriate technicians and local tractor drivers, shopkeepers, etc. Technical staff in extension total 45, most of whom hold a diploma in agriculture, except for 6 university graduates in agricultural engineering. Typically, each extension center operates in an area with about 1,000 farm holdings. The major extension activity continues to be the supply of inputs, of which the most important are fertilizers, seeds and tractor services. In 1976 chemical fertilizers were sold to farmers free of internal transportation charges; pesticides were distributed without cost; and tractor services were charged at the equivalent of about US\$1.50/hour, as contrasted with full operating costs of US\$6.50/hour. The private sector sells to farmers at full costs petroleum products, pumpsets, fertilizers and other agricultural chemicals, although volumes are small relative to sales by the extension service. Recently technical advice to farmers has been given greater emphasis, in part through establishment of more demonstration plots on farmers' fields. But limited back-up support and inappropriate training or aptitude of technical staff hamper the total extension effort. In general, most of Oman's agriculture operates with little significant input of technical advice from the research and extension programs.

Table 17. GOVERNMENT SERVICES TO AGRICULTURE

Activity	1971	1972	1973	1974	1975
Production and experimental farms (number)	6	7	8	13	13
Extension centers/subcenters (number)	17	17	20	22	27
Fertilizers distributed /1					
Nitrogen (nutrient tons)	27	73	187	251	409
Phosphate (nutrient tons)	2	19	55	85	95
Potash (nutrient tons)	-	6	18	85	106
Tractor hours rendered to farmers (number)	-	-	10,784	16,635	30,341
Northern Oman, Interior	-	-	1,753	4,324	8,828
Batinah	-	-	9,031	12,311	17,759
Dhofar	-	-	-	-	3,672
Khasab	-	-	-	-	82

/1 Made available to farmers at extension centers and departmental headquarters. Due to storage losses and wastage, amounts actually applied by farmers may be less. In addition, small quantities of fertilizers are provided through private market channels. The figures for 1975 relate to 1,485 tons of ammonium sulphate and 600 tons of compound fertilizer of 18-15-15 or 15-15-15 analysis. About two-thirds of the ammonium sulphate was distributed in the Batinah Coast.

Source: National Statistical Department.

32. Agricultural Marketing. Until recently, almost no effort had been made to improve the private sector-oriented marketing system for agricultural production. Mark-ups at all levels appear to be high relative to the whole-sale price and, for several commodities such as fruits and vegetables, wastage

is extensive. ^{1/} No systematic investigation of the marketing system has been undertaken, although several studies mention the need for improvement. A study of banana marketing in Dhofar Province, undertaken in late 1976, suggested that spoilage losses may approach 40% of production. In 1975 the Government began to establish farmer cooperatives for the marketing of production inputs and output. Fruit and vegetable marketing has been stressed. By late 1976, 8 cooperative societies with about 2,000 members had been registered. The program has benefitted from good leadership, but shortages of trained staff limit effectiveness at the field level. The government also is establishing wholesale market outlets in a few major urban areas to market output from its production farms. Government-owned date processing plants at Nizwa and Rustaq purchased about 1,500 tons of dates in 1976 (less than 4% of production) from farmers at guaranteed prices.

33. Agricultural Credit. Since the creation of the first extension centers in 1971, a small amount of interest-free government credit has been made available to farmers for the purchase of motorized pumpsets. In 1974 the government began a program of credit to fishermen in Dhofar which permitted purchases of boats, motors and equipment on credit. The program was extended to Northern Oman in 1975. Terms of these loans include a grant element of 25%, with the balance repaid over 2 years without interest. The new Development Bank of Oman, chartered in 1976 with a share capital of OR 10 m but not yet operational, may become an additional source of institutional credit for agriculture and fisheries.

34. Aflaj maintenance. One of the most significant programs of government assistance to agriculture is the grant fund available for aflaj maintenance. Administered by the Irrigation Department, and relying upon local committees and field staff of the department, the program provides grants to repair and maintain the country's system of about 3,000 aflaj. The number of major repair jobs financed by the program increased from 30 to 70 in 1974-76 while government expenditure from the fund rose from OR 200,000 to OR 380,000. Despite this effort, a general view is that labor shortages, particularly of the skilled workers needed in the difficult, sometimes dangerous, task of aflaj maintenance, have resulted in a gradual deterioration of the system.

^{1/} Surveys by the MAPFM's Department of Statistics provide sample prices for the Mutrah market in June 1976:

<u>Commodity</u>	<u>Wholesale Price</u>	<u>Retail Price</u>	<u>Mark-up as Percent of Wholesale Price</u>
	-----OR per kg-----		
Tomatoes	0.563	1.105	96
Cucumbers	0.360	0.578	60
Eggplant	0.131	0.315	140
Potatoes	0.249	0.388	56
Dry onions	0.077	0.211	174
Dates	0.211	0.398	89
Mangoes	0.450	1.322	194
Bananas	0.132	0.351	166

35. Omani farmers have demonstrated considerable eagerness to use modern production inputs. The volume of chemical fertilizer made available through government extension centers increased from 375 tons in 1972 to 2,100 tons in 1975. Hours of tractor services provided to farmers by government rose from nearly 11,000 to 30,000 in 1973-75 (see Table 17) while the number of citrus and date trees sprayed with insecticide by government teams nearly tripled in this period.

36. Expansion and improvement of these services is needed. The above tonnages of fertilizer imply applications in 1975 of about 55 kg per cropped ha, or less than one-fourth the amount which maximizes economic returns on cereals in Oman. In some cases fertilizer provided to extension centers is not distributed and allowed to deteriorate in warehouses. Not infrequently, inappropriate fertilizer application prevents realization of the full benefits. Spray teams are hindered by inadequate transport and problems posed by the large numbers of smallholdings with tree crops interplanted with other crops. Access to many of these holdings is difficult and low levels of farmer education limit efforts to mount safe, effective spray programs under their control.

Income and Employment in Agriculture

37. At present productivity levels, agriculture increasingly is becoming a secondary source of income. Although sample size is small (270 families) and the accuracy of responses may be questioned, recent socio-economic surveys in Northern Oman suggest that frequently the portion of farm family income earned from agriculture is less than the income derived from non-agricultural activities. (See Table 18.) Total family income (cash plus farm-produced home consumption) varied widely among districts but averaged about OR 260 per year (or assuming 6.5 members per family, OR 40 per capita).

Table 18. FARM AND OFF-FARM INCOMES IN NORTHERN OMAN
(1973 OR)^{1/}

	District								
	Shinas	Sohar	Saham	Barka/ Masnah	Iski	Al Hamra	Wadi Quryat	Buraimi	Dariz
Number of Farms in Sample	21	27	31	54	32	26	19	28	32
Gross Farm Income									
Crop Sales	83	244	254	201	19	48	161	278	34
Livestock Sales	3	7	18	7	1	10	29	21	33
Other	1	17	10	2	-	8	-	-	1
Total	87	268	282	210	20	66	190	299	68
Other Income									
Resident, Off-farm	264	494	579	215	98	133	32	475	156
Non-Resident	35	71	73	92	51	78	58	177	126
Total	299	565	652	307	149	211	90	652	282
Total Gross Income	386	833	934	517	169	277	280	951	350
Cash Farm Expenses	477	497	564	443	270	334	471	487	314
Net Family Cash Income	-91	336	370	74	-101	-57	-191	464	36
Farm-produced Home Consumption ^{2/}	150	150	150	150	150	150	150	150	150
Total Family Income	59	486	520	224	49	93	-41	614	186
Other Income as percent of Total Family Income	507	116	125	136	304	227	-	106	152

^{1/} The surveys were carried out in early 1974. The reference year was 1973, reportedly a very poor agricultural year, particularly for dates, limes and wheat. Information was derived through memory recall. The consultants noted a tendency to underestimate incomes and overestimate farm expenses. Results are best interpreted as indicating orders of magnitude.

^{2/} Mission estimate, assuming family consumption per annum of 25 kg. of meat, 120 kg. milk, 540 kg. dates (dry weight basis), 72 kg. limes, and 240 kg. other fruits and vegetables.

Source: Basic data for the districts of Shinas, Sohar, Saham and Dariz were reported in ILACO, Water Resource Development Project, Northern Oman, Interim Report (January 1975), Vol. 3. Data for other areas are in Sir Alexander Gibb and Partners, Final Report, Phase I, Soils and Agriculture Studies, with Interim Water Resources Assessment (April 1975).

38. In the absence of a population or agricultural census, estimates of rural population, work force and migration are necessarily crude. Assuming a total country population in 1976 of about 800,000, a rural population of perhaps 485,000 is possible. On the basis of plausible labor force participation rates, this implies a labor force in agriculture and fisheries of about 110,000 (of whom perhaps 10,000 are in fisheries).

39. Outmigration from rural areas occurred at a rapid pace in recent years, first in response to attractive job opportunities in neighboring states and more recently as a result of petroleum-induced development in Oman's non-agricultural economy. While considerable physical migration from agriculture and fisheries has occurred, the rapidly-expanding road network has permitted non-farm employment for some months of the year with permanent residence maintained on the farm. Some studies suggest that up to a third of the farm work force was employed in off-farm work in recent years, much of this in commerce, construction work and, frequently, in the defense force of neighboring states. The precise extent of rural-urban migration is not known. A working paper by the Development Council Secretariat suggests that this is in the order of 4,000 workers per year.

IV. THE FIVE-YEAR DEVELOPMENT PLAN, 1976-1980

40. Comprehensive planning for agriculture and fisheries development is a new activity in Oman, dating essentially from the Economic Development Law of February 1975. Within the national development objectives of broadly-based income gains and increased emphasis on non-oil economic activity, The Five-Year Development Plan outlines an ambitious program for expansion of the agricultural and fisheries sectors. Together these sectors are projected to expand in real terms by 13.7% p.a. in 1976-80. Although growth rates for agricultural and fisheries are not separately estimated, rapid expansion in fisheries output is implied. No detail is provided with respect to yields and cropped areas. The proposed strategy for agriculture includes an expansion of cropped area through new land and water development as well as efforts to increase yields in already-cropped areas. The major emphasis is on yield increases. Strengthened research, extension, input supply services, and marketing programs are stressed as the means to higher yields. An agricultural development fund within the MAPFM is suggested to finance these activities. A major element in the strategy for fisheries development is assistance to traditional fishermen through provision of cold stores, marketing and transport facilities, boats and other fishing gear.

41. Rapid increases are proposed for public and private investment in these sectors. Total investment in agriculture and fisheries would cumulate to OR 57 million in 1976-80. Government expenditure would total OR 41 m (OR 14.4 m for fisheries, OR 7 m for animal husbandry, OR 14.4 million for water resource development, and the balance - OR 5 m - largely for crop production.) This allocation for agriculture and fisheries constitutes a rapidly growing share of total public sector investment (1% in 1976 to 11.8% in 1980).

Table 19. PROPOSED CAPITAL EXPENDITURE IN AGRICULTURE
AND FISHERIES, 1976-80
(1976 prices)

	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>Total</u>
Public Sector Capital Expenditure						
Agriculture (mil. OR)	1.0	4.1	5.5	7.5	8.5	26.6
Fisheries (mil. OR)	1.6	1.8	3.0	4.0	4.0	14.4
Total (mil. OR)	2.6	5.9	8.5	11.5	12.5	41.0
Agriculture and Fisheries as percent of total public sector expenditure	1.0	2.3	4.6	8.5	11.8	4.4
Public and Private Sector Capital Expenditure for Agriculture and Fisheries (mil. OR)	4.6	8.9	11.5	15.5	16.5	57.0
Percent of Total Capital Expenditure	1.5	2.6	4.3	6.8	8.2	4.2

Source: Development Council, The Five-Year Development Plan, 1976-1980.

42. The project content of the Plan was to be provided in subsequent months by the MAPFM. At the time of the mission's visit in late 1976 work was underway to allocate these sums among various departments of the agricultural and fisheries directorates and to develop investment projects. In general, project work was at a preliminary stage. The proposals made by the various departments (but at the time of the mission's visit not yet approved by the Ministry or the Development Council) include:

- (i) Agricultural research. The major effort would be to strengthen work on the principal crops such as limes, dates and vegetables. Research on crop protection is to be improved. The major proposed capital expenditure is to establish a fruit research station at Sohar, improve laboratory facilities at Rumais and establish new facilities and research sites in Dhofar. The Agricultural Research Department plans to obtain the services of additional expatriate professional staff.
- (ii) Agricultural extension. The Extension Department proposes to increase the number of local extension centers from 23 to 35 and to approximately triple the number of technical staff to 150 by 1980. Because of the shortages of

trained Omanis, virtually all of this increment will be expatriates. Acquiring expatriate staff in these numbers with the appropriate qualifications and experience is considered difficult. The major capital program for the extension service is the proposed construction of 6 regional extension centers, each to include offices, a cold store, veterinary clinic, vehicle repair and maintenance facilities, a parking shed for 150 tractors, seed and fertilizer stores.

- (iii) Agricultural training. The major program is the Bank-supported agricultural school at Nizwa. School construction was to be completed by the end of 1977, although delays are envisaged. Three types of training will be offered: (1) a 3-year secondary school to produce 34 middle-level technicians annually (with the first output about 1981); (2) a one-year post-primary course to train 70 young farmers in agriculture, animal husbandry and farm mechanization; and (3) a 1-2 weeks' training course for 80-100 government staff employed in agricultural development work.
- (iv) Cooperatives and marketing. The Cooperative Department plans to establish 20-25 cooperative societies and 4 agricultural collection centers annually during the plan period. Expansion of agricultural market outlets in urban areas is being discussed. It is proposed to send 6 staff members abroad annually for training in cooperative methods and management. The shortage of qualified staff is seen as the major constraint to the proposed development program for cooperatives and marketing.
- (v) Livestock development. Three major capital projects have been proposed for the veterinary service: (1) Construction and staffing of 6 regional veterinary hospitals and 22 smaller clinics; (2) construction of a veterinary diagnostic laboratory in the capital area; and (3) construction of a veterinary quarantine station. The required large increase in personnel with veterinary training is to be obtained abroad. Recruitment had not begun in late 1976. Concerning animal production, it is proposed to reorganize research activities, establish a second breeding/research facility in Dhofar and expand the production farm at Sohar both in cropped area and number of dairy cows. The Animal Production Department also proposes to strengthen programs of cross-breeding research and distribution of improved animals to farmers and to initiate a poultry hatchery program.
- (vi) Irrigation and water resource development. In already-cultivated areas aflaj maintenance is to be given high priority. The collection and interpretation of water

resource data, initiated by consultants in recent years, will be continued. Experimental work in aquifer recharge through the construction of dams is being considered. Drilling and testing of wells and small-scale land development in areas with unexploited agricultural potential is proposed. In late 1976 the Water Resource Department proposed a work program which provides for the development of about 1,100 ha over the next 3-5 years (beginning with 100-200 ha each at Al Kamil and Ad Dariz, 200 ha at Wadi Quryat and 100 ha at Wadi Dank). Agreement has been reached between the Bank and government to utilize remaining funds in Loan 985-OM to support a limited program of water resource exploration and development near Sohar. The allocation of the OR 14.4 million for water resource development among government agencies (in particular, the Water Resource and Irrigation Departments and the new National Water Resources Council) remains to be determined.

- (vii) Agro-industrial development. In the public sector, the government plans to increase output of its two date-processing plants from less than 1,500 tons in 1976 to 4,000 tons by 1980. Remodeling of these plants to permit small unit packaging is to be completed in 1977. The feasibility of a coconut processing factory in Dhofar is under examination. Expansion of dairy production from government farms in Dhofar and Sohar is planned. In the private sector the main activities include commissioning of the 4,800-ton flour mill in the capital area and expansion of production from the dairy products plant (based on the reconstitution of imported raw materials). Government has proposed the establishment of a privately-owned animal feed mill to support the dairy, beef and commercial poultry industries.
- (viii) Economic research and data collection. With assistance from FAO, a valuable effort was initiated in 1976 to conduct a 5% sample survey of the country's agricultural holdings. This is to be supplemented by a more comprehensive farm management survey of 100 farms throughout the country. Completion of this work is proposed for the early years of the plan period, although this depends heavily upon continued FAO assistance and the availability of enumerators, transportation facilities and other back-up support.
- (ix) Fisheries development. The objective is to expand production through assistance to Omani fishermen using traditional methods and joint ventures with foreign fishing interests which employ more capital-intensive techniques. The major investment program proposed is the

construction or improvement of fishing harbor facilities at Rayzut, Sur, Sohar, Musandam, Salalah and Masira. Workshop facilities to repair boats, engines, fishing gear and vehicles are to be constructed at the main fishing ports. The Omani trawler fleet is to be increased from 3 to 10. Additional cold stores, ice factories and marketing centers are proposed and a sardine and tuna canning factory, including a fishmeal facility, is under consideration. A Fisheries Development Fund of OR 2 million is to be established to provide credit to fishermen for the purchase of boats and gear. Training for Omani fishermen is to be provided through the existing Japanese-Omani joint venture and the regional training center in Kuwait. The annual production target for the next several years suggested by the Directorate of Fisheries is 200,000 tons, or approximately a four-fold increase from the present catch.

An Assessment

43. After several years of relative neglect, the greatly increased allocation of public sector investment for agriculture and fisheries is to be welcomed. It is a clear manifestation of government's recognition of the need to accelerate income growth in the non-petroleum sectors and to improve the welfare of large numbers of the agriculture and fishing population, many of whom have benefitted relatively little from the petroleum-led urban-oriented development of recent years.

44. The proposed investment balance between agriculture and fisheries and the stress on fisheries expansion is consistent with potential in these sectors. Evidence suggests that Oman's fisheries resources are unusually rich and amenable to rapid development. Government assistance to traditional Omani fishermen is commendable and the joint ventures with foreign firms reflect realistically the limited reservoir of technical knowledge of modern fisheries in Oman and the need for international marketing experience.

45. Within agriculture more than half of the proposed public sector expenditure of OR 26.6 m is allocated for water resource development, more than a quarter for animal husbandry and the balance largely for crop production in already-cropped areas. An important question, discussed at greater length below, is the relative allocation between new land development and measures to improve yields on presently-cropped land. There is need to continue exploration of the country's water resources, as now planned for in the Sohar area, to ascertain the extent to which the arable land base can be expanded. But this must be done with due consideration for the economic soundness of any agricultural development which might result. The objective should be to locate areas large enough for development on economic terms.

46. The realism of the overall investment targets for agriculture and fisheries may be questioned. Public sector development expenditure for these sectors appears to have averaged about OR 2 m in 1973-76. The plan projects this to increase from OR 2.6 m to 12.5 m in 1976-80. Limited capacity within the MAFFM for project preparation and implementation raises

serious doubts regarding the likelihood of achieving this increase. The use of expatriate contractors for, e.g., extensive civil works or construction programs related to land and water (or fisheries) development, of course, could absorb large capital sums very quickly. However, this may be inappropriate. At this stage of the country's agricultural development, the government should focus on the strengthening of basic support services and administrative structures, i.e., activities which require government commitment, manpower and time, but relatively limited investment in physical infrastructure. Given these considerations, the plan targets for public sector capital expenditures in agriculture and fisheries may be too high.

47. Relative to the recent past, when aggregate output of agriculture and fisheries seems to have declined, or at best, stagnated, the implied combined annual growth rate for these sectors of 13.7% is ambitious. The investment program, even if it is fully implemented, would have a meaningful impact on output only toward the end of the plan period. Moreover, the labor migration from agriculture can be expected to continue and constrain agricultural growth. Even with rapid expansion in fisheries output, an annual aggregate growth rate for these two sectors averaging 13-14% may be difficult to achieve.

V. DEVELOPMENT OPTIONS AND PROSPECTS

Fisheries

48. Prospects for fisheries development in Oman differ markedly from those in agriculture. The fisheries resource is large and can be exploited efficiently with known technology. Present labor shortages pose no fundamental problems and, in fact, foster the use of productive, capital-intensive approaches. A major consideration in the development strategy for fisheries is the future role of the traditional fishermen who now account for most of the industry's employment and output. Modern fishing methods, while generally efficient means to increased output, will not produce widely-distributed benefits to traditional fishermen or generate a significant number of new jobs. Boats of the class now operated by ARABCO are expected to yield a catch of about 100 tons annually per crewman. At these output levels, the country's estimated fish catch in recent years could be produced by fewer than 1,000 fishermen or less than 10% of those who now depend primarily upon fishing as a livelihood.

49. However, with careful planning, the simultaneous development of traditional and modern fisheries must go ahead because it contribute to Oman's output, diversification and income distribution objectives. Commercial financing is likely to be available for expansion of modern fisheries in Oman. But more extensive government involvement is required to develop the traditional sector. The objectives should be to assist these fishermen, first, by expanding market outlets and then providing them with the equipment, facilities and supporting services to supply those markets. Provision of appropriate shore installations and landing facilities would be needed.

Important fishing villages should be provided with small cold stores and icemaking equipment. In some villages, without natural harbors, simple jetties could be constructed. The key to the development of the modern, export-oriented sector, which will require major investments, is the involvement of selected international companies with worldwide market outlets, in a joint venture with the Government or Omani private interests.

50. The outlines of a program for the mutual development of the traditional and modern fishing are being defined by the Government with the assistance of the World Bank. This type of development, focusing on supporting services and infrastructure to expand demand and supplies of fish products, could be duplicated in subsequent years in other parts of the country. Successful implementation could increase traditional production and slow migration from this sector. These developments, together with expected production gains from modern fisheries activities, could be a major source of non-oil income in future years.

Agriculture

51. The development problems of agriculture are more difficult. Basic resources of suitable land and available water appear to be inadequate to permit significant expansion to new lands. The economics of such expansion remain to be determined. Deterioration of soil and water quality threatens production in some cropped areas. Small farms, complex water rights and the predominance of scattered tree crops all operate to reduce possibilities for labor-saving technologies in the present labor-short environment. Despite recent progress, the present range and quality of government services to agriculture are inadequate to sustain rapid growth.

52. However, despite these difficulties, growth in the agricultural sector is both desirable and feasible from technical and economic viewpoints. Accelerated growth is desirable to provide improved incomes in rural areas, to slow migration to urban areas, and moderate the trend of a rapidly-growing dependence upon agricultural imports. Although the ambitious growth targets of the plan may not be achieved, with vigorous government support and appropriate policies, it should be possible to gradually move away from stagnation in crop production. However, agricultural imports are likely to account for a growing portion of consumption, even with a reversal of production trends.

53. Accelerated agricultural growth requires some combination of increased yields in already-cropped areas and new land development. Relatively large increases in yields appear to be technically feasible. In general, actual crop yields in Oman are low compared to those attainable with proven cultural practices, or those achieved in other regions with

similar soil, water and climate. 1/ This is not surprising in view of the relatively undeveloped system of supporting services for agriculture, in large part a reflection of shortages of trained manpower and the few years in which agricultural development has been of serious concern to the government.

54. The economics of attaining these yield increases through improved cultural practices appear to be attractive. Proper, timely application of fertilizers is among the most promising of these improved techniques. Yield increases of 30-50% and incremental benefit-cost ratios of at least 4:1 are possible from fertilizer use on farmers' plots planted to local wheat varieties. 2/ Fertilizer response to exotic varieties is likely to be even higher.

55. Improved plant spacing, time of planting, weeding, pest and disease control are other proven means to increase yields. All of these improved techniques promise quick returns to those producers who employ them. Several require relatively little expenditure by farmers. Proper plant spacing in

1/ A recent study provided the following estimates of actual crop yields in Oman and those considered achievable with proven cultural practices:

<u>Crop</u>	<u>Present average yield</u> -----tons/ha-----	<u>Potential yield</u> -----	<u>Present yield as percent of potential</u>
Dates	4.5	10.0	45
Alfalfa	45.0	90.0	50
Wheat	1.25	2.25	56
Limes	1.0 (fresh)	1.5	67
Onions	3.0	15.0	20
Vegetables	5.0	15.0-30.0	17-33

Source: Sir Alexander Gibb and Partners, Water Resources Survey of Northern Oman: Final Report on Phase I Soils and Agricultural Studies (1975)

2/ At the Wadi Quryat Station in 1975-76, the application of 1 ton of nitrogen (from ammonium sulphate) would produce 10-11 tons of wheat (local varieties) in the most promising trials. At present wheat and fertilizer prices, this yields an incremental benefit-cost ratio in excess of 5:1.

vegetable crops and the application of inexpensive foliar sprays to treat trace mineral deficiencies in tree crops are examples. ^{1/} However, to achieve these potential gains in yields on a nationwide basis will require time, patience, farmer education and extension services. Consequently, widespread results cannot be expected over the Plan period. However, with sustained efforts, agricultural production growth can be stepped up through higher crop yields over the longer term.

56. In contrast to the production possibilities from known yield-increasing technologies used on already-cultivated areas, the benefits from new land development involve much greater uncertainty. Water resources, while considered adequate for limited development, are not yet proven. Development of this water would be costly. Soil suitability in several areas where water is believed to exist also remains to be confirmed by detailed soil surveys. Supporting infrastructure would have to be provided in most areas of potential.

57. An important question concerns the operation of new farms. The financial performance of government production farms is generally unsatisfactory and improved managerial procedures would be required before this organizational approach could be recommended for new areas. Providing these lands as new farms to interested Omani farmers may be possible, although the present labor shortage makes this an uncertain prospect.

58. The distribution of incomes within rural areas also would be affected by the choice of development strategy. Measures to increase productivity in cropped areas hold the potential to increase incomes of a large number of farmers. An extensive program of new land development could result in large public sector expenditure which benefits relatively few of the farm population. But if sizeable quantities of unused groundwater could be found, economies of scale might make some of this development economically worthwhile.

59. These considerations suggest a cautious program of land development, based upon reasonable assurances regarding water and soil suitability and economic viability. However, recent studies to identify such possibilities

^{1/} A specific case of the yield-increasing potential of these techniques relates to tomato production. Research in Oman under the Bank-supported technical-assistance project has produced experiment station yields of 50-60 tons/ha from earlier planting of a well-known imported variety. This, while realized on a small area, may be compared with the estimated national average yield of 14 tons. The improved variety was combined with 3 basic cultural practices: (1) closer plant-spacing to permit 36,000 plants/ha, compared with the usual 13,500; (2) direct seeding, together with proper fertilizer placement under the seeds; and (3) additional fertilizer application during the growing season. These techniques also would extend the current short production period, now an important constraint on income possibilities from this crop.

are not encouraging. 1/ There is need to continue a limited program of water resource exploration and development to determine if suitable areas can be identified of a size required to generate the necessary economies of scale. Planned exploratory work in the Sohar area should provide valuable information for making investment decisions in this regard.

60. Growth in agriculture is likely to be achieved most efficiently largely through measures to increase yields in cropped areas. This should be supplemented by carefully-developed programs for new land and water development where potential benefits provide a sound basis to expect expansion on economically-viable terms. Such an approach to development would require further strengthening of agricultural supporting services. A number of issues need to be considered in this regard, some of which are discussed below.

61. Agricultural research. In view of the number of studies already done in agriculture and the ongoing research activities, there is a need for a thorough review of the national research effort, focusing on the range and quality of existing work, the adequacy of existing facilities and the problems occasioned by the shortage of experienced staff. Of particular concern in such a review should be the adequacy of present and planned work in soil and water management, irrigation technology, date and citrus production, plant protection and the economic analysis of research results. Establishment of national research priorities is needed to prevent dissipation of scarce research expertise.

62. Agricultural extension. With good organization and discipline and with relevant research back-up in the form of technology packages and some specialist staff, effective extension services could be provided without large

1/ Bank efforts in 1976 to identify projects in the Batinah Coast for the development of new land areas of less than 100 ha suggested excessive costs (on the order of US\$9,700/ha as capital investment, \$5,200/ha in annual operating costs) relative to likely benefits. Development of larger areas might result in lower unit costs, but would require additional testing for water availability. Preliminary studies of development prospects on unutilized land in Dhofar failed to turn up a potential project with an economic return (evaluated at 1973 prices) in excess of 7%. (Sir William Halcrow and Partners, Surveys and Investigations of Land and Water Resources Development in Dhofar: Draft Final Report, May 1975). The latest study in this regard (Hunting Technical Services, Ltd., Pre-feasibility Study to Investigate Alternative Means of Establishing Commercial Farming in Interior Oman: Final Report, October 1976) examined prospects in the Sharkiya, generally considered as having the greatest development potential from the viewpoint of soil and water availability. It estimated that initial investment costs would total OR 5,650/ha, with possible expansion at OR 900/ha. Economic rates of return were not calculated. A cautious pilot project of 20 farms at 4 ha each was proposed.

numbers of highly-trained staff. Continuous supervision and on-the-job training of field staff are important. Salaries, allowances, and terms of service should be reviewed to ensure that adequate incentives exist to attract and retain qualified Omanis in extension work. Backstopping efforts should be strengthened, including the timely provision of input supplies to extension centers, adequate transportation, office facilities, demonstration and teaching materials, etc. The selection process for expatriate extension personnel should be improved to ensure that field staff have the technical training and aptitude for effective work with farmers. Field staff should be encouraged to increase their contacts with farmers, especially on the latter's farms. Of particular importance is additional fertilizer promotion and educational efforts to ensure that farmers use fertilizers and other modern inputs correctly.

63. Input supply. The distribution of fertilizers and the provision of tractor services by the extension service has reduced the time available for the dissemination of technical advice. Without remedial efforts, this problem is likely to become more acute. Government should consider measures to encourage the private sector to expand its role in providing these inputs and services. Fertilizer distribution, tractor and spraying services may now have reached a volume to interest private merchants.

64. Agricultural marketing. Marketing problems, evidenced by price instability, extensive wastage and high mark-ups, are particularly acute in the case of perishable products. The much-improved road network has reduced marketing costs but few of these benefits have been passed back to farmers. The cooperative development program is a useful step to organize producers, but meaningful benefits to them are likely to be some time away. The government should also consider other measures to assure remunerative prices for farmers. One way would be to enter the market directly, in competition with the private sector, when prices fall below specified levels. Any such effort must be carefully planned, limited in terms of geographic and commodity coverage, and consistent with the availability of trained manpower. For some products additional wholesale-level storage or processing capacity is necessary to accommodate temporary market surpluses.

65. Rural credit. As agriculture expands and production processes become more complex, there is need to improve farmers' access to production credit and inputs as well as medium-term credit for such activities as equipment purchase and tree planting. Efforts should be made to strengthen institutional credit programs, possibly through the Development Bank, and to provide credit outlets in the most important production areas. Effective credit may replace some input subsidies. These subsidies should be examined to determine the extent to which they could be reduced or eliminated as a result of expanded credit programs. There is need to finalize administrative arrangements for effective use of the new Fisheries Development Fund, including determination of the respective role of the Development Bank and the Directorate of Fisheries. Village-level extension agents will be needed in the major fishing centers to introduce fishermen to the use of institutional credit and to supervise its use.

66. Data collection and planning. Economic planning in Oman is greatly handicapped by the serious deficiencies in the agricultural data base on production and prices and information on ownership of agricultural assets, labor utilization, etc. The on-going agricultural sample survey and farm management surveys planned for later months deserve strong support by government. They should be supplemented by regularly-collected information on production through systematic reporting by field-level personnel such as extension agents and rural schoolteachers. Similarly, sound planning for fisheries development requires information on number of fishermen, types and number of fishing vessels, and on the value, volume and species caught.

67. Water resource development. The skill with which Oman's water resources are managed is perhaps the most critical determinant of agriculture's future development. Formulation of a national water plan and regulatory measures to ensure that all existing and future water use is in the national interest are high priority activities which should be supported by the National Water Resources Council (NWRC). There is need to define carefully the respective roles of the NWRC, the Irrigation and Water Resources Departments and other government agencies involved with water supply and use. To provide a more comprehensive picture of available water, it is essential to continue the monitoring and interpretation of information from existing rain gauges and aquifer testing systems. Of importance to the older agricultural regions, many of whom have little unutilized water available, is the continued maintenance and improvement of the aflaj system. Without vigorous efforts in this regard, there is danger that Oman's most efficient water distribution system will fall into permanent disrepair.

68. Longer-term development issues. Longer-term agricultural development strategy to increase productivity and earnings of rural labor would require basic changes. The most complex and politically difficult of these may be the consolidation of small plots of land to permit more efficient use of motorized farm machinery. Land consolidation and the introduction of new production techniques are difficult, time-consuming processes requiring extensive public education, continuous government support and technical assistance to farmers. The registration of land now being done mostly in urban areas, needs to be accelerated in the rural areas. There also is a need to address the issue of a system of water rights which meets the needs of modern agriculture. In some areas of aflaj irrigation, where land and water rights do not coincide, the existing system prevents the most efficient use of one of the country's scarcest resources.

Livestock

69. In the livestock sector progress in expanding output depends heavily on the success of efforts to increase feed supplies and improve animal health and husbandry practices. These in turn relate to broader issues of agricultural research, extension and provision of basic inputs, and further development of veterinary services. Increased feed supplies are particularly important in the Batinah Coast, the Interior and the Salalah Plain where irrigated forage, frequently alfalfa, is the main feedstuff. Although alfalfa

yields are more satisfactory in Oman, relative to potential, than are yields for most other crops, there is scope for further gains. Yields of 45 tons under typical farm conditions are only about half those achieved under similar agro-climatic circumstances in neighboring countries. Indigenous alfalfa varieties are well-adapted, but seed is in short supply and cultural practices could be improved. A simple low-cost technology, virtually unknown among farmers at present, is inoculation of seed at planting with nitrogen-fixing bacteria. Treatment of seed with rhizobium at the Wadi Quryat station doubled yield of local alfalfa varieties.

70. Because of their inherent productivity, the livestock and soil resources on Dhofar's Qara range warrant special development efforts. The development of more than 30 boreholes on the range in recent years has exposed large areas to year-round grazing and established the basis for increased livestock numbers. Without careful range management there is danger that overgrazing will reduce livestock production in the near term and damage the resource base for expansion in the future. Control of livestock numbers is an increasingly-important management task for this area. While the sale of young animals for fattening on the plain is a useful outlet, there is need to examine the economics of the fattening program and determine whether it is the soundest approach to utilization of the land and livestock resources on both the mountain range and the Salalah plain. It should be remembered that the plain is the only place in Oman, and perhaps in the Gulf area, where climate permits year-round production of vegetables. More intensive land use systems than those employed in the fattening program might produce higher economic returns.

71. Until significant progress in expanding feed supplies and improved animal husbandry is achieved, the introduction of improved local or exotic breeds will provide few benefits. The forage development program requires fertilizer trials on legumes and grasses and performance testing of exotic forage species, particularly saline-tolerant varieties. Extension efforts should focus on proper fertilization and simple cultural practices such as seed inoculation. Government should undertake steps to ensure a reliable supply of high-quality grass and legume seed, particularly alfalfa. Carefully-supervised alfalfa seed production on a government farm or through contract arrangements with reputable private growers may be useful.

72. The veterinary service should be expanded to provide diagnosis and treatment for simple ailments of livestock. Facilities and staff, typically veterinary assistants or others with practical, relevant training, should be made widely available for this purpose. Methods of producing poultry under small-scale, village conditions could usefully be demonstrated at extension centers, with emphasis on housing, management and feeding with use of locally-available feedstuffs. Closer working arrangements should be encouraged among veterinary, animal production and agricultural extension field staff.

73. In Dhofar, fertilizer and forage variety trials on the plains and the Qara range should be strengthened. New range management systems should be introduced, possibly through a pilot ranching program. Components of the program could include animal health, forage development, rotational grazing, hay production and feeding systems to retain young animals on the range for longer periods before shipment to the plains for finishing.

CHAPTER TEN

HYDROCARBONS, MINING AND MANUFACTURING

I. OIL AND GAS

History

74. The history of Oman oil in its present phase began in 1937 when the Iraq Petroleum Group (I.P.C.) was granted the last concession in their Arabian group of concessionary areas. This original concession, subsequently transferred to a new company, Petroleum Development (Oman and Dhofar) Limited (P.D.O.), was for a period of 75 years. In April 1960 all the partners in the original IPC group withdrew from the venture except Royal Dutch Shell and Partex, with a new shareholding of 85% and 15% respectively. The main reason for the withdrawal was the high cost of an operation that had so far met with no success.

75. In 1967, the company relinquished a major part of the three miles of territorial waters acreage of its concession situated on the East Coast which was taken up by a German Consortium headed by Wintershell A.G. as part of a much larger offshore concession area. In June 1967, Partex concluded an agreement with C.F.P. whereby C.F.P. purchased 10% of the share capital of P.D.O. from them. Exports of oil from Oman commenced in August 1967.

76. On December 4, 1973, the Oman Government signed a participation agreement with P.D.O. whereby, as of January 1, 1974, the Government would acquire a 25% share in P.D.O. Compensation payment was put at \$72 million. In July 1974 an agreement was reached with P.D.O. raising the Government's share in the operating company to 60% retroactive to January 1, 1974. Compensatory payments were set at \$34 million, raising total Government compensation payment to \$106 million. The present composition of the shareholding in P.D.O is Government (60%), Shell (34%), CFP (4%) and Partex (2%).

77. The first drilling in Oman took place at Fahud in January 1956. Oil indications were found but not in commercial quantity. In 1962, P.D.O. began its drilling programme in Yibal, where gas and oil were discovered. In itself, however, the quantity of oil did not yet allow commercial production. This success was followed by the discovery of an oil accumulation at Natih. These discoveries led the geologists to believe that oil could also exist in the Fahud structure. Subsequently, it was the Fahud structure that proved to be the largest accumulation, and today is therefore the best known.

78. In 1972, three new fields were discovered in the Ghaba area, and in Dhofar a limited quantity of heavy oil has been found. Two other fields (Saih Rawl and Al Haboor) were also discovered in Northern Oman near its border with UAE. The oil in Dhofar is low gravity crude (16-18° API) with high sulphur content. City Services had already relinquished the area and the Government decided in 1977 to exploit the Dhofar oil fields.

79. The concession area of ELF-ERAP (offshore) in Musandam in the Strait of Hormuz contains small reserves and is shared equally with Iran. It contains high proportions of gas condensate and it is estimated that only 20% of the 500 million bbl of probable reserves are recoverable. ELF-SUMITOMO is planning to drill one well in the concession area South of Fahud in 1977. Sun Oil has drilled two wells in its concession area in Masira Island. Quintana, an independent U.S. Company is prospecting in Oman near the UAE border and shows some optimism in its search. The company plans to drill two wells in 1977. In addition to these activities, there are three additional new areas in Dhofar which are open for bidding.

Oil Reserves and Production

80. Total recoverable oil reserves in Oman as of January 1, 1975 were 1.1 billion barrels based only on primary recovery methods. Other more optimistic figures in Oman for oil reserves estimated by other consultants, were 3 billion barrels which would be equivalent to 24 years of production at the 1975 rate. However, as a result of the increases in oil prices and the application of secondary and tertiary methods, plus some new oil fields coming into production in 1975 and 1976, proven recoverable reserves as of end 1976 were estimated at 5.8 billion barrels (including secondary and tertiary recovery methods). Except for the Dhofar area, the oil found in Oman is light (34° API in the Fahud area and 35.4° in the Ghaba area), has a low sulphur content (approximately 1% per weight), and it is associated with only a small amount of gas. The average depth of wells is between 4 and 5 thousand feet.

81. Commercial production of crude oil started in August 1967 and continued to increase from 1967-1970 when it reached 332,000 bbl/d; it dropped in 1971 and 1972 as a result of technical limitations. In 1973, because of secondary recovery methods applied, production increased to 293,000 bbl/d. However, production declined again in 1974, mainly due to problems facing compressors and the drop in pressure in the Fahud fields. The gas used in the compressors is probably not suitable. Although P.D.O. installed four compressors, it was still not possible to stop the decline in production caused by the pressure loss in the field. The other cause of the decline is the water cut problem in the Qarn Alam field in Ghaba area. The oil is taken from cracks, and the water is flowing in faster than anticipated. It is not likely that this problem will be overcome. In 1975, production increased again and reached 341,000 bbl/d because four of the Ghaba fields started production. In 1976 production will register its peak of 360,000 bbl/d and production is expected to decline continuously unless new fields are discovered and exploited. Presently, the three oil producing areas of P.D.O. are: Fahud, Ghaba and Lekhwair. Virtually all production is exported and hence production and export figures are identical.

82. The following four alternative estimates have been made for future oil production during the Plan period and can be used for estimating the oil revenues.

Table 20. ALTERNATIVE ESTIMATES FOR CRUDE OIL PRODUCTION IN OMAN 1976-1980

Alter- native	Year	1976	1977	1978	1979	1980	Remarks
A	Million bbl/yr	135.0	127.4	115.0	101.5	90.2	"Experts Estimate"
B	Million bbl/yr	135.0	132.0	128.0	125.0	122.0	5 - year Plan
C	Million bbl/yr	135.0	127.4	119.7	112.5	105.8	Mission Case I
D	Million bbl/yr	135.0	127.4	119.7	114.5	114.5	Mission Case II

83. Alternative A is a conservative estimate made by the P.D.O. showing minimum production rates, because:

- (a) the Dhofar fields production is not included; present estimates range from 3.6 to 10.8 million bbl/yr, to be reached by 1980;
- (b) any further increase in production from existing fields due to intensified secondary recovery is not included, and
- (c) any additional production is neglected from new discoveries expected by 1979, together with the production from the off-shore field in the Strait of Hormuz.

84. Alternative B is used for the forecast of revenues in the Five-year Plan. The Plan does not give any justification for the small decline. Alternative C is the "Mission Case I" with a rate of decline of about 6% per annum, due to the problems with the compressors and the pressure loss in the secondary recovery process, and no additional production from new fields included except for Dhofar. The underlying assumptions for alternative D, the "Mission Case II" are that the P.D.O. would not be able to overcome the pressure drop in the oil fields before 1980, but that production in some new concession areas would add to the existing production to slow down the rate of decline. Case I is used as the base case in this report, mainly because of the long lead time required to bring new fields into production. Beyond 1980, if the concerted efforts of the government at using advanced secondary recovery methods and the aggressive exploration program prove to be successful, oil production could start to rise again.

Production Costs

85. Production costs were rising from 1970 to 1973 because of exploration and development activities. However, in 1974 and 1975 total production costs increased sharply due to the costs for expansion of the Al Fahal port, and the costs for linking the Ghaba fields with the main pipeline. Production costs per barrel are likely to increase from 1977 to 1980 because of increased exploration activities, investment and operating costs for secondary recovery, and due to the decline in production. Therefore, it is expected that production costs will rise from an estimated 78 cents per barrel in 1976 to \$1.25 per barrel in 1980. Production costs have always been high in Oman compared to other Gulf areas due to difficult terrain and high transportation costs, difficult exploration and low well productivity. A breakdown and the historical development of production cost is given in Table 7.3.

Oil Pricing and Government Revenues

86. Although Oman is neither a member of OPEC, the Organization of Petroleum Exporting Countries, nor of OAPEC, the Organization of Arab Petroleum Exporting Countries, it largely follows the changes introduced by both organizations, and P.D.O. is obliged to consult with the Government of Oman to implement these changes. The changes in Oman crude posted prices per barrel were as follows: \$2.785 on April 1, 1973; \$3.043 on October 1, 1973; \$5.723 on October 16, 1973; \$12.298 on July 1, 1974. The posted price for Oman crude was \$12.548 at the end of December 1976. After the December 1976 OPEC conference in Qatar from which a two-tier price system emerged, Oman raised its price by 7.5 percent. The Government concluded an agreement with P.D.O. whereby the company will pay for its buy-back crude 93% of the posted price. In January 1974, the Oman Government concluded an agreement with Gulf Oil and C. Ithoh of Japan, providing for sale to this third party of about 10% of its participation crude oil for the year 1974 and 1975. The amount has increased to 80,000 bbl/d in 1976 representing about 40% of its participation crude at an average price of \$11.70/bbl.

87. The Government's oil revenues from 1967-1973 consisted of royalties and income taxes on net profits paid by P.D.O. on total production. Starting from 1974, the oil revenue consisted of royalties and income tax on 40% of the equity crude plus 93% of the posted price on buy-back participation and sales to third parties. The increase in Government oil revenues between 1971 and 1973 was mainly due to the improved financial terms. From 1974 onwards the increase was due mainly to the sharp increase in posted prices. Total Government revenues from oil increased from OR 1.9 million in 1967 to OR 44 million in 1970 and to an estimated OR 470 million in 1976 (Table 5.5).

The Crude Oil Refinery Project

88. Several alternative refinery projects have been proposed and studied from a full fledged 60,000 bbl/d refinery down to a simple 10,000 bbl/d "topping" unit. A "full refinery" could be economical and therefore, competitive for export markets, only with a capacity of 60,000 bbl/d or above. Since the local market including fuel oil sales to tankers may grow up to

about half of that size, the other half, with a variable breakdown of product mix, would have to be exported. Since most neighbouring countries have large refineries or projects, the mission suggests further consideration of a medium-size topping unit of about 30,000 bbl/d for which investment cost would be about \$25-30 million (1976 prices). A topping plant based on Oman crude would produce 50% heavy ends (fuel oil and "bunker C"), 30% middle distillates, and 15% naptha. "Bunker C" could be supplied to crude oil tankers, while virgin naptha could either be added to crude oil to increase its API and hence its value or be sold to petrochemical plants, for example, in India.

Natural Gas

89. Natural gas in Oman exists in two forms: associated with oil and as non-associated "dry gas". The main source of "dry gas" is Yibal. Probable and proved gas reserves are estimated at about 4,000 billion SCF down to the abandonment-pressure. The gas contains little sulphur (sweet gas). The gas calorific value is between 900-1,100 Btu/SCF with an average of about 1,050 Btu/SCF. Assuming a delivery rate of 140 million SCFD (=46 billion SCFD per year) which is the pipeline capacity, the reserves would last about 80 years, and at a rate of 320 million SCFD (the pipeline capacity if the gas would be compressed), the reserves would still last about 40 years (see Table 7.7).

Gas Pipeline Projects

90. The Yibal-Sib/Mina Al Fahal/Al Ghubra Pipeline project was designed originally to supply a 2,000 tons per day ammonia plant, which however only needs about 85 million SCFD. 309 km of 20" pipeline were bought at a cost of about \$30 million (1975). The distance from the oil fields near Yibal to the proposed head station near Azaiba between Sib and Mina Al Fahal, from where gas would be distributed to consumers, is about 320 km. The construction of this pipe is underway. A loan of about \$60 million from Kuwait and UAE for the construction of the pipeline has been arranged. The pipeline could be in operation in mid-1978.

91. Since the foreseeable projects are unlikely to fully utilize the gas that will be available after the Yibal-Al Ghubra pipeline is built, the Government is considering a gas pipeline from Sib to Sohar (200 km). Such a gas pipeline would be sufficient to deliver at a moderate pressure drop from Sib to Sohar, at least 40 million SCFD, which in turn would be adequate to supply the proposed copper smelter (5 million SCFD) and another 80 MW power plant cum desalination if it is needed. However, the economic justification of the copper smelter and the gas pipeline would have to be carefully analysed, as will the need for further power generation and other potential gas users at Sohar.

Cost, Pricing and Revenues

92. The consulting firm TETRATECH has estimated the total "production" and transportation cost of the gas including field installations and receiving stations at about \$0.50/MSCF declining to about \$0.20/MSCF, depending on the

gas delivery rate. A preliminary mission estimate confirms that capital related costs including maintenance, but excluding gas losses, would be about \$0.45/MSCF at a gas delivery rate of 140 million SCFD, and about \$0.50/MSCF at a 40 million SCFD delivery rate.

93. The Government has decided that the gas price should be half the equivalent crude oil price in BTU terms. Therefore, at a crude oil price of \$13.20/bbl in 1977, the gas price would be \$1.32/MSCF. Accordingly, the government revenues from natural gas sales at gas prices equivalent to half the expected crude oil price at pipeline capacity with some compression could be about \$100 million in 1982 measured in 1977 dollars (See Table 7.8), if all the projects come on stream at the time assumed.

Power Plants and Sea Water Desalination Units

94. As described and analyzed in greater detail in the chapter on power, there are three large power plants in operation: Riyam (37 MW), Salalah (30 MW), Al Ghubra (78 MW). The Al Ghubra plant includes also a 4 million gallons per day sea water desalination plant, and uses, at present, crude oil. Ghubra will be operated on gas when the pipeline is completed.

95. The total potential consumption of natural gas for power generation only, would probably not exceed about 80 million SCFD by 1982, as compared to a pipeline capacity (without gas compression in the field) of about 140 million SCFD. However, as power generation expands, the potential consumption of gas in the eighties would increase.

96. The Government should further investigate the production of calcium carbide (as an exportable form of energy) at a rate equivalent to 20-40 MW, and the production of vinyl chloride derived from calcium carbide, or from acetylene via natural gas cracking, which would also require a salt electrolysis - another large power consumer. The production of methanol could also be considered. At this stage, these are only preliminary suggestions and would need detailed analysis to establish the economic justification of the projects and the market for the output.

LNG Project

97. A project to liquify natural gas and to export it as "LNG", (liquified natural gas) has been considered by the Government. The proved gas reserves in Oman of about 4,000 billion cubic feet would be adequate to feed over a reasonable lifetime of the plant, a minimum "standard" capacity LNG plant per line with 100 billion SCF per year. The plants in Algeria and Indonesia have up to six such lines per plant, that is 600 billion SCF per year total capacity. After accounting for other local gas needs of at least 25 billion SCF per year, the gas resources in Oman would cover the need for an LNG plant, over a 30 year time span. However, the inherent problems (high investment cost, marketing problem) associated with a large LNG project - several of which are under construction or consideration in the Gulf area, (Qatar, Iran, Saudi Arabia, Abu Dhabi) may have influenced the Government's decision to delete the LNG project from the priority list at least during the present Five-Year Plan.

Fertilizer Project

98. Although the Government's project list still includes a fertilizer project without giving any details there is apparently no active work under way on such a project. India is said to have negotiated urea supplies from Oman. The amount of natural gas required to feed a 3,200 tons per day urea plant - which is double the "standard" size - would be about 85 million SCFD of gas.

Other Projects

99. The projects list (Table 9.1) includes a few industrial projects which could considerably increase the gas consumption, such as the manufacture of glass products, cement, sponge iron, and crude oil refining. The largest consumer of natural gas on this list, would be the sponge iron project using the direct reduction process; a 400,000 tons per year sponge iron plant would consume approximately 22 million SCFD. The proposed 1 million tons per year cement factory, would need (in addition to the electrical power) about 15 million SCFD and the copper smelter about 5 million SCFD. Gas consumption for a flat glass with a 10,000 TPY capacity would need only about 1 million SCFD of natural gas. The proposed 30,000 bbl/d oil refinery could also use for heating purposes natural gas instead of fuel oil, at a rate of about 6 million SCFD of natural gas. A calcium carbide furnace, if found to be economically justified after further study, would be a large consumer of power (between 20 and 40 MW) and hence, of natural gas. However, these project possibilities are in most cases in preliminary stages of consideration and their feasibility has yet to be established.

Alternative Forecast for Natural Gas Consumption

100. Based on these project possibilities an alternative forecast for gas consumption was prepared (Table 7.9). The total potential consumption of natural gas would increase from about 25 million SCFD in 1979 to 208 million SCFD in 1982, and future potential consumption - probably not before the mid-1980's - could be about 330 million SCFD. However, without further study it is not known how many of these projects would turn out to be economically justified. The maximum pipeline capacity after installing gas compressors in the fields, of about 320 million SCFD, would still be sufficient even if large energy consuming industrial projects would materialize such as fertilizer, aluminium, and calcium carbide.

II. MINERALS AND MINING

101. Apart from oil, various mineral resources exist in Oman. At present, geological knowledge exists on copper, chromium, manganese, iron, nickel, coal, asbestos, and limestone although their commercial exploitability in most cases has yet to be established. The search for minerals started only in 1972. There are three main regions with mineral deposits: namely the Northern Hajar mountains, the Southern Hajar mountains and the Jebel al Gara region in Dhofar.

Copper: Mining and Smelting

102. Copper ore (sulphide) deposits are found all over Oman; however, larger deposits exist about 20 km west of Sohar and near Sunayah, where new deposits were discovered. There are between 16 and 18 million tons of drilled proved reserves. A 1971 report by Shell concluded that copper reserves are not sufficient for mining operations; however, Omani Government officials as well as consultants and potential partners believe otherwise. There are three copper mines near Sohar and average copper content in the ore is about 2%. These three mines could have a production rate of 20,000 tons per year of 26-28% concentration. At this extraction rate, proved reserves in the Sohar area would last about 16 years, adding about OR 10 million per annum to the foreign exchange income of Oman (provided the copper is sold at least as "copper cement", or "fire refined" copper).

103. An existing feasibility study dated November 1975 covers mining, production of concentrate, the smelter for producing fire refined copper, and the infrastructure required. The Government has decided to proceed with the copper project but the marketing problem for copper ore and products still needs to be solved. Incremental production cost will have to be carefully reviewed in relation to world market prices.

104. A company called "Oman Mining Company" was started in 1973 as a joint venture between the Oman Mineral Development (Government) and Marshall Oman Exploitation (a US company) and Prospecting Ltd. of Canada. This arrangement has been changed according to the Government's wish to assign 51% to the Government and 49% to the foreign partners.

105. Since the cost of transportation for concentrate to Europe is estimated at \$40 million per annum, it is planned to install a smelter for producing "fire refined copper" or "black copper" with a copper content of between 94 and 97% which can be melted to produce "anode copper" with 99% copper content. There exists no plan for further electrolytic refining. The copper ore would be transported by truck from the mines to the coast north of Sohar, which is only 23 km distant. The road from Sohar to Buraimi at the UAE border is completed, but some more road construction is needed. A new jetty is projected for handling fuel, equipment, and copper exports at this place. As a fuel for the smelter, 5 million SCFD of natural gas would be needed, for which a gas pipeline from Sib could be a solution. The required electrical power of about 4 MW could be produced from gas as well. However, the economic justification of such a pipeline would have to be carefully considered.

106. Total investment for an integrated operation (3 mines, mill, smelter, complete supporting facilities, power station, town site, jetty, Muscat office and housing plus \$6 million for exploration, 18% contingency, and \$4 million initial working capital) is estimated by the mission at about \$120 million compared to the Plan assumption of \$140 million. An extended time horizon for the project's implementation would probably be required due to the time needed for planning, company formation, and infrastructure projects. Therefore, extraction of ore and production of copper may not be possible before mid-1980. Because the planned production rate seems to be on the low side and the proven

reserves are limited, the project should be studied further. In view of the limited reserves and marketing difficulties, the economic justification of this project needs to be carefully reviewed.

Other Minerals

107. Oman also has deposits of manganese, chromium, nickel and iron. Chromium in the form of chromite is found at many places throughout Oman; nickel, iron and manganese deposits are located in the Eastern Hajar Mountains west of Sur. The deposits are still in an inaccessible area but a road is nearing completion connecting Sur with the roads from Muscat and Nizwa to the South. Studies are underway. Further geological research is necessary, to determine reserves and quality of some or all of the above-mentioned minerals. Although the Government's list of industrial projects does not include any projects associated with minerals exploration, the mission believes that the Plan should allow for some exploration expenditure; the item "Manufacturing" in the Plan amounting to OR 15 and 20 million in 1979 and 1980 respectively may accommodate such expenses in the absence of clearly defined other manufacturing projects.

108. Iron ore found in Oman probably is of a low grade, and suitable for direct reduction only after blending with imported higher grade ore. A direct reduction and re-rolling project is discussed later in this report.

109. Throughout Oman, there are also huge deposits of limestone of good quality, suitable for cement manufacturing and for metallurgical purposes. Main deposits are located in the Muscat area, and near Sohar. Some minor projects need limestone, such as manufacturing of lime and sand blocks, earthenware sanitary products, and glass products. A lime bricks project costing about OR 5 to 6 million is being negotiated with Kuwaiti partners.

110. In the Hajar mountains, there are deposits of marble. Two quarrying projects are under preparation as well as a tile factory proposal based on local marble, with an annual capacity of 1 million tiles plus 4,000 m3 of marble.

111. Asbestos has been found near the copper ore deposits. Contrary to the findings of a 1970 Shell geological study, the Government, based on recent drilling tests, now reports asbestos of good fibrous quality found in four areas in Oman - the best one located West of Sohar. Preliminary results indicate reserves of 8 million tons of asbestos. A feasibility study prepared by Eternit was expected to be ready in January 1977. The asbestos cement project is under construction with a capacity of 31,000 tons per year and as an import-substitution project will benefit the booming construction sector. Financing of the project (4.2 million OR) which will be provided entirely by the private sector, does not include any allowance for asbestos mining. About OR 2 million each year in 1979 and 1980 should be included for financing of exploration and pilotproduction of asbestos. Roads and other infrastructure would also have to be provided as well as an expanded jetty at Sohar, probably in conjunction with the copper project. There is also under advanced study an asbestos fiber project at about OR 3 million investment cost.

112. Close to Sur, there are coal deposits, and the Government has initiated dredging. Preliminary results show an extraction potential of 10 million tons of anthracite-type coal, with low sulphur and low ash contents; no study is available yet. The mission discussed the possibility to use anthracite-type coal for manufacturing electrodes for aluminium and calcium carbide production. There is, however, neither a partner nor a study yet. Phosphate rock has been found in Dhofar and prospection is said to begin soon, but no details were made available to the mission.

III. OTHER MANUFACTURING INDUSTRIES

113. The Ministry of Commerce and Industries has issued an updated list (see Table 9.1) dated October 4, 1976, of all 51 industrial projects now completed or under consideration. At the end of 1976, there were only a few manufacturing plants completed or in operation, namely plants for producing flour, a dairy products plant using imported raw materials, furniture, aluminium, pepsicola, processed dates (two plants) and some minor undertakings such as an automatic laundry, a printing press, bakeries, and bottling of industrial gases. Total investment cost for these projects may be estimated at less than OR 5 million. Out of a total of 51 projects, about 13 projects are under construction, completed, or started up already; 3 projects are advanced, that is, under negotiation with private/foreign partners, or in the bidding procedure; for 11 projects, feasibility studies are available; and 24 projects are in a preliminary stage.

114. Some of these projects have private sector participation. Table 9.2 lists 27 investment projects with a major participation of the private sector, for which some information was available; about 16 other projects seem to be in such a preliminary stage that no information was available. At least 7 projects are under construction or startup, with total investment cost of about OR 11 million, private capital contributing almost 90% of the financing for these investments.

115. In the preceding paragraphs, some of the major industrial projects (as listed in Table 9.1) have already been described and commented on, e.g. LNG, oil refinery, copper, fertilizer, petrochemicals, desalination and power, asbestos fiber and cement. For many of the remaining projects, the paucity of information makes a detailed discussion difficult. There are three major projects; cement manufacturing, sponge iron, and re-rolling mill.

116. The Swiss firm CEMENTIA and APCM prepared a feasibility study on a cement factory in Oman. In spite of the many cement projects in the Gulf region, Oman is now considering a 1 million tons per year cement plant which would provide for substantial exportable quantities, replacing the 350,000 tons projects as originally proposed. If market prospects can be assured, an increase in the capacity compared to the original proposal may be justifiable and its feasibility is now being studied. The project would be located near the end station of the Yibal al Ghubra gas pipeline, and natural gas to the amount of about 14 million SCFD would supply the energy required for cement manufacturing, in addition to power requirements of about 24 MW.

117. A project for a direct reduction of iron ore, based on imported pellets using natural gas as a reductant, was developed together with foreign partners such as KORF (FRG). There are a number of competing iron and steel projects in the Gulf area. Certainly, the availability of "cheap" natural gas is a necessary but not a sufficient justification for a direct reduction project. The export market of sponge iron or products made therefrom needs to be thoroughly investigated before embarking on such a project.

118. A rolling mill would be based on steel to be produced from sponge iron in an electric furnace. Offers for partnerships have been received from various foreign steel companies and a study is available, prepared by the White Weld Group.

119. The investment costs for an integrated project are estimated at OR 34.4 million. Considering the constraints imposed by the lack of counter-part management in Oman, the project is not likely to be ready for implementation before 1978.

120. The White Weld Group together with businessmen, have proposed to create an "Industrial Area". The purpose would be, to provide sites and infrastructure to local and foreign investors. An area covering 30-60 hectares close to Ras Suwadi and to the sea, is under consideration. The project list (Table 9.1) includes a number of small-scale industrial projects requiring OR 1 million investment or less, such as the production of earthenware sanitary products, local marble, nails and screws, batteries, matches, footwear, tobacco products, vegetable oil, soap, soft drinks, industrial gases, and others. These projects will be carried out by local businessmen, and management and technological know-how would be provided by foreign partners where necessary. An industrial area may be instrumental for the implementation of these projects. The proposed Development Bank could be instrumental in helping small and medium scale industries.

121. The Government also fosters the development of a handicraft industry, by planning to implement four training centers for copper and silver, for pottery, for weaving and for traditional boats. Handicraft making of copper bowls is an old tradition in Oman, but without mechanization to produce pre-fabricated parts, this small sector of the economy could face difficulties. There is a Ministry of Inheritance, taking care of handicraft industries.

The Institutional and Legal Framework

122. Based on a management consultant's report, issued early 1975, the Ministry of Industry and Commerce, which employs 335 people, was organized along the following lines:

- (a) Industry: which had the following units: Planning (Project Study Department), Management and Control of Industrial Projects, Small/Medium Industry, and Quality control and standards.

- (b) Commerce: which is responsible for internal trade, foreign trade relations, department of companies, commercial register, supplies and marketing of fuel and fuel products.

123. Tourism: The focus of the Ministry is essentially on commerce and industry with an effort to persuade an essentially commercial society to develop industries to the extent possible. Tourism is given low priority and given the distance of Oman, the high cost of living and the labor shortages, the Government is well advised to have a low key approach to tourism at this stage.

124. There are four basic laws governing the industrial development: The Investment Law, the Commercial Law, the Company Law, and the Foreign Investment Law. The latter in its revised version, now provides for a minimum Omani share holding of 35%; more than a 25% participation is sufficient to change a company's rules or policy. Developing industries are being protected by a new law "Encouragement and protection of development of industry" which contains various incentives. Essential features of this incentive package are: (a) free access to feasibility studies undertaken on major projects at Government expense; (b) 5-year tax holiday on corporate income tax, provided the company was carrying out projects listed in the Development Plan; and (c) provision of free industrial sites in case of a joint company owned by Omanis and foreigners. In addition, companies can enjoy nearly zero duty for imports of all input materials, and liberal remittance of investment profits abroad. Under these incentive provisions more than 500 Omani companies and close to 300 jointly owned companies have registered as of October 1976, although most of them were small in size and concentrated in the business of domestic and foreign trade, handicraft or house-construction. The Government is also in the process of establishing a development bank with an initial capital of OR 10 million. In some cases, the Government is setting up companies under its own management and control, and at a later stage tries to sell parts (or all) of such companies to the public. An example is the flour mill which was under Government administration; recently the company structure changed and the Government now holds a minority share only.

The Five Year Plan - Overall Targets

125. The Plan differentiates between defined projects which "started" since 1975, or for which detailed studies are available, and financial allocations to sectors for which projects are not yet clearly defined. The public capital expenditures planned for industry are shown in Table 12.1.

Table 21. BREAKDOWN OF PUBLIC INVESTMENT IN INDUSTRIAL SECTORS
(OR Million)

Project	1976	1977	1978	1979	1980	Total
Oil Refinery	-	2	13	8	2	25
Gas Pipeline	5	8	4	-	-	17
Copper Project	0.3	10	14	-	-	24.3
Cement Project	2.0	2.3	-	-	-	4.3
Flour Milling	0.5	-	-	-	-	0.5
Miscellaneous Industries	0.1	4.8	5	10	15	34.9
Total	7.9	27.1	36	18	17	106

126. There have been delays in some of the major projects shown in the above table e.g. cement and copper, compared to the planned dates of commencement. Consequently, actual expenditure may be lower than expected during the Plan period. However, some of these shortfalls are likely to be made up by other investment if funds are available. Also, since many of the projects in the miscellaneous category and other small projects are merely preliminary ideas, it is difficult to judge the realism of the forecast capital expenditures. In any event, the delays in the large projects are likely to mean a less sharp fall of investment over time, i.e. the investment in early years would be lower than forecast and higher in later years.

127. The Plan estimates value added in manufacturing in 1980 (1976 prices) of OR 36 million, including OR 5 million in natural gas and OR 6 million in copper, compared to a plan estimate of OR 2 million in 1976. This represents a very high rate of increase, although on a small base. In view of the delays in major projects that have already occurred, and the time it takes to prepare and implement manufacturing projects, such an increase in value added in the next four years is unlikely. Despite these considerations, however, if some of the projects discussed in the earlier paragraphs materialize value added in manufacturing will undoubtedly be a multiple of the value added in 1976.

128. The main constraints and problems hampering speedy industrialization will be the following. First, is the inadequate quantity and quality of management in all industrial activities. Considering the high cost for expatriates, extensive training must be initiated parallel to project studies and implementation in order to increase the number of Omani staff within a few years. There is a need for additional technical assistance, which in the industrial sector should concentrate on project preparation, training of middle-level manpower, especially technicians, financial accounting staff, and skilled workers (in-plant training and fellowships), and assistance in negotiating contracts with potential partners, and equipment suppliers. However, despite all efforts, the reliance on expatriate management, skilled and unskilled labor will continue. Due to the relatively high wages paid in Oman, foreign labour from

India, Pakistan and other countries will continue to be attracted. Secondly, although some of the projects on the Government's list may not materialize, there is a danger of too many projects being considered, which may overtax the limited project implementation and management capacity. A carefully phased investment program, with concentration on a few high priority projects at any time would be desirable. A third problem may be the concentration of most activities in the Muscat area. Therefore, the copper project near Sohar, mining projects near Sur, and a sugar refinery and others should receive priority attention. A major problem is the limited domestic market for manufactures other than simple consumer goods. Consequently, great attention will have to be paid to export markets and the cost competitiveness of industrial production. In this context, regional cooperation among the Gulf States to avoid duplication in production of some goods would greatly facilitate in ensuring markets and help in setting up economic size plants. In February 1976 an agreement was signed in Doha to establish a Gulf Organization for Industrial Project Studies, with an advisory role for regional cooperation.

CHAPTER ELEVEN

POWER

I. PAST TRENDS AND GROWTH

129. In 1970, the public power system in Oman consisted of scattered relatively small diesel generator sets. The larger portion of these generators (2.2 MW) supplied a small grid in the capital area which included Muscat, Mutrah and Ruwi (Table 9.4). The rest (a set of small unconnected diesel generators of combined capacity of 2.13 MW) supplied the city of Salalah in the region of Dhofar. Several privately owned small generators were also operating throughout Oman at the time. These were owned by either the Petroleum Development of Oman (PDO), hospital or military installations. Their surplus electricity was sold to domestic and commercial consumers that were not connected to the public grid. For example, between 1969 and 1976 PDO's sales were approximately 0.5 GWh per year (Table 9.6).

130. The public generating capacity in all parts of Oman experienced an average yearly rate of growth of approximately 62.5% (from 4.3 MW to 137.3 MW) between 1970 and 1977 because of the increased economic activities associated with the oil revenues. In the capital area, installed capacity had an average yearly growth rate of 76% (from 2.2 MW to 115.3 MW), while the installed capacity in the city of Salalah had an average yearly rate of growth of approximately 70.5% (from 2.13 MW to 22 MW). In addition, the rural electrification program had by the end of 1976 electrified 6 villages or towns with a total combined installed capacity of 8.22 MW. Concurrently, the transmission network has also been expanding where the following capacities were added: (a) 40 kilometers

of 33 kV double line between Riyam and Sib; (b) 5 kilometers of 11 kV single line in the capital area; and (c) 30 kilometers of 132 kV double circuit lines from Ghubrah to Sib; and (d) 20 kilometers of 32 kV in the city of Salalah.

131. Since 1970, the economic development efforts of the Government and the growth of the private sector led to an unprecedented surge in infrastructure projects and commercial activities. Consequently, the demand for electricity in the capital area increased, where the average yearly rate of growth in the electricity sold to all customer classes was equal to approximately 74% (from 6.7 GWh to 188.1 GWh) between 1970 and 1976. Between 1970 and 1976 the yearly rate of growth of electricity consumption by the domestic customer class and the industrial customer class was equal to 69% (from 6.7 GWh to 157.7 GWh) and 79% (from 2.9 GWh to 30.4 GWh) respectively (Table 9.7). Meanwhile, the number of domestic customers connected had an average yearly rate of growth of 109%.

II. ORGANIZATION

132. The electricity subsector falls under the administrative jurisdiction of the Ministry of Communication (MOC). The general directorates of electricity for the capital area and Dhofar are two of several directorates that are managed by MOC. The manager of the electricity directorate for the capital area reports directly to the Minister.

133. The Directorate General of Electricity (DGE) for the capital area is divided into three divisions: (a) the administrative affairs division; (b) the financial affairs division; and (c) the technical affairs division. The administrative affairs division coordinates all of the directorate's affairs with the exception of the financial and technical matters. The financial affairs division, divided into five units is responsible for general accounts, salaries, accounts receivable, purchases and inventories. The technical affairs division, divided into ten units, is responsible for the daily operation of the system in the capital area.

134. The technical staff of the directorate are all expatriates with the exception of two engineers. Staffing of the electricity directorates is inadequate relative to the size of the northern system (the technical division has a total of nine engineers including the shift engineers). The scarcity of technical staff is due to two factors: The first is the directorates' inability to attract and retain technically competent expatriate staff because of the low salaries and benefits offered by the Ministry relative to the other sources of employment in the Gulf area in general and Oman in particular. The second is that the Omani engineers (small in number and consequently highly demanded throughout the economy) are usually employed by both the private and public sectors in high administrative rather than technical positions.

135. Although the present organizational structure of the subsector and the creation of the development council was implemented to achieve tighter control, higher degree of coordination and more intensive and efficient use of the scarce skilled staff, and the Minister of Communication is a member of the Development Council, there would be need for strengthening coordination at the technical staff level between MOC and the Council.

136. Exact details of the power requirements for projects are revealed to the technical affairs division sometimes at too late a stage, when projects are at their final stages of completion. This imposes severe difficulties on the operation of the system because changes during implementation usually alter the projects scale, its power requirement and possibly its geographical location.

III. DESCRIPTION OF THE EXISTING SYSTEM

137. Oman's power subsector is divided into three principal unconnected systems; namely the northern system, the southern system and the rural system. The capital area and its adjacent palace are provided with power from the northern system. The southern system supplies the power requirement of the city of Salalah and its surrounding area in the region of Dhofar. The rural system will be composed (1978) of 26 villages and small cities supplied by diesel generators at the site. In March of 1977 the installed capacity of the northern and southern systems was equal to 110.3 MW and 22 MW respectively (Table 9.3). In addition, a system consisting of 4 generators with a total installed capacity of 1.7 MW is operating in the Island of Masira. The Masira system was constructed by a German firm and has been operated since its commissioning in 1976, by an American firm (Globe Chemical Systems) under a contract agreement with MOC. A power plant that exclusively provides the power requirements of the military and consists of four generators of undisclosed capacity is also in operation in Oman.

The Northern System

138. The northern system is comprised of two generating plants of Riyam Bay and Ghubrah and the transmission and distribution network around the capital area including the palace (Table 9.4).

- (a) Riyam Power Station. Riyam power plant was constructed in two stages known as Riyam A and Riyam B. Riyam A consists of the first six diesel generators installed. These are of different rated output ranging from 1.1 MW to 5.0 MW and a combined rated voltage of 11-kV. Riyam B is composed of three diesel generators that were installed since 1974. The three generators have a uniformly rated output of 6.7 MW each and a rated voltage of 11-kV.

- (b) Ghubrah Power Station. The Ghubrah power station is a combined power and desalination plant. It consists of four steam units with a combined installed capacity of 67.9 MW. Presently three of these generators (27.9 MW) are in full operation. The fourth unit (50 MW) has been in operation since mid-March 1977 at less than its full capacity (40 MW). Ghubra is a dual-fired type plant that can operate on either oil or gas. Since its commissioning it has operated on diesel oil until recently (June 1976) when it was switched to Omani produced crude oil. The plant will be fueled by gas when the gas pipeline is completed. On the average Ghubra's output constituted 36.5% of the total energy produced by the northern system in 1976 and 62.8% of the output of the first quarter of 1977.
- (c) The Transmission Network. The transmission network in the capital area is comprised of three principal load centers which are the western grid serving the Ghubrah airport area and the Seeb palace; the Eastern grid serving Medina Qabous, Falag and Ruwi all located in the capital area but referred to as cities; and the Muscat grid which serve the cities of Muscat and Mutrah also in the capital area. The Eastern and Muscat grid are each connected to the Riyam Bay station. The Eastern grid is connected by 33-kV overhead double line while the Muscat grid is connected by an 11-kV overhead double circuit transmission line. The Ghubra generating plant is connected to the Western grid with a 132-kV overhead double line and to the injection point (which is between and connected to both the Western and the Eastern grid) with a 33-kV overhead line. MOC is in the process of constructing a 132-kV double line linking the Ghubrah generating plant to the Eastern grid. Implementation of the plan was delayed because of disagreements within the Ministry over the location of the point of connection to the existing network. Some supported the view that the connection should be directly to the grid, while others preferred the connection to the existing injection point between the Eastern and Western grids. The 132-kV line is being constructed according to the preference of the first group.

The Southern System

139. The bulk of the southern system's installed capacity is situated in the city of Salalah. It will be comprised of six diesel generators with a heterogenous rated output and an expected total installed capacity of 28.8 MW. Five of these generators are currently operating with a total installed capacity of 22 MW. The sixth generator (6.8 MW) is being installed and will be commissioned in September of 1977. A 33-kV network and an 11-kV ring are used to transmit power in Salalah.

The Rural System

140. The rural system is administered directly by the Ministry of Communication. By mid-1978 the system is expected to encompass twenty six villages. The rural system is divided into five regional areas. The villages and towns scheduled for electrification are a part of an overall rural development program. The villages in Phase I of the rural electrification program were chosen because of their relatively large population size.

141. At present (April 1977), the generation and distribution systems of ten villages towns have been completed (Sur, Nizwa, Sumail, Beya, Al Buraimi, Ibri, Sohar, Al-Khabura, Sahem and Al Rustaqa), yet none is in operation because of the lack of technicians and engineers. MOC has been trying to acquire the services of expatriate engineers to operate the rural system, but its efforts went unrewarded. The principal obstacle to MOC success is the harsh living conditions involved with the employment offered. Global Chemical Systems (the same U.S. firm currently operating the system in the Island of Masira) has signed a two-year contract (March 1977) with MOC to operate and maintain the electric systems in the ten villages. Another contract is being considered with the same U.S. firm for the operation of the rural system which will include all the villages in Phase I (26 villages). The contract calls for the operation of the 26 systems, the construction of housing facilities for the staff and the drilling of water wells (to be used as engine coolant). The contract, when in effect, will be for four years and will cost the Oman Government about OR 45 million (which seems unusually high).

Autogeneration

142. At present, there is a substantial autogenerating capacity (76 MW) as compared to the existing public capacity in the capital area (115.3 MW). The growth in demand for autogeneration was due to the slow growth of the public power system to keep up with the increase in domestic demand and the poor standards of reliability caused by the inadequate transmission and distribution facilities. In terms of its total installed capacity, privately owned autogeneration is expected to increase from approximately 36 MW to 109 MW between 1976 and 1980 (Table 9.8). PDO will continue to represent the largest single autoproducer in Oman (36 MW in 1976). Its sales of power to domestic customers have been at a steady yearly rate of 0.5 GWh between 1971 and 1976, which is expected to continue well into the 1980s. The average rate charged by PDO per kWh sold is 15 Bizzas (\$0.044).

IV. TARIFFS AND FINANCIAL ASPECTS

143. Electricity rates are determined by MOC in consultation with the Ministry of Finance. However, changes in either the level or structure of rates must be approved by the Ministry of Finance. A uniform rate of 20 Bizzas (\$0.059) per kWh consumed is currently being charged by DGE. The rate is invariant to either time of consumption or customer class. Revenues from the sale of electricity are collected by the electricity directorates' in both

the capital area and Salalah and MOC for the rural system (when in operation). All revenues are in turn forwarded to the Ministry of Finance and constitute a part of the Government's general sources of funds. The yearly operating capital of the directorates are determined by the Ministry of Finance in consultation with the Ministry of Communication. Their budget does not bear any relationship to the revenues collected in the preceding year(s).

144. Until the gas pipeline is completed in 1978 and given the existing rate per kWh, the production of electricity imposes an unwarranted economic cost on the economy of Oman because tariffs are not based on the opportunity cost of providing power. The rate of 20 Bizzas (\$0.059) does not cover the average incremental cost (from a marginal costing point of view) of supplying power. In its efforts to extend electricity to all its citizens and public projects, the government absorbs the difference between the incremental cost of producing an extra kWh and the rate paid for it by the consumer.

145. When the gas pipeline is completed by mid 1978, the existing tariff of 20 Bizzas might cover the incremental cost of producing electricity because of the substitution of domestic gas for diesel and crude oil in generating electricity. This will depend on the capital cost and efficiency of the blocks of capacity to be added during the planning period considered in the formulation of a tariff policy. The dependency of cost recovery on the capital cost of future additions is dictated by the fact that the government had decided to set the future price of gas at the equivalent of one half of the international oil price, that is, at the current price of \$13.20/bbl of crude oil, the price of gas would be \$1.32/MSCF. Independent consultants (TETRATECH) have estimated that the total production cost of the gas (including transportation, field installation and receiving stations) will be equal to \$0.50/MSCF (expressed in 1976 dollars). The gas pricing policy proposed has economic merit, if this price will be maintained in order to foster the growth of income generating industrial projects. The same price may not be desirable for commercial consumers and the non-essential segment of domestic consumption.

146. The failure of the tariff policy to differentiate in its structure between customer classes is principally responsible for the magnitude of the financial burden borne by the government. The existing rate is uniform irrespective of the end uses to which electricity is put, i.e. lighting, air cooling, manufacturing, etc. Since 1970, air cooling evolved as one of the benefits offered to attract and retain qualified expatriates and emerged as a symbol of prosperity for the urban poor. The economic cost of the incremental capacity maintained for air cooling can be appreciated by considering the difference between the summer and winter peak loads, where in 1976, the summer peak loads were more than 3 times the winter peak loads resulting, in part, in an annual load factor of less than 30% (Table 9.5). The cost imposed on Oman in providing this capacity is equal to the difference between the revenue foregone by not imposing a seasonal (summer) capacity charge and the segment of the revenue collected by charging the flat rate on the basis of kWh consumed. This difference could partly finance systems expansion.

147. The integration of a capacity charge in the tariffs coupled with the establishment of a lifeline level of consumption for the urban poor could serve several purposes in the short run:

- (a) Meet the Government's objective of providing cheap electricity to the poor because of the lower rate associated with the lifeline level of consumption.
- (b) Curtail the rate of growth of demand for electricity particularly by the urban poor and generate additional revenues from those who can afford it.
- (c) Reduce the pressure for system expansion by delaying the date for commissioning the next block of capacity or by allowing the excess capacity in the existing system and any additions to it to be used for the partial absorption of autogeneration.

148. If no change in the level or structure of tariffs is desired by the policy makers, the difference in the peak demand for capacity between the two seasons could be used to reduce Oman's import of diesel. The existing autogeneration could be connected to the public grid and refrain from generating electricity during the winter season. In the summer, when the public system experiences capacity constraints, autoproducers could operate their respective systems. This would result in the improvement of the load factor of the public system and savings stemming from the use of domestic crude (gas in the future) instead of imported diesel to generate electricity in the winter season. The size of the existing autogeneration has some implication on the optimum investment policy for public power system expansion which will be discussed under the section devoted to future developments (para. 156).

149. The organization of the subsector and financial control under which it operates have some adverse impact on the fiscal performance of the directorates. The absorption of the revenues collected from the sale of electricity into the general Government revenues and the control of the Ministry of Finance over its inflow into the directorate, distorts the entity concept necessary for the operation of a utility. Consequently there is an absence of both a success indicator and a measure of efficiency at the directorates' level which destroys the incentive for both improvement and innovation in the operation of the system.

V. LOAD FORECAST

150. Load forecasts are produced at the ministerial level within the Ministry of Communication. Each takes DGE's forecast of the demand of connected and new customers as their point of departure. In order to produce MOC's load forecast, the electricity consultant of the Ministry (a full time system operation specialist retained as a permanent staff member of the Ministry) integrates DGE's forecast and the new large loads anticipated by

other ministries and the national economic plan. MOC's forecast makes no distinction between customer classes. It only addresses the maximum possible load that could be imposed on the system as a whole with no reference to the time and duration of customer peaks. The forecast for the capital area (Table 9.10) assumes an average rate of yearly growth in demand for capacity of approximately 47% between 1977 and 1980.

151. Because of its load forecast, MOC is expecting a shortage of capacity in the northern system by the summer of 1978, if the installed capacity is not increased. The decision to increase the capacity will await the recommendation of a consultant's study (financed by a \$1.5 million loan from the Bank). The first task in the terms of reference of the study requires the consultants to assess the immediate power needs of the northern system, determine the least cost alternative (as a part of a forthcoming overall investment plan) for meeting that need and provide the specification for any equipment that might be required. There are no detailed indications in the five-year economic plan (Table 9.9) of the magnitude of the new capacities to be added, except an allocation of OR 28 million over the Plan period to be spent on electricity projects in the Capital area.

152. It is possible to consider three situations for a forecast till 1980: (a) a high growth forecast which is based upon the trend line from 1971 and yields a yearly rate of growth in the demand for capacity of 55.7%; (b) an intermediate growth forecast based on historic data but constrained by 1977's rate of growth which gives an average rate of growth in capacity demand of 32%; and (c) a low growth forecast that is targeted to a 10% rate of growth in 1980 and produces an average yearly rate of growth of 21%. Under all assumptions and unless the yearly growth rate is less than 20%, the capital area would require a new block of capacity by not later than the end of 1980 (based on demand for capacity of 75 MW for 1977). The assumed rates of growth and the dates for the shortages of capacity under the assumption of a 115.3 MW and 165.3 MW installed capacity are summarized below:

		<u>Assumed rate of growth of demand for capacity</u>		
		55%	32%	21%
No additional capacity between 1977-80	System installed capacity of 115 MW	'78	'79	'80
50 MW generator added in 1978	System installed capacity of 165 MW	'79	'80	'81

153. Forecasting the load growth in the capital area is difficult because of the unprecedented increase in the domestic customer demand for electricity both in absolute terms and on a per capita basis. The rapid migration of the population from rural to urban Oman raised the expectation of the population and resulted in the average electricity consumption reaching levels that are inconsistent with the levels of frequently used economic indicators such as

personal income, gross national product, etc. The forecast of electricity consumption is difficult because of the expectation element which is highly correlated with the past performance of the economy rather than the current or future performance.

VI. FUTURE DEVELOPMENTS

154. The five year plan includes OR 44.20 million for the period 1977-1980 of which OR 19.20 million was allocated in 1977 (probably in the installation of the fourth generator at Ghubra). The balance of the investment program is for electricity projects (no specifications are available) around the capital area (Table 9.9). The investment in electric networks outlined in the plan refer to the work currently under construction that involves the transmission and distribution systems in the capital area. The work in progress is as follows:

- (a) construction of a distribution substation (costing \$800,000) to be commissioned by the end of 1977 (2 x 10 MVA transformers and five feeders with 1,000 MVA);
- (b) a 33-kV line (6 kilometers) from Ghubra to Kouran;
- (c) a 33-kV line (15 kilometers) from Ghubra to Madina Qabous;
and
- (d) a double circuit 132-kV line (20 kilometers from Ghubra to Ruwi.

The two 33-kV lines are provisional because they are built to deliver some of Ghubra's power to the heavy load centers in the capital area until the 132-kV line from Ghubra to Ruwi is commissioned.

155. MOC has a tentative plan to add a fifth steam unit (50 MW) at Ghubrah, but this cannot be installed in time to meet the forecast 1978 summer demand. It is difficult to determine whether it can be accommodated (without sacrificing other projects) because no information on the extent of cost overruns of projects already completed is available. GDE will await the engineering consultant's recommendation on the least cost alternative by which the demand in 1978 can be met.

156. Since Oman has a significant amount of autogeneration (76 MW) relative to the capacity of the northern system, the future blocks of capacity to be added should be significantly larger than required for meeting the demand of existing and new consumers over the planning period in order to gradually absorb the autoproducers into the public system. The rate of the absorption would be determined by the yearly excess capacity available. Consequently, the rate of capacity utilization would increase over the planning period in addition to the savings in the import of diesel by substituting the use of gas (See Chapter 10).

157. Because of Oman's proven reserves of gas, its economic development should carefully consider the scope for gas based chemical industries and fuel intensive industries. The development plan should have considered a comprehensive investment program aimed at upgrading the quality and increasing the capacity of Oman's power system. Meanwhile, because of the potential for possible water shortage in the future, desalinated water should be studied as an option in planning for future water supplies. Therefore, power system development planning and, in turn, development planning should also include consideration of desalination because of the potential for joint investments. The joint water/power investment plan would need to give the dates for commissioning new block of capacities and the magnitude of their associated investments.

158. The Government in its pursuit of social justice implemented Phase I of the rural electrification program. The approach adopted in electrifying the 26 villages follows the conventional wisdom of comparing the cost streams associated with two alternatives: the cost of providing electricity to each village from the public grid and the cost of providing the same amount of electricity through a small diesel generator placed at the site. Because of the distance involved in extending transmission lines, the limited system capacity in the capital area and the relatively low rate of forecasted demand by the rural customers, the local power supply alternative was selected. However, if the future shadow wages of the expatriate skilled labor required to man the small system were considered in the analysis, the isolated systems alternative might be rejected. Some benefits that were associated with the centralized generation system were not considered. These were:

- (a) The ability of the entire system to be operated centrally, consequently requiring a smaller number of expatriate skilled labor who in turn can train a small number of nationals to take over the system.
- (b) The potential for future extension of electricity to other villages that are located close to or on the path of the transmission lines. This would have decreased the capital cost per kWh sent to the rural system while increasing the average revenue collected because of increased sales, and consequently improving the rate of return on the investments in the rural electrification program.
- (c) In the case of Oman, the use of non-associated gas or even domestic crude at a central generating plant (for example Ghubra) is less costly than the imported diesel oil.

159. Considering the proposed cost of running the rural system of 26 villages for four years of OR 45 million, that sum would finance a 10 MW central generating capacity and 400 km of 115 kV. The centralized alternative compares favorably with the cost of the contract under consideration by MOC because the cost of the former is distributed over at least 25 years.

CHAPTER TWELVE

TRANSPORT

160. Prior to 1970 the demand on the transport system was limited. The bulk of marketed products moved only short distances within the range of donkey transport. A few products were carried over longer distances but the flow was small and much of this traffic was carried along the coast by dhow. The transport requirements of the oil sector, even by 1970, were considerable but they were largely self contained within the operation of Petroleum Development of Oman (PDO), the concessionnaire. Nevertheless, the search for oil not only put the vast, essentially unchartered area of inner Oman and Dhofar on the map, but more and more vehicles were introduced to bring supplies to the oil camps, more and more trails became rough roads, then graded roads and finally, a few asphalt roads. Besides the direct stimulation to transport demand engendered by the oil sector, oil provided the needed funds for development and, in 1969 the investment program included a new port at Mutrah, a start in modern road construction, and an international airport.

Road Transport and the Road System

161. In 1970 there were only 10 km of asphalt surfaced and 1,847 km of graded road in all of Oman. There were only 1,000 motor vehicles and most of these belonged to the Armed Forces or PDO. Initially, most of the vehicles were, of necessity, four-wheel drive as this was essential for operating over many of the unpaved tracks and wadis (dry river beds) which dominated the roads.

162. By 1976 the paved road network had been expanded to 1,272 km of paved and about 8,500 km of graded roads. This change was reflected in the composition of the vehicle fleet which, by the end of 1976, exceeded 44 thousand vehicles. At that time the formerly ubiquitous four-wheel drive Land Rover was being replaced by light trucks in the country and passenger cars in the urban areas so that it no longer was the major type of vehicle in the fleet.

163. At the present time most of the basic road network is in place or under construction, designed by foreign consultants and built by foreign contractors. The paved road network averages only a little more than two years in age and only 10 km of paved roads is as much as seven years old. Since almost all the paved roads remain under warranty for a year after completion, maintenance of the paved road network, to this point in time, has not been a problem and probably will not be a problem in the immediate future. However, as the Directorate of Roads (DR) which is responsible for the maintenance of the Oman highway system, does essentially no routine maintenance on the paved network, it is essential that provision be made now for such maintenance in the future. Equally important, the DR program of routine maintenance on the unpaved network needs significant improvement to protect the investments already made and to keep road user costs at a reasonable level.

Ports

164. Oman has a number of natural harbors including the historically important ports of Muscat and Mutrah. However, until the construction of Port Qaboos at Mutrah between 1970 and 1975, the country had no port with deepwater berths. Cargo discharged at Muscat (general merchandise) or nearby Mina al Fahal (oil company cargo) was offloaded onto barges and then moved to small jetties. Heavy cargo was discharged "over the beach" at Mutrah, something no longer possible because of a road constructed along the beach.

165. Port Qaboos, protected by a 700 meter breakwater, has a navigable channel dredged to 11 meters. The port has 11 berths, 10 transit sheds, a cement silo and is to have a grain silo and fish canning facilities. The port has a theoretical capacity of some 1.5 million tons of cargo per annum and in 1976 handled 1,178,400 shipping tons of cargo (of which all except three tons were imports).

166. The old port of Muscat still services dhow traffic, which now may be on the order of 30 to 50 thousand tons annually. The PDO port at Mina al Fahal serves as the export terminus for Oman's oil and in 1976 handled almost 18 million metric tons of petroleum, as well as 35,000 shipping tons of cargo for PDO. 222,000 shipping tons were handled at Raysut (Salalah) in Dhofar Province, a "new" port essentially completed in 1975 which is now being expanded with nine deepwater berths which will give it a capacity of about 1 million tons per annum.

167. Southeast of Muscat, where the Gulf of Oman joins the Arabian Sea, lies the port of Sur, once the main link to Zanzibar, when it was under the Sultanate, the Persian Gulf and India. Now only a few dhows stop at Sur which has only natural berths and no facilities. Some building of dhows continues in the Sur area, which are used primarily in the coastal trade and still provide a major transport link to Dhofar Province.

168. Although the Port of Mina Qaboos is moderately congested at the present time, reflecting the general import boom in the Middle East, this can be expected to lessen both as a result of the boom "topping out" and because of the vast investment being made in port infrastructure all through the Gulf. The present expansion of the port of Raysut in Dhofar will provide excess capacity for that province in the immediate future.

Civil Aviation

169. Although civil air transport is still in an early stage of development in Oman, the climate and subsoil of the country provide numerous natural landing places for light aircraft. Primitive airstrips, most with no more than some stones marking the runway and a windsock, exist in all parts of the country including some in otherwise inaccessible points in the mountains. Regular domestic service is limited to flights between Muscat and Salalah. The military provides irregular but fairly frequent service on a "space available" basis to Khasab, Sohar, Buraimi, Nizwa, Sur, Masirah and Salalah.

PDO provides air service for its staff to the various oil installations. Total domestic air traffic is modest, amounting to perhaps 25,000 passenger movements between Muscat and Salalah and a few thousand more on non-scheduled and military flights per year. Nevertheless, this represents a significant increase over levels of just a year or two ago.

170. Seeb International Airport, 32 km west of Muscat, opened in September 1972. With a runway 3,000 meters long the airport can handle B747 as well as other large airplanes. In 1976, 323,700 passengers were handled at Seeb as well as 12,621 tons of cargo. The airport has adequate capacity for current traffic although some expansion in repair facilities and hangar space probably is desirable.

171. Railways. There are no railways in Oman and no railway construction is planned or likely.

Transport Policy and Planning

172. Transport policy and planning have been essentially on an ad hoc basis. This is not surprising given the short history of modern transport development. When funds became available the Government put a high priority on the development of transport infrastructure and used foreign consultants and contractors to design and construct highways, ports and airports. Many of the investments were obviously high priority items, essential to the development of Oman. Other investments in transport infrastructure may have been premature, especially as to scale. All tended to be expensive, not only because of the special conditions that existed (contractors had to import even some unskilled labor, there was no back-up infrastructure or local construction industry etc.) but because of the sudden surge of construction activity, not only in Oman but throughout the Middle East. Oman probably also paid high prices because of its inexperience in procurement procedures.

173. Equally critical is the question of maintenance. As construction of modern transport infrastructure really only began at the beginning of this decade, there is no past experience in the maintenance of such infrastructure. The DR, for all practical purposes, is less than four years old. Further, it is not fully staffed, with many of the positions especially at the higher levels not filled and others filled by expatriates.

Organization

174. The Ministry of Communications is the agency with overall responsibility for the transport sector. The DR has direct responsibility for planning, construction and maintenance of the road network. However, because so many senior posts are vacant the formal organization of the DR remains only a theoretical scheme. The actual working organization is a good deal simpler since the DR now only has three actual operating divisions; Maintenance, Mechanical and Administrative. The Maintenance Division functions quite independently. The Mechanical Division, being situated in the capital area, is in fairly close DR contact, and under fairly close control, of DR headquarters. The Administrative Division functions as the administrative staff

of DR and is located in the new headquarters office in Muscat. The division is logically divided into four sections: Records, General, Personnel and Accounts.

Planned Capital Expenditures on Transport

175. Oman's Five-Year Development Plan projects a total capital investment on transport infrastructure of OR 223.3 million (US\$647.6 million) over the period 1976 through 1980. Of this total almost 73 percent (US\$471.5 million) would be invested in roads, about 19 percent (US\$122.1 million) in ports and just over 8 percent (US\$53.9 million) in airports. Most of the investment (80 percent or US\$518.5 million) is scheduled for the first three years (1976 through 1978) of the program, reflecting the fact that the major part of the basic transport infrastructure is now in place or under construction.

176. The major transport projects now underway include the new Muscat-Mutrah road, the Bidbid-Sur road and the Mutrah-Quriyat road, as well as the port Mina Qaboos grain silos, expansion of Raysut port (just getting underway) and the Salalah airport. Projected transport projects include a number of mountain roads in the southern region, secondary roads in the interior, improvements to Sur and Sohar ports and improvement works to Seeb International Airport.

177. While the Plan details projected capital expenditures there is practically no information on recurrent expenditures. These are shown only in the aggregate for all sectors with an approximately 12% yearly increase projected. In the past current expenditures for transportation and communication have grown rapidly, from OR 0.3 million in 1971 to 2.2 million in 1974. Provisional data indicate a sharp, and unexplained, drop to OR 0.9 million in 1975. More detailed data are available for at least the current expenditures for the Directorate of Roads which indicate an equally rapid growth of recurrent expenditures during the four years (1973-1976) that the D.R. has been fully operational. However, like almost all governmental agencies in Oman, the D.R. only prepares its budget on a yearly basis and has no longer term projection of recurrent expenditures. Given the rapid growth of the transport system generally, and the highway network in particular, and that the development has been largely on an ad hoc basis, the lack of longer term budgeting is understandable. However, for the future every effort should be made to prepare longer term budgets, particularly since maintenance needs will become increasingly important.

CHAPTER THIRTEEN

CONSTRUCTION

178. Construction has been a major economic activity in the seventies as 80% of Oman's development expenditure since 1970 were devoted to infrastructure. The largest proportion went to transport schemes including roads, airports and ports (30% of total), followed by public utilities especially electricity and water (16%), and Dhofar development which was virtually all infrastructural (13%). The construction work has been mainly performed by foreign contractors and most materials, capital goods, and most of the labor have been imported, constituting a heavy drain on Oman's foreign exchange resources. Moreover, the private sector has also been very active and its construction of commercial premises and residential housing has been expanding at a fast rate. The Government has also been involved in several housing projects, the main one being Qaboos city (a new town 15 kms west of the capital) and has been extending generous assistance to civil servants in the field of housing. Construction has also benefited from the sharp increase in commercial bank credit facilities made available to it.

179. The share of construction in GDP increased from 10% in 1970 to 14% in 1973. In 1974, the construction sector experienced a substantial expansion (142% in current prices), fuelled by the increase in Government and private sector spending. However, its share in GDP was reduced to 10% because of the sharp rise in oil prices. In 1975, its share in GDP went up to 12% and value added in construction rose by 54%. The growth in construction activity slowed down in 1976 reflecting the completion of some of the Government's major infrastructure projects and the emergence of vacancies in rental units for the first time since 1970. As no data exist on either construction permits and completions (measured by area or value), or breakdown of construction as between industrial, commercial and residential units, it is possible to make statements on construction activities only in general terms. According to available data, it is estimated that between 65% and 75% of gross domestic fixed capital formation has gone into construction activities during the past six years. Expansion of the sector has not been without inefficiencies in management and cost-effectiveness and the Government's facilities for monitoring construction have been inadequate.

180. The construction sector has dominated non-agricultural employment. Preliminary results from the 1975 employment survey indicated that total employment increased from 35,000 in 1970 (20,500 Omanis and 14,500 expatriates) to 93,000 (28,000 Omanis and 65,000 expatriates) of which no less than 75,000 or 81% were employed in the construction sector. The survey also suggested that of employees in the construction industry only about 19,000 or 25% were Omanis, the majority of which were unskilled whereas less than 5% of the expatriates were unskilled. It indicated that between 1972 and 1976 wage rates for all categories of construction workers increased by over 40%. However, since late 1973 the wage rates for Omani laborers have increased by over 20% whilst the rates for expatriates have risen by only 10%.

181. Until recently the construction sector was heavily dominated by foreign construction firms, but the number of domestic and joint firms have in the past two years expanded rapidly. Public works projects initiated by the Government are first offered to the domestic firms for execution and only afterwards to the foreign firms. There has been a proliferation of small construction contractors and no specific regulations exist to govern their activities.

182. Demand for building materials has been largely met by imports. Cement, steel and wood, have all been imported while most crushed stone, concrete aggregate (gravel and sand) have been supplied domestically. Imports are only recorded by value and not by quantities and some imports are not recorded at all including imports by Government departments, by contractors implementing certain Government projects, and materials imported through Port Raysut in Dhofar. Imports of cement increased from OR 1.5 million in 1973 to OR 7.4 million in 1975, fabricated and finished building materials and structures of iron, steel and aluminum from OR 1 million to OR 6.5 million, bricks and tiles from OR 0.3 to OR 1.5 million and wood from OR 1 million to OR 2.6 million in the corresponding period. Even some gravel crushed stone, limestone and sand had to be imported.

183. Provisional figures produced by the National Statistical Department (NSD) indicate that the cost of construction materials has risen by nearly 90% since December 1972, but has fallen by about 30% since a peak reached in September 1974. NSD has also developed a tentative index of the cost of construction which although crude suggests that the cost of construction increased by more than 100% between December 1972 and September 1974, but subsequently fell by about 20%. However, the cost of house building increase by about 15% between March 1974 and March 1976 1/.

184. Although in the Five-Year Plan, there is a shift towards income-yielding projects, infrastructure still accounts for the bulk of investments (60%) with economic infrastructure (26%), housing and construction (24%) and social infrastructure (10%). A total investment of about OR 814 million is forecast in the Plan for the construction component of projects of which about 82% is in the public sector. Private sector investments are to gradually increase from OR 25 million in 1976 to OR 33 million in 1980, principally in private residential and commercial building. As a result of this decline in total outlays on infrastructure it is estimated that value added in construction will decline by about 35% between 1976 and 1980, but will still maintain its importance as the second largest sector contributing about 6% of GDP at current market prices.

185. The capacity of available construction resources, including foreign, joint, and domestic construction firms now working in Oman appear adequate

1/ Cost per square meter of first class construction in the Capital area amounted to about OR 60 in 1970-71; OR 100 in 1972-73; OR 120 in 1974 and OR 150 in 1975-76. In the interior it is higher.

to execute the projects currently envisaged in the Plan. The cut-back in construction investment forecast in the Plan should result in decreasing participation by foreign construction companies. The decrease in planned infrastructure investment by the Government is likely and commendable, while the suggested rising level of private sector investment in construction may not materialize as there is already some surplus of apartments. The expansion of port facilities on the one hand, and overstocking by merchants on the other, will ensure the availability of building materials at competitive prices and reflect trends in world prices. The planned cement plant will be more than adequate to supply domestic needs.

186. The most significant impact to be expected is a reduction of employment in construction starting towards the end of 1977, when most of the ongoing larger projects are completed. NSD projections of employment indicate that employment in construction will be reduced from 75,000 in 1976 to about 48,500 in 1980 (35% decline). Since expatriates account for no less than 75% of total employment in this sector, the reduction may have only limited domestic social consequences. However, as most Omanis employed in construction are unskilled, the impact of reduction of activity could affect them directly unless appropriate measures are taken to improve their skills. If a large number could be trained, it is estimated that the number of employed Omanis in this sector could very well increase by more than 50% to 29,000 and account for about 60% of all laborers in this sector. Another aspect that may have a significant impact on employment of Omanis in construction is related to the geographical distribution of projects which will take place as more projects will be implemented in the interior and southern regions.

187. The rapid increase in construction activities may have led to declining efficiency due to the limitations and inadequacy of Government facilities to effectively monitor construction activities. The Government needs to increase its supervision of construction firms and introduce regulations for the industry, train building inspectors and impose penalties or sanctions for non-compliance with contractual obligations.

CHAPTER FOURTEEN

HEALTH

188. Enormous improvements have been made in the health sector in the last six years although a tremendous amount still remains to be done. It is important to remember that in 1970 health services were virtually non-existent and since that time there has been a rapid growth in facilities. For example, the number of hospitals has risen from zero in 1970 to 13 in 1976, the number of clinics/dispensaries from 10 to 42 and the number of beds available for patients from 12 to 1,252. There has been a comparable expansion on the employment side with the number of doctors increasing from 13 in 1970 to 101 in 1976, specialists from zero to 59 and nurse from 2 to 522. Bearing in mind the current population, these numbers are still very small and show the

further expansion which is needed before a satisfactory and nationwide service can be provided.

189. The Plan proposes that capital expenditure in the health sector over the five year period will amount to OR 33.9 m (in 1976 prices) out of a total capital budget of OR 934.8 m. Of the health sector budget, OR 12.40 m is earmarked for the southern region, OR 9.22 m for the interior and OR 12.24 m for the capital region. Of the southern region expenditure over 50% is going on the new 280 bed Salalah Hospital due for opening in early 1977.

190. In terms of the provision of facilities, the Ministry of Health is trying to implement a three-tier system suited to Oman's long-term needs and the geographical spread of population. The objective is to have a large number of small clinics or dispensaries throughout the country, located in such a way that everybody has reasonable access to one. These clinics provide preventive and curative medicine and are staffed by trained paramedical personnel, assisted by regular visits from doctors. About 80% of the country is covered by such clinics at the present time, although this figure includes the areas covered by mobile air and sea clinics.

191. The second tier is the health centre and it is intended that each clinic should have a centre within about two hours' travel, staffed by doctors on a permanent basis with X-ray facilities and suchlike. In many respects, the health centres are really small rural hospitals.

192. The third tier is the network of hospitals (14, including the new Salalah Hospital). Two hospitals are in the southern region, 5 in the capital region and the remainder in the interior. Most have between 50 and 80 beds, the main exception being Salalah with 280. Obviously, facilities available vary substantially but most cases requiring hospital treatment can be dealt with in each hospital. Exceptional cases will be transferred to Salalah or the capital region where the facilities should soon be capable of dealing with virtually all problems. At the present time chronic cases have to be sent abroad but increasingly Oman has the facilities and expertise to cope.

193. The Ministry has two main objectives: (i) to provide clinics/dispensaries throughout the country and (ii) to provide international standard hospital facilities in the capital region. Given the limited funds available for health facilities, choices have to be made and the Ministry feels that it is in these two aspects that the greatest contribution can be made to improving the health of the country's population. It is accepted that the provision of proper hospital facilities throughout the country would be a misallocation of resources at the present time.

194. Mention should be made of certain special programmes under way. Some diseases are currently endemic in Oman and the ministry with assistance from appropriate international bodies is making major efforts to reduce the incidence of these diseases. The main problems concern malaria, trachoma, tuberculosis and hepatitis. A major UNDP/WHO programme on malaria began in 1975 and a WHO investigation into the scale of the trachoma problem ended recently and a curative programme should commence shortly. In many respects,

elementary health education and improvements in diet will have a tremendous beneficial effect at little cost, and the Ministry has made great advances in these aspects, primarily through the schools and the clinics.

195. As in most other sectors, Oman is having to depend heavily on expatriates but a major domestic training programme is beginning to get off the ground. During the Plan period it is intended to concentrate on nurses and other paramedical personnel and have Omani doctors and specialists etc. trained outside the country. This is in line with the prime objective of spreading the coverage of the clinics. In this respect, some of the officials expressed fears that Oman may not be able to train or acquire the necessary skilled manpower in line with the expansion of facilities. It was argued that wage rates in Oman are low and that increasing competition from neighbouring countries such as the United Arab Emirates and Saudi Arabia was having an adverse effect on the flow of expatriate personnel to Oman. In comparison with many other countries, however, there do not appear to be undue problems in persuading expatriates to work in the rural areas rather than in the capital region.

196. One of the constraints on the growth of the health sector was the administrative capacity of the Ministry. There has been a clear distinction within the Ministry between public health (preventive medicine) and medical service (curative medicine) which has led to some duplication of facilities. Integration of the various facilities is underway but it is understood that some opposition persists and although in itself this may not be a major issue, it does suggest that administrative and manpower problems may exert a brake on the rate of expansion of services.

A SUMMARY OF MAJOR FINDINGS AND CONCLUSIONS
OF THE WATER RESOURCE STUDIES IN OMAN

I. The ILACO Study of Northwest Oman

ILACO, Water Resource Development Project: Northern Oman

(Second Interim Main Report, plus Annexes, January 1975;
Final Main Report, plus Annexes, July 1975).

1. This study, carried out over a two-year period beginning in May 1973, covered an area defined by the Omani coast line north from Al-Khabura to the border with the United Arab Emirates, the country's northern border to Buraimi, the road from Buraimi to Ibri and from Ibri back to Al-Khabura. Project area population in 1974 was estimated at 80,000, of whom 54,000 were assumed to derive a significant proportion of their income from agriculture. About 8,800 ha in the project area were cropped, with 6,800 ha in the Batinah and 2,000 in the Interior. This constituted approximately one-quarter of Oman's total cropped area. The study was terminated by government after only a small part of the exploratory drilling program was completed. The consultants noted that conclusions regarding water availability were to be regarded as tentative, pending the completion of future well drilling and monitoring activities.

2. The study concluded that water would be a far more important constraint on the expansion of cropped area than suitable land. Potentially arable land in the project area not cropped at the time of survey totalled 19,000 ha in the Batinah and 7,000 ha in the Interior. It was concluded that overall a precarious balance existed between groundwater abstraction and availability. In some areas near the coast water use probably already exceeded fresh water recharge, resulting in increased problems of soil salinity and reduced crop yields. However, it was noted that much water was lost through wasteful irrigation practices. Some increase in cropped area was possible if irrigation efficiency could be increased from the estimated level of about 45%.

3. Given the general balance between water supplies and use, the major potential for expanding agricultural output in the project area lay in increased yields from already-cropped areas. Yields of most crops were considered low relative to potential. The major constraints on crop yields were identified as: (1) agricultural labor shortages and deficiencies in weeding, pruning and pollination of date palms; (2) poor irrigation practices; (3) soil salinity and low water quality in the Batinah coast; (4) ineffective use of insecticides and fertilizers; and (5) poorly developed agricultural research, extension and marketing services.

4. For the Batinah coastal region, the major recommendation was to shift the cropped area inland in few kilometers where both soil and water supplies were considered more suitable. Irrigation units of 100-200 ha

were proposed, with one or two such units established in the near future as pilot projects. For the Interior, where both land and water resources were considered more limited, a re-allocation (and more efficient use) of water to the most productive lands was suggested as a major development strategy. Other recommendations included: (1) continued improvement in physical infrastructure and agricultural support services; (2) establishment of one or two lamb fattening projects to determine the economic feasibility of livestock fattening with irrigated fodder; (3) continued monitoring of meteorological and ground water phenomena; (4) studies of selected villages to determine the feasibility of land consolidation and to establish the basis for integrated development projects; and (5) promulgation of legislation for the conservation and more efficient use of available groundwater supplies.

II. The Gibb Study of Northcentral Oman

Sir Alexander Gibb and Partners, in association with the Institute of Hydrology, Wallingford, England, Water Resources Survey of Northern Oman, Final Report (June 1976; main Report plus five supplementary volumes). An integral component of this survey was Final Report on Phase I: Soils and Agricultural Studies, With an Interim Water Resources Assessment (April 1975), prepared by the above consultants in association with International Land Development Consultants (ILACO) and Societe Grenobloise d'Etudes et d'Installations Hydrauliques (SOGREAH).

5. The project area, located south of that examined by ILACO, is bounded by the coastline northward from Muscat to Al-Khabura, thence inland to include the important agricultural areas of Rustaq, Wadi Quryat, Adam, Nizwa and Sam'il. Topographically, the area, totalling some 14,500 km², can be conveniently divided into the northern and southern basins which drain the Jabal Akhdar/Jabal Nakhil mountain range. The northern basin includes the important agricultural area of the Batinah Coast.

6. In 1974, some 12,300 ha were under crop, of which 5,800 were in the Batinah. Seventy percent of the cropped area was in date palms. Agriculture is the major water user in the area, although industrial and urban demands abstracted from the Sib fan near the capital are increasingly important. A large part of the study period (August 1973 - January 1975) was unusually dry, a factor which complicated the task of estimating long-term availability of water. Because the proposed exploratory drilling program was not implemented, the planned hydrogeological survey of the southern basins did not take place.

7. Concerning soil quality, the major constraints on agricultural production were judged to be salinity, principally in the Batinah, and the shallow arable layer and poor drainage of the inland areas. With United States Bureau of Reclamation (USBR) standards for land classification, an additional 25,700 ha were considered suitable for cultivation

in the Batinah. Elsewhere, suitable uncropped areas totalled 4,100 ha, including 2,900 ha at Wadi Quryat, 510 ha bordering on cultivated areas and 675 widely-scattered ha elsewhere.

8. As in most regions of the country, water was judged a more important constraint than soil. For the northern basin, the consultants concluded that a close balance exists between availability and use of water. The high degree of hydrological interdependence among inland villages implies that village cropping systems are likely to be affected adversely by any new abstractions of water. Along much of the Batinah coast, the steadily increasing abstractions are resulting in rising salt content of water from existing wells.

9. The consultants noted that earlier judgments regarding water availability in the Batinah were over-optimistic. They recommended that the only surplus water readily available for development in the northern basins, the 15 million meters³/year ($m^3/yr.$) believed lost to sea from Wadi Sama'il, be reserved to meet domestic and industrial needs of the capital area.

10. In the southern basin, annual water use is estimated at $44 m^3/yr.$, of which Wadi Nizwa and Wadi Dahla account for half. Evidence suggests excess groundwater totalling $5 m^3/yr.$ in Wadi Nizwa and $10 m^3/yr.$ in Wadi Halfayn. If carefully exploited, these supplies are considered adequate to support up to 250 ha in the Wadi Bahla area and 150 ha each in Wadi Nizwa and Wadi Halfayn.

11. Some further development of water supplies may be possible over the longer-term. The consultants estimate that surface runoff losses from the study area average some $95 m^3/yr.$ to the sea north of the mountains and $65 m^3/yr.$ to the desert in the south. For the northern basin conservation techniques are recommended to reduce surface runoff losses and facilitate recharge of aquifers. These include low barrages in mountain wadi subbasins and water spreading techniques in the alluvial plains.

12. South of the mountains further extension of the irrigated areas in Wadi Bahla, Wadi Quryat and Wadi Sayfam may be possible if present surface runoff losses are conserved by subsurface storage. Elsewhere in the alluvial plains of the southern basin evidence suggests that either the soils are not suitable for irrigated agriculture or that groundwater is likely to be widely dispersed and not readily exploitable.

13. A final recommendation is to continue to maintain and monitor the hydro-measurement systems established by the consultants in the project area. Further drilling programs should be associated with specific development programs.

III. The Renardet-Sauti-ICE Study of North-East Oman
Renardet-Sauti-ICE, Water Resources Survey in North-East Oman;
Interim Report (March 1975)

14. The boundary of the survey area of some 16,000 km² extends along the northeast coast from Muscat southeastward to Ras al Hadd, including the Wahiba Sands as the southern limit and the Jaalaan desert as the eastern extremity. The survey area includes the Sharkiya, considered by experts in Oman as the most promising for near-term agricultural development from the viewpoints of soil and water availability. Cultivated oases comprise less than 1% of the survey area. Total population was estimated to be 45,000, including 15,000 at Sur, 20,000 in the Wadi al Bathaa and Mudaibi Valleys, 5,000 at Quryat and 5,000 elsewhere.
15. The consultants concluded, on the basis of reconnaissance-level soil studies, that possibilities for expansion of the cropped area were very limited in the Sur and Quryat areas. In contrast, the Wadi al Bathaa plain was believed to contain about 6,000 additional ha suitable for agricultural development.
16. No additional water supplies were identified at Sur and Quryat. It was considered likely that supplies could be more than doubled in the Wadi al Bathaa (from 2,000 to 5,000 liters/sec) and the Mudaibi (from 1,000 to 2,000 liters/sec) areas. Given likely soil and water availability, it was indicated that cultivated land in the survey area could be increased from 2,000 to 6,000 ha. The consultants proposed an increase of 4,000 ha, including a 500-ha expansion to existing oases and new developments of 1,500 ha at Ad Dariz and 2,000 at Al Kamil.
17. Subsequent to the above report, another consultant examined the possibility of developing "large-scale commercial farming" in the survey area. (Hunting Technical Services Ltd., Pre-Feasibility Study to Investigate Alternative Means of Establishing Commercial Farming in Interior Oman, Final Report; October 1976.) This group concluded that the low yield of existing wells, variable water quality and the absence of large blocks of suitable soils precluded such development. Instead, the establishment of intensively-cropped small farms of 4 ha was recommended, each to be supported by Service Extension Centers equipped to provide a wide range of agricultural services.
18. A pilot project comprising 20 farms in the Kamil-Al Wafa area was proposed. Because of low water and labor requirements, wheat was suggested as a major crop, together with winter vegetables, beans, and oil seeds. Phase I of the pilot project would include more detailed water and soil surveys and socio-economic studies to locate the most favorable site. Phase II would include drilling of the well-field, installation of the irrigation system, establishment of the Service Center and on-farm development. The initial investment costs of OR 5,650 per ha were considered high because the pilot project would bear full costs of the Service Center capable of supporting farmers on a much larger area. Expansion of the pilot project area at a capital cost of about OR 900 per ha was considered possible.

IV. The Halcrow Study of Dhofar (Southern Oman)

Sir William Halcrow and Partners, Surveys and Investigations for Land and Water Resources Development in Dhofar (Interim Report, December 1973; Draft Final Summary Report, May 1975, plus four annexes dated August 1975).

19. The study grows out of a contract of May 1973 between the consultants and the Dhofar Development Department. The area comprises some 30,000 km², including the Salalah Plain, the southern slopes of the Qara Range (the Jebel) and the northern slopes (Negd). The population in 1973 was estimated at 45,000, with 25,000 in the Salalah area, 15-20,000 in the Jebel and 2,000 nomadic tribesmen in the Negd. The labor force on the Salalah Plain totalled 6,000, of whom only 400 were primarily dependent upon agriculture. At the time of the field survey work, uncertain security conditions in the Jebel forced the consultants to focus primarily upon development possibilities on the Salalah Plain. Livestock population in Dhofar was estimated at 10,000, largely cattle and goats, with most of the cattle in the Jebel.

20. On the plain about 1,000 ha were cropped in 1973. Another 1,300 ha were considered suitable for irrigation development, albeit with large inputs of fertilizer and careful soil and water management. An additional 1,900 ha were considered of marginal value for irrigation. In the Jebel and Negd only small isolated pockets of land were judged suitable for cropped agriculture, although much of the area represented a valuable pasture resource.

21. Due to irregularity of surface water supplies, agricultural development on the plain must rely primarily on groundwater. The consultants estimated that the annual recharge of the plain totals about 125 million cubic meters (mm³). About 60 mm³ were believed to be concentrated in the development area where suitable soil exists. Some 15 mm³ of this was being abstracted at the time of the survey. The remaining flow of 45 mm³ (with a plausible range of 30 to 60 mm³) was the most critical determinant of agricultural expansion. It was suggested that 15-30 mm³ could be extracted without risk of serious salt water intrusion in supplies already in use.

22. Because of uncertainties regarding water quality and availability, the consultants recommended a cautious, carefully-controlled plan of development. The major objective was to integrate and strengthen the livestock-based economy of the Jebel with the mixed farming economy of the Plain. Livestock production in the Jebel was to be increased through a cross-breeding program, improved husbandry practices and the provision of watering points. (By April 1975, 32 deep wells had been drilled in the Jebel as part of the government's on-going development program; 22 had been equipped with pumps, pipework and storage facilities.) The proposed project components for the undeveloped areas of the Salalah Plain included large-scale, mechanized units to produce beef, mutton and milk from irrigated green fodder, supplemented by locally-produced grain and other feedstuffs.

23. The beef-fattening operation, ultimately to cover 500 ha, involved the purchase of 6-month old calves from the Jabel and fattening over a 21-month period under a zero-grazing system. The sheep component, on another 500 ha, was based on the importation of improved mutton-type breeding stock and feedlot fattening of lambs for slaughter at 6 months. The dairy component would include the establishment of two intensive production units on 100 ha each, each with 600 exotic-breed cows. Upgrading of local dairy cattle would be encouraged through improved extension services and an artificial insemination program. Efficiency and volume of forage production were key determinants of project success.

24. Development would be phased over a 4-5 year period, with some of the project output destined for the capital area and other Gulf States. At 1973 prices, capital costs for the proposed development on the Plain were estimated at OR 1,895 per irrigated ha (through Year 9, excluding replacements). The economic rate of return was calculated to be 2.1%. It was suggested that justification for the project would be strengthened by non-quantifiable benefits, included the accelerated pacification of the area and reduced defense expenditures.

Reviews of the Major Water Resources Studies

25. In 1975 the Government of Oman contracted another consultant to review that major water resource studies completed by that time (Joannou and Paraskavaides Overseas, Ltd., Reconnaissance Survey of Northern Oman Water Resources and Development Prospects; August 1975). This study relates only to northern Oman and does not consider the important Gibb survey of northcentral Oman (which was not available at the time). The conclusions, viewed as "indicative" and "preliminary" by the consultant, tend to be more optimistic with respect to available water resources than other studies of the region. They suggest that with the 11-year water resource development program proposed in the report, the irrigated area of Northern Oman could be doubled, in addition to meeting all industrial and domestic consumption requirements for water. Entrapment of water now believed lost to the sea would, in the consultants' view, permit irrigation of an additional 18,500 ha while an improvement in irrigation efficiency from the present estimated 50% to 75% would increase water availability for an additional 11,000 ha.

26. Questions remain regarding the general validity of these conclusions. Underlying data regarding rainfall, run-off and aquifer characteristics are no more satisfactory than for other studies. The economics of the proposed aquifer re-charge techniques have not been explored. Exclusion of the Gibb study, which covers an important agricultural area, is a serious deficiency. No consideration was given in the Joannou and Paraskavaides study to suitability of soils for agricultural expansion. And the feasibility of increasing irrigation efficiency to 75% over a wide area is open to serious question.

27. In late 1975 an FAO/UNDP Collating Mission provided yet another summary and evaluation of existing water resource (A Summary of Water Resources and Agricultural Development Reports in the Sultanate of Oman;

draft, October 1975-January 1976). This report confirmed the prevailing view among consultants that there were no large unexploited reservoirs of suitable water in Oman. Overall, available water resources were in general balance with exploitation, although in some areas additional water and suitable soil would permit limited expansion of the cropped area. The economics of such development were not carefully explored. The Sharkiya was identified as one of the most promising areas for expansion, together with more limited possibilities in the Interior of Oman, Dhofar and, with improved management of existing water resources, the Batinah Coast. The FAO Mission stressed that water was a much greater constraint to expansion of the cultivated area than was suitable land. It also pointed out that the paucity of basic data regarding rainfall, run-off and aquifer characteristics preclude for the present a precise quantification of Oman's water resources.

28. There is no reason to disagree with the basic conclusions of the UNDP/FAO Mission. The curtailment by government decision of the planned program of borehole drilling and testing limits the extent and precision of information regarding Oman's water resources. But present knowledge provides no basis to suggest that the country has a large unexploited water supply, nor that its coincidence with suitable lands would permit more than a modest expansion in cropped area. On the contrary, overexploitation of available water appears to be a growing phenomenon in several areas, e.g., parts of the Batinah Coast, the Sur area and Buraimi in the Interior, leading to receding fresh water tables and, in some areas, deterioration in water quality through salt water intrusion. With limited additional land and water and growing water demands for both agricultural and non-agricultural uses, careful management of these resources must be a high priority objective of government. Because water and land development are unusually costly in Oman, a cautious policy of expansion is required. Careful consideration should be given to the economics of such expansion and to the merits of achieving the same policy objectives through alternative development strategies such as the intensification of production in already-cultivated areas.