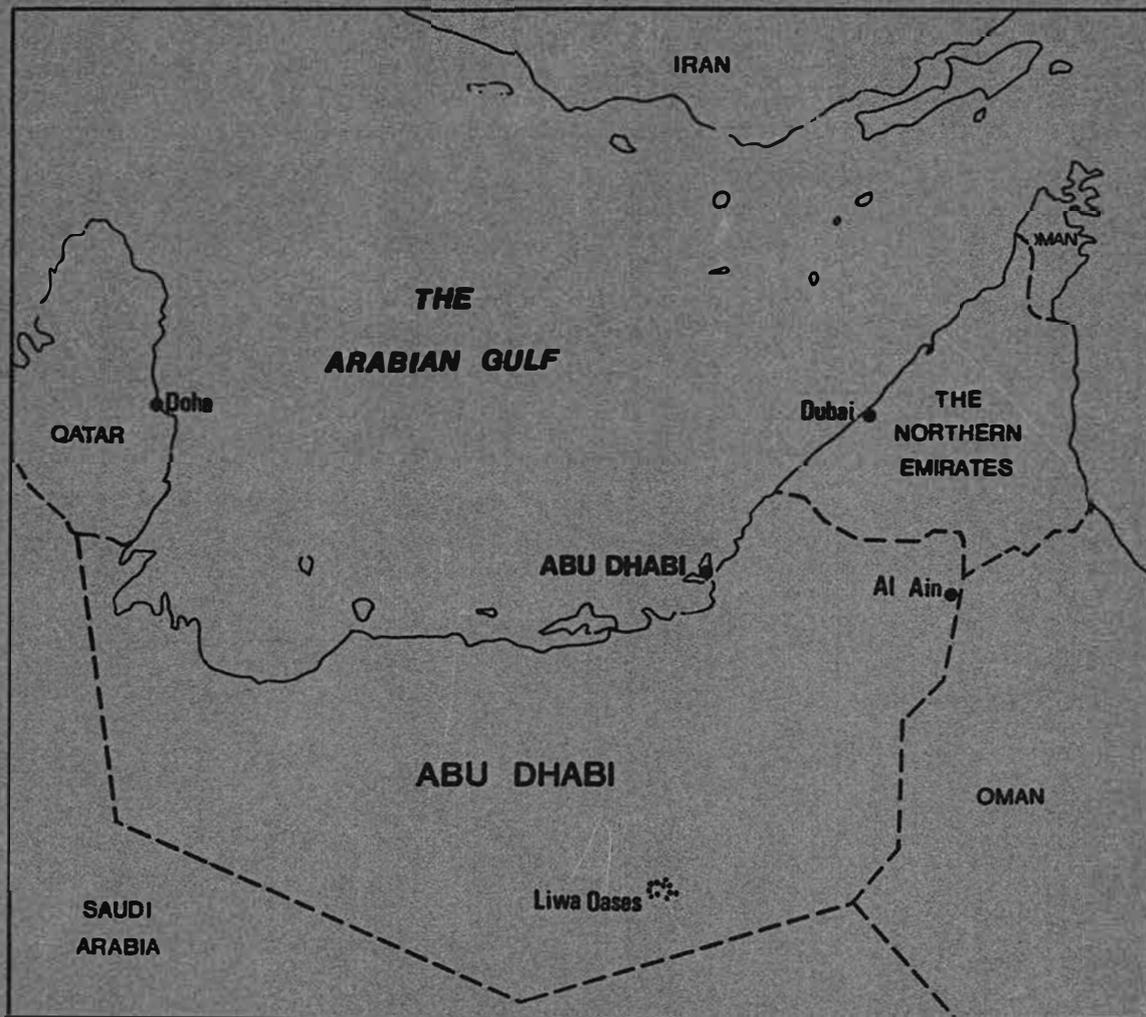


A MEMORANDUM ON AGRICULTURAL DEVELOPMENT IN ABU DHABI



OCTOBER 1974

A MEMORANDUM ON AGRICULTURAL

DEVELOPMENT IN ABU DHABI

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1. INTRODUCTION

This memorandum was prepared as a desk study in U.K. It is based upon past experience in Abu Dhabi and the northern Emirates, and such documents as are available in this country. The sources used are given in the bibliography in Appendix I.

The memorandum sets out to:

- (i) Describe and assess the present status of agriculture in Abu Dhabi.
- (ii) Give a brief description of recent development schemes.
- (iii) Assess the problems and constraints associated with agricultural development.
- (iv) Make tentative suggestions regarding the assistance required for the acceleration and improvement of existing schemes.
- (v) Outline and comment on possible new projects and government priorities for agricultural development in Abu Dhabi.

Abu Dhabi is the largest and richest Shaikdom or Emirate within the United Arab Emirates (U.A.E.). The Emirates became a political entity in December 1971 with the federation of Abu Dhabi, Dubai, Sharjah, Ajman, Um Al Quwain, Fujairah and later Ras Al Khaimah. On external affairs the U.A.E. speak with one voice, yet within the federation each country maintains it's own sovereignty. Before the federation the Shaikdoms were protected by Britain and loosely grouped as the Trucial Oman or Trucial States. There has always been a degree of integration and interdependence between the Shaikdoms. Since federation a policy of increasing integration has been practised. Abu Dhabi is the most dominant partner in the U.A.E. mainly because it has the largest oil revenue. Shaik Zayed Ben Sultan is both the ruler of Abu Dhabi and the first President of U.A.E. At the time of federation, government ministries were set up to control all sectors of the economy and life in the U.A.E. In effect these ministries are almost entirely concerned with the northern Shaikdoms. Abu Dhabi has maintained and reinforced its own corresponding ministries and departments. Within the context of this memorandum it is of importance to note that the Union Ministries of Agriculture and Fisheries, and Electricity and Water are responsible for all emirates except Abu Dhabi. In Abu Dhabi the corresponding ministries are The Ministry of Municipalities and Agriculture, The Ministry of Electricity and Water, and The Ministry of

Public Works. All these Ministries play a part in the development of agriculture, water supplies and fisheries both within the U.A.E. as a whole and in Abu Dhabi in particular. Abu Dhabi may be trying to develop its natural resources independantly of the neighbouring States, yet any development must take into account the development programmes, research experience and agricultural production of the other member States of the federation. It should also be mentioned that any development of agriculture, or water resource exploitation by the Oman in the oasis of Buraimi could have a marked effect in Abu Dhabi. Although this memorandum is concerned with the agricultural potential of Abu Dhabi, it should be viewed within the wider context of the United Arab Emirates and Western Oman.

Prior to the 1960's Abu Dhabi town comprised a small fishing port; its hinterland, with the exception of Buraimi and Liwa oases, consisted of a low lying, largely unpopulated desert. Agriculture at essentially subsistence level, was the major occupation of families in the oases coupled with nomadic pastoralism in the desert. Three major physical constraints have mitigated against the development of agriculture:

- (i) A harsh arid climate.
- (ii) A paucity of fertile, water retentive soil.
- (iii) A paucity of surface or ground water.

Even though there has been a rapid upsurge in all other sectors of the economy, agricultural development has been slow because it is still restrained by these three factors.

Al Ain, within Buraimi oasis, has historically been the centre of agricultural production in Abu Dhabi. This dominance still remains. With the upsurge in the economy, and a proportional increase in total population and especially in urban communities there has been a natural increase in the demand for food. Neither Abu Dhabi nor the other emirates have been able to meet this demand from internal production. Notwithstanding the physical constraints it is considered that agricultural production could be improved and expanded within the limits of available resources. Hitherto agricultural development has also been retarded by the following factors:

- (a) The tendency to import food, paid for by the high oil revenues.
- (b) The lack of qualified and experienced personnel in the fields of agriculture, water resources, animal husbandry and fisheries.
- (c) A shortage of basic information on soils, climate and water resources.

- (d) The absence of basic agricultural statistics on existing agricultural holdings, crop areas, yields and production, livestock numbers and products, and data on food supplies and consumption.

The combination of these environmental and human constraints has given rise to a situation where government policy on the development of agriculture is indefinite, which is reflected by the present generally low standard of productivity within the agricultural sector.

2. THE AGRICULTURAL SECTOR

2.1 Natural Resources

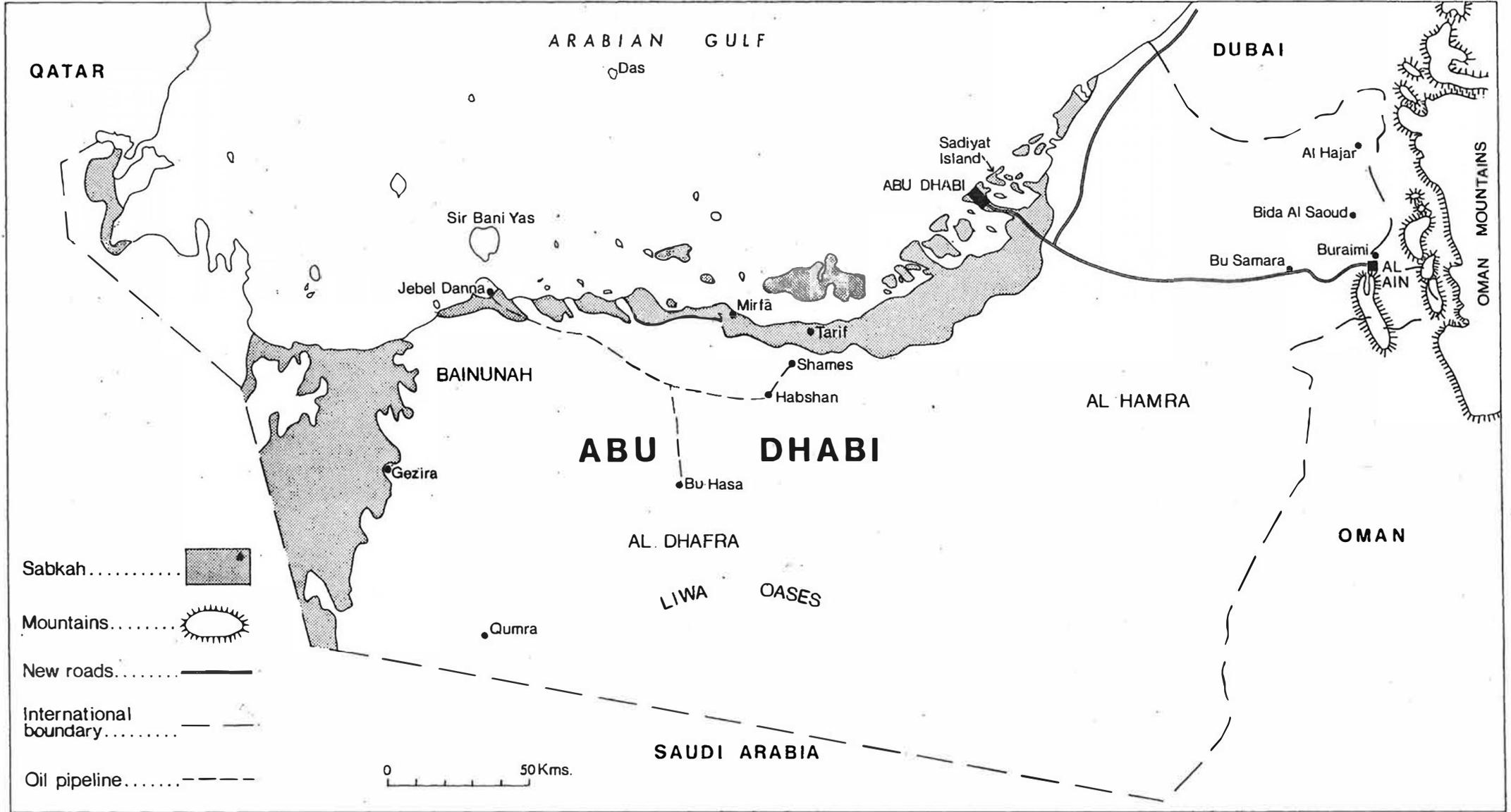
Abu Dhabi covers an area of about 65,000 sq km and has a common border with Saudi Arabia in the south, Oman in the east, Dubai in the north and Qatar in the west (Figure 2.1). The major physiographic divisions can be seen, in section on Figure 2.2. Along the gulf coast there is a belt of low lying 'sabkha', or salt flats, inland there are extensive gravel plains and vast areas of sand dunes. In the east the sand dunes diminish at the foot of the Oman Mountains and give way to an outwash gravel plain. In the south the sand dunes achieve a local relief of 100 metres. Excluding the sand dunes the only feature of any prominence is the limestone anticline of Jebel Hafit (1160 metres) south of Al Ain Oasis. Similar but smaller Cretaceous limestone ridges rise slightly from the surrounding sand to the north of Al Ain.

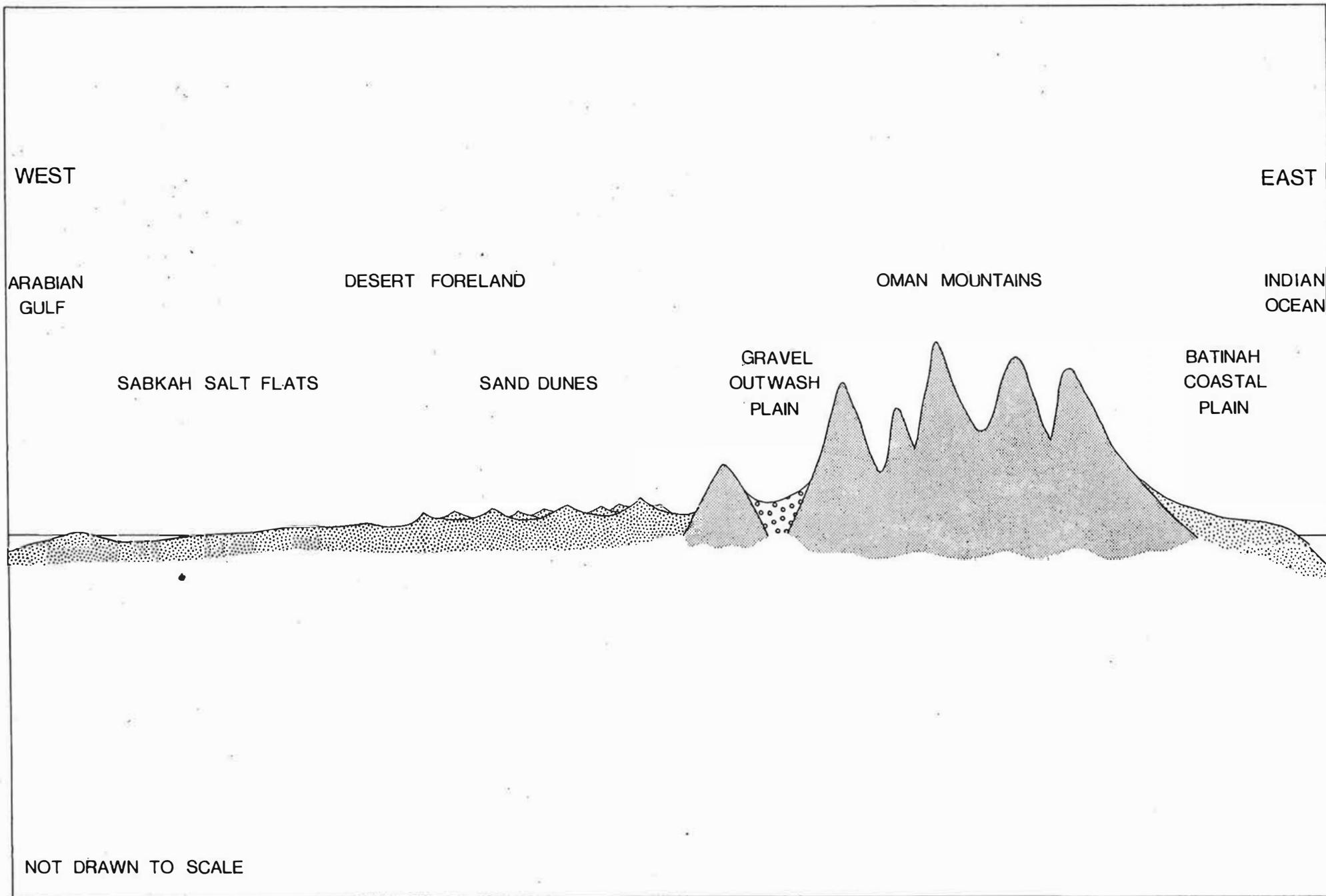
Meteorological stations have been established in the Trucial States since 1965. Prior to this rainfall and temperature data was collected at Sharjah from 1933, see Table 2.1. Rainfall is generally scarce and erratic in occurrence. During some years there has been no recorded rainfall, and in others the total rainfall for the year has fallen in a very short period. The annual rainfall ranges from zero to about 300 mm, and normally falls during the winter between November and March.

Temperatures throughout the year are generally high. In July and August temperatures of 45°C have been recorded in the interior. During the winter the mean temperature is about 20°C. The rate of evaporation from an open water surface is estimated to range between 3000 - 4000 mm per annum.

The tendency for rainfall to be concentrated into short intervals,

LOCATION DIAGRAM





SCHEMATIC SECTION ACROSS THE OMAN PENINSULA

NOT DRAWN TO SCALE

TABLE 2.1 Sharjah Town. Average Temperature and Relative Humidity

(1949 - 66) Average Rainfall (1936 - 66)

Month	Temperatures (Degrees Centigrade)		Relative Humidity Per Cent Average at 1600 hrs	Rainfall	
	Average Maximum	Average Minimum		mm	Inches
January	29	9	62	24	0.9
February	31	10	64	18	0.7
March	35	11	60	9	0.4
April	38	14	59	10	0.4
May	41	18	60	4	0.2
June	43	21	62	-	-
July	45	24	61	1	...
August	44	24	62	-	-
September	43	22	63	1	...
October	38	18	59	1	...
November	33	13	56	11	0.4
December	29	9	59	27	1.1
Annual Average	45 ⁽¹⁾	8 ⁽²⁾	61	106	4.2

(1) Average of highest each year.

(2) Average of lowest each year.

creates intense surface run off in the Oman Mountains. The run off concentrates in deep wadis, some of which drain to the west into Abu Dhabi. In the mountains the wadi floods can cause considerable damage but once the flow disgorges onto the plain the force is dissipated and the water seeps into the gravels. This recharge of the gravels at the foot of the Oman Mountains is very important, because it provides the major recharge source of fresh water for Abu Dhabi. The groundwater generally drains west and north under the desert foreland towards the coast. As it approaches the coast the groundwater becomes increasingly saline. Unlike Saudi Arabia, Abu Dhabi does not appear to be underlain by any deep aquifers containing fresh 'fossil' water. Therefore as agriculture cannot be supported by rainfall the assessment and intelligent development of shallow aquifers in the east is of the utmost importance.

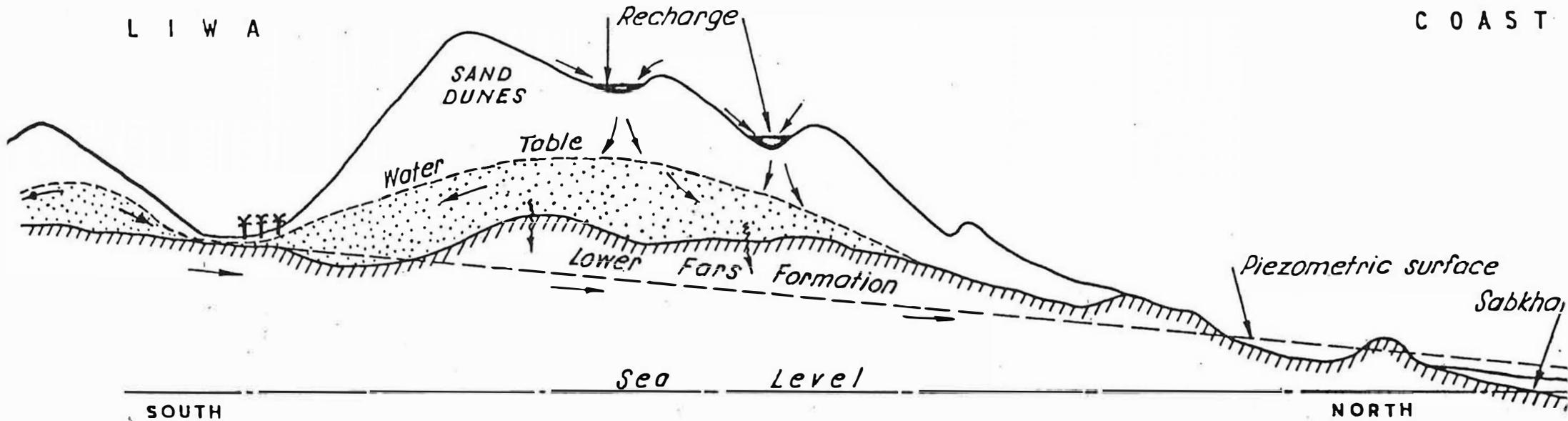
Though no complete soil survey of Abu Dhabi has been carried out it is recognised that most of the soils are poor. Soils with some potential for irrigated agriculture exist on the outwash fans in the east and in desert flats between the sand dunes. Due to the sparse vegetation all the soils have a low humus content (less than one per cent) and tend to be lacking in structure. Vertical and horizontal textural changes do exist but have been inherited from the original sequence of deposition. Most of the soils are light textured and well drained. In some areas, particularly along the western periphery of the outwash fans, and in the desert flats, the products of weathering have not been leached out, and the present agricultural potential is limited by an accumulation of soluble salts.

Though a small percentage of the total country has soil with some agricultural potential the major limiting factor in agriculture is the shortage of water for irrigation. Consequently agriculture has been traditionally practised in the Al Ain - Buraimi area because fresh groundwater is obtainable from the outwash gravels of the Al Jaww plain. Very rudimentary agriculture has also been practised in the south in an area termed the Liwa Oases, where there is a localised water table close to the surface at the base of the high sand dunes, see Figure 2.3.

2.2 The General Status of Agriculture

In 1968 a census revealed that about 8 per cent of the 'economically active' population (about 2,300 people) in Abu Dhabi was involved in agriculture and fisheries. This percentage is very small in comparison with the

SCHEMATIC SECTION: LIWA TO THE COAST



NOT TO SCALE

NOTE: FIGURE TAKEN FROM GIBBS-HUNTINGS REPORT(22)

- Direction of flow
- Ground water transmitted from perched aquifer to lower fars formation.

corresponding figures in other emirates excluding Dubai. Though the economically active population has greatly increased the percentage is still the same and the numbers involved now probably amount to approximately 4 - 5,000.

Table 2.2 is a collection of statistics obtained from a variety of sources which give some indication of the role, size and importance of agriculture in the country. There is no information on crop yields or agricultural production, therefore the contribution of agriculture to the food demands of the population cannot be assessed. The area of land under cultivation is a matter of some contention. The estimates put forward in Table 2.2 are composites of estimates from many sources. The figure of 2,000 hectares for the whole country includes approximately 900 hectares of trees recently planted along the Abu Dhabi - Al Ain highway and around various settlements and oil fields in the interior. The figure of 1,000 hectares under cultivation around Al Ain is based upon surveys undertaken by Sir A Gibb and Partners, Hunting Technical Services and J.L. Stevens in 1969-1970. The Ministry of Municipalities and Agriculture estimates that there are some 4,500 hectares under cultivation around Al Ain. This is considered to be a gross over estimate.

It is difficult to assess the importance of agriculture since there is no information quotes on the role of agriculture in the gross domestic product. In terms of the economy and development expenditure, its role is undoubtedly minor. In human and cultural terms the importance and influence of agriculture is probably much greater. Prior to the discovery of oil, the animal husbandry of the nomadic Bedu, and the status orientated, traditional growing of dates and fruit in the oases was an integral part of the lives of everyone in the country. The present generation of leaders were brought up in this environment and it is their openly expressed ambition that part of the oil revenues should be used to make the country more green and pleasant. Examples of this attitude are evidenced by afforestation schemes along the highways and the incentives offered to Bedu to settle and become horticulturists.

The main emphasis on expenditure and national effort at the present time is devoted to the construction of roads, water supply, sewerage systems, hospitals, schools, and offices. Forty per cent of the economically active population is involved in the construction industry. It is probable that after the programme of construction has abated a greater proportion of government expenditure will be directed towards agricultural development.

TABLE 2.2 Agriculture in the Economy of Abu DhabiSelected Statistics

1. <u>Area</u>		
Total area of Abu Dhabi		65,000 sq km
*Cultivated area (see text)		2,000 ha
*Cultivated area of Al Ain area (see text)		1,000 ha
*Cultivated area of U.A.E. (Fenelon [1])		1,300,000 ha
2. <u>Population</u>		
Total population of U.A.E. 1968 (census [30])		179,075
Total population of Abu Dhabi 1968 (census [30])		46,375
*Total population of Abu Dhabi 1973 (U.A.E. Year-book 1973)		100,000
Economically active population in Abu Dhabi 1968 (census [30])		29,284
Percentage of economically active population involved in Agriculture 1968 (census [30])		7.8%
*Rate of population growth (Current Estimate)		10% p.a.
3. <u>Government Revenue</u> ('000,000 Dirhams)		
1967	410	} U.A.E. Statistical Handbook 1973 [40]
1968	550	
1969	680	
1970	860	
1971	1,650	
1972	2,160	
*1973	3,230	(British Overseas Trade Board July 1974)
*1974	13,500	(British Overseas Trade Board July 1974)
4. <u>Abu Dhabi 5 Year Development Plan 1968-1972</u>		
	Projected Expenditure on Agriculture '000,000 Dirhams	Expenditure as a percentage of the total
1968	0.88	1.6%
1969	1.77	2.7%
1970	2.56	3.9%
1971	4.13	7.3%
1972	4.05	7.1%
Note: Economic Intelligence Unit Annual Review of Abu Dhabi (October 1974) states that only 2,000,000,000 Dirhams were spent out of a total of 2,959,100,000 Dirhams before the development plan was shelved.		
5. <u>Abu Dhabi 1973-1974 Budget</u> (E.I.U. 1974 [8])		
Main Development Allocations	'000,000 Dirhams	%
Municipalities	245	25.9
Industry and Electricity	159	16.8
Communications	145	15.3
Education	101	10.7
Public Buildings	91	9.6
Loans and International Obligations	76	8.0
Health	43	4.5
Housing	35	3.6
Agriculture	-27	2.9
	Total 922	100
6. <u>U.A.E. Budget 1974-1975</u> (Middle East Economic Digest 23-8-74[6])		
Total Expenditure		1,691,700,000 Dh
Agriculture and Fisheries		15,809,000 Dh

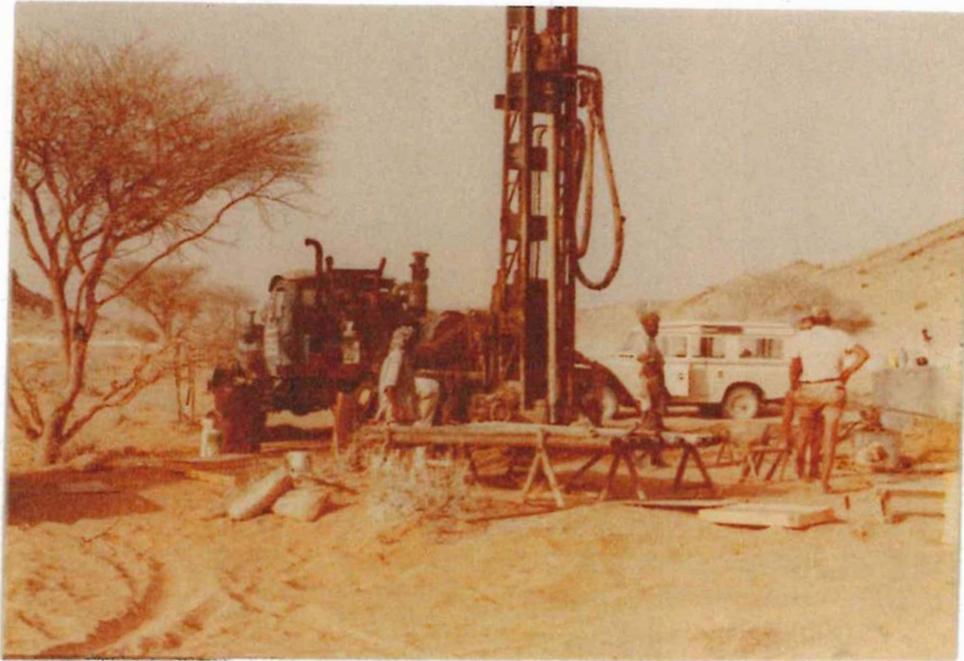
(* Denotes an estimate. The source of the estimate is given in brackets)

TABLE 2.3 Abu Dhabi Emirate. Imports by Main Commodity Groups. 1969-1971

(Thousand Dirhams)

Commodity	1969	1970	1971
Machinery	143,460	76,210	54,560
Motor vehicles	63,410	35,110	41,890
Building materials	52,300	20,620	23,170
Foodstuffs	43,470	37,420	48,910
Spare parts	41,050	25,070	33,300
Pipes and pipe fittings	33,030	9,880	11,590
Electrical goods	24,850	20,600	20,170
Cement	20,850	5,230	6,290
Household furniture	20,710	5,720	5,710
Motor oil and grease	18,670	14,560	15,440
Tools and hardware	14,710	10,620	11,630
Steel bars and steel items	13,810	10,330	11,280
Air conditioners	13,770	4,750	7,480
Cables	11,540	6,470	7,350
Textiles	9,130	9,200	11,990
Household appliances	8,010	5,100	5,720
Cigarettes and cigars	6,260	6,460	8,870
Medicines	5,650	5,800	5,590
Alcoholic drinks	5,440	2,980	5,320
Tyres and tubes	4,590	3,780	5,290
Stationery and office equipment	4,190	3,420	4,110
Paints	4,180	2,280	2,560
Arms and ammunition	4,100	1,520	7,620
Office furniture	3,410	1,490	900
Photographic goods	1,880	2,000	2,700
Cosmetics	1,840	2,200	3,060
Chemicals	1,820	1,820	3,630
Carpets	1,820	1,050	1,820
Watches and clocks	1,630	1,300	1,700
Oilfield equipment	1,160	10,540	84,560
Live animals	940	1,840	3,350
Tea	850	580	1,520
Gas cylinders	810	520	730
Footwear and leather goods	790	1,210	2,190
Jewellery	490	320	550
Crockery and cutlery	400	890	1,050
Miscellaneous	7,740	3,560	5,830
Totals	592,770	352,450	469,420

Note: Columns may not add to totals because of rounding.



a) SOUTH AL AIN
Exploratory drilling for water near Jebel Hafit.



b) AL HAJAR
Drilling a production well, 30 kms north of Al Ain.



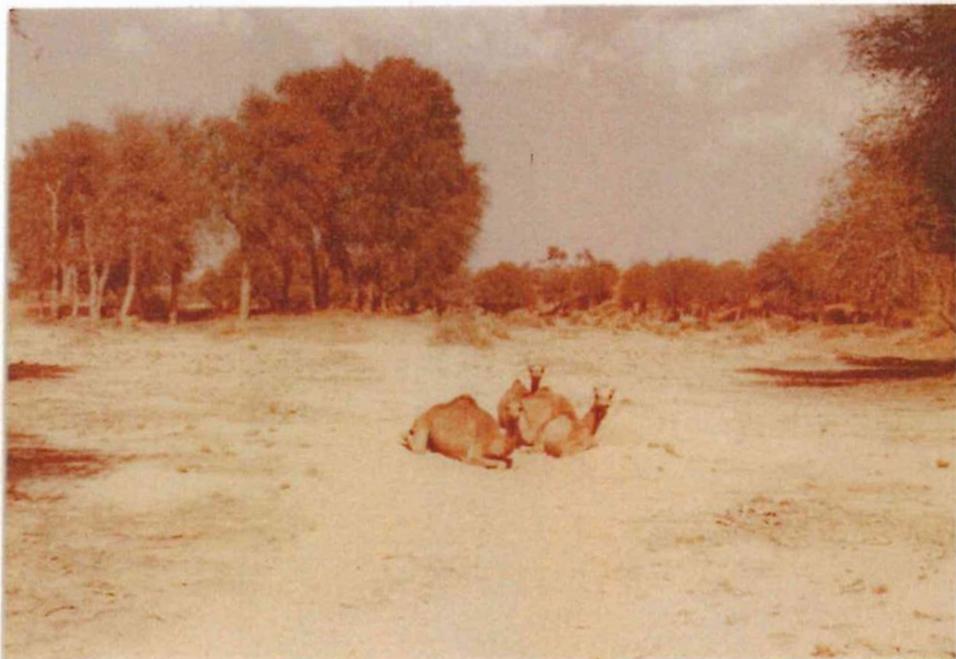
a) **AL AIN**
Looking across Wadi Shik to the new urban development.



b) **BURAIMI**
Mud fort with date gardens in the background.



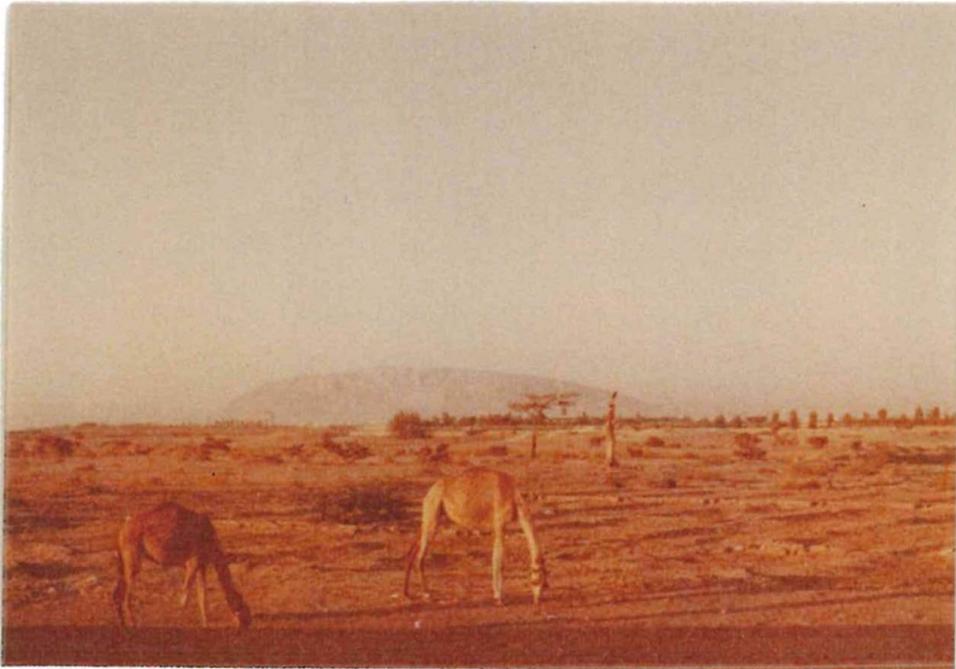
a) SAYH AL AIRJ (NORTH AL AIN)
Part of the gravel plains with potential for agricultural development but lacking water supplies.



b) WADI MASHIQ
An elongate depression in the Northern Dunes characterised by fine textured soils.



a) **MAS'UDI**
Large modern farm adjacent to the Northern Dune Field.



b) **AL AIN**
Potential agricultural land in the foreground, Jebel Hafit (1160m) in the distance.

2.3 The Agricultural Sector in Detail

Agriculture in Abu Dhabi is very fragmented and practised on a small scale at various levels of sophistication.

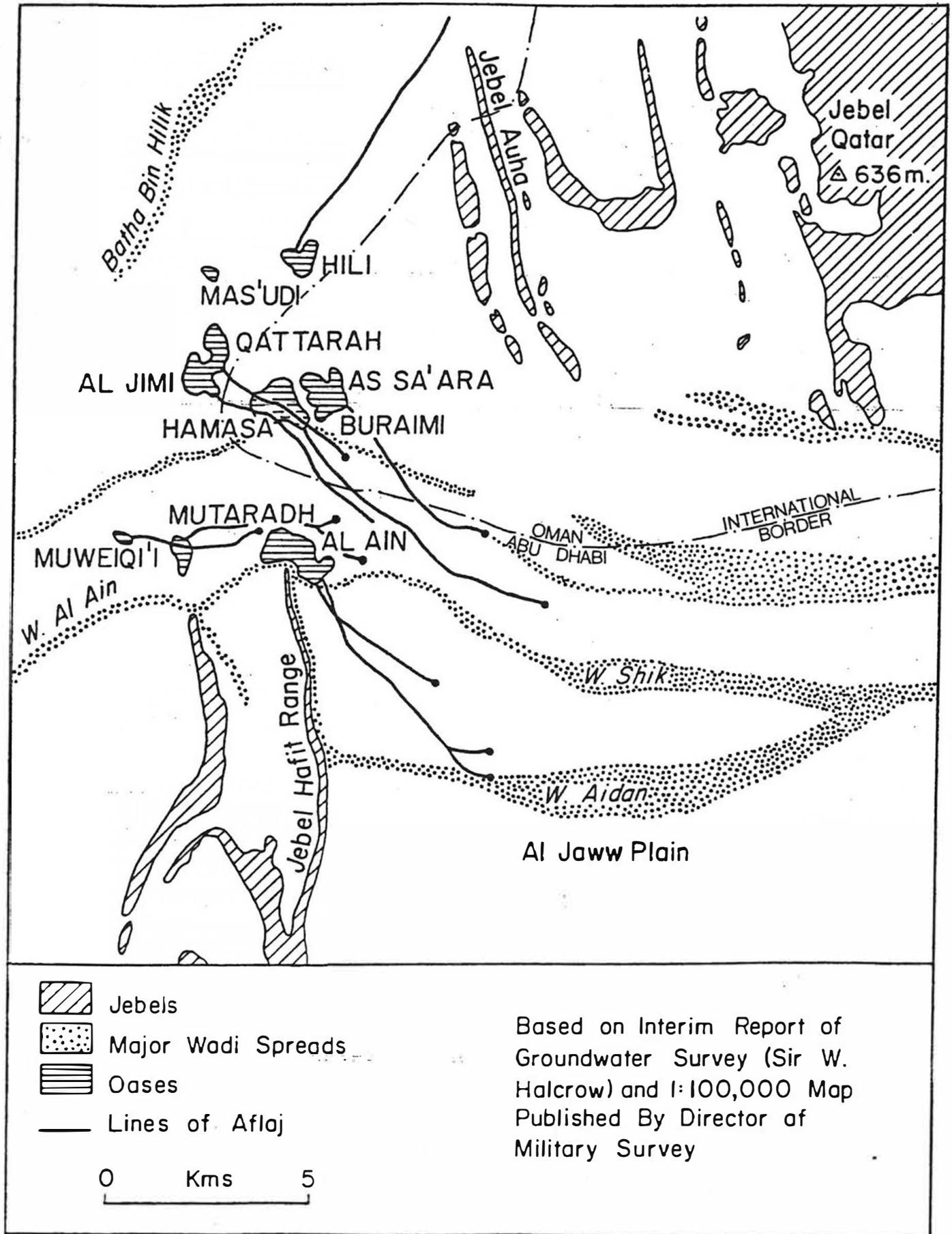
2.3.1 Al Ain - Buraimi Oasis

Al Ain is situated 160 kilometres inland from Abu Dhabi town on the border with the Oman and about 15 kilometres from the Oman Mountains. It is connected with Abu Dhabi town by a modern dual carriageway. Al Ain is the major settlement in a group of villages, most of which are on the Abu Dhabi side of the state border with the Oman. Across the border is the ancient settlement of Buraimi.

The soils of the Al Ain area can be classified as sedosols. This is a term which has not received universal usage, but adequately describes these soils, which have a very poor structure, yet possess textural characteristics inherited from the original depositional sequence. To the south east, and east of Al Ain is the Al Jaww plain which comprises alluvium washed out of the Oman Mountains. The finer material has been deposited in the west of the plain and is the base material for the soils of Al Ain. The soils generally have a sandy - loam or loamy - sand texture and are well drained. Close to the shallow wadis which cross the plain the surface layers have a more coarse gravel texture. To the north and west of Al Ain there are the north east - south west trending Northern Dunes. These are fine to coarse aeolian sands banked up into high dunes and have no agricultural potential. All the soils of the area have a low water retentive capacity. This creates problems in traditional irrigation practice because large quantities of water are needed over and above the plant requirements.

The water supply for the oasis is obtained from the shallow aquifers underlying Al Ain - Buraimi and the adjacent area. Traditionally the aquifer has been tapped by hand dug wells in the settlements together with aflaj (man made underground conduits which intersect the water table) draining the Al Jaww plain and the area to the north east of Hili village (for the configuration of major aflaj see Figure 2.8). The aflaj feeding the Al Ain area deliver approximately eleven mcm/year (Gibbs - Huntings [24]), similarly the aflaj leading into the Omani settlements deliver about five and a half mcm/year. To the west of Al Ain there are two well fields, Sa'ad and Bu Samarah which supply 1.7 mcm/year by pipeline to Abu Dhabi Island. This will cease once the desalination plants on Abu Dhabi Island reach full operating

LOCATION OF THE AL AIN GROUP OF OASES



-  Jebels
-  Major Wadi Spreads
-  Oases
-  Lines of Aflaj

0 Kms 5

Based on Interim Report of Groundwater Survey (Sir W. Halcrow) and 1:100,000 Map Published By Director of Military Survey

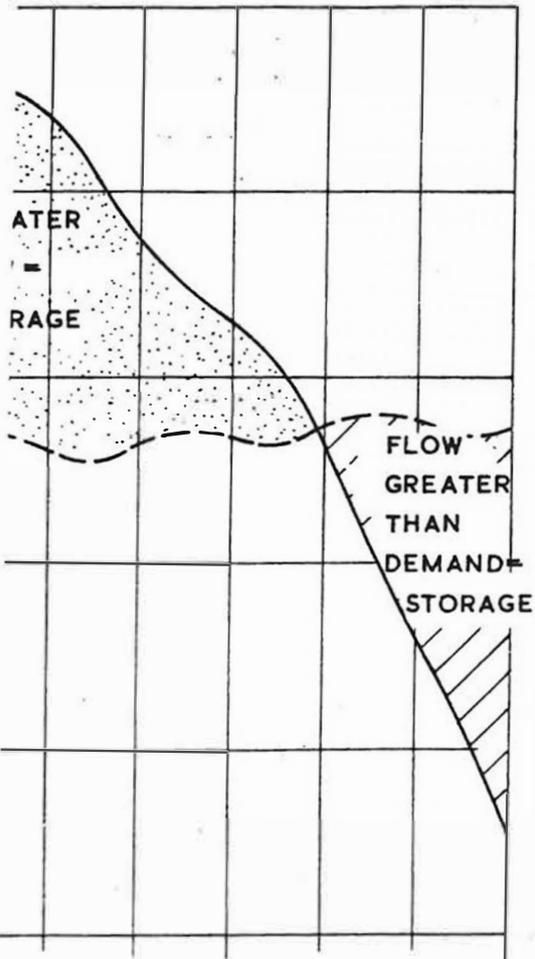
capacity thereafter the supply will be available for Al Ain. The rate of water abstracted from the manually operated dug wells is probably minimal, however in recent years diesel driven pumps have been made freely available and it is evident that the aquifer around Al Ain is being overpumped. The water table surface in many places appears to have fallen five metres below its average level in 1969, and therefore if this rate of abstraction continued it is likely that wells will soon begin to dry up.

The delicate balance between the recharge and abstraction of groundwater in the oasis is shown in Figures 2.9 and 2.10. Figure 2.11 shows the balance for the future as envisaged by Gibbs and Huntings [22] in 1969 on the basis of their proposals for development. The relevant ministries are aware of the danger in the situation yet they appear to be making no effort to curtail pumping in and around Al Ain. They have however begun to consider the possibility of tapping the aquifers under the sand dunes to the north. Recently well fields were installed at Bida Al Saoud and Al Hajar (Figure 2.4) and it is estimated that a further 4-5 mcm/year could be safely abstracted from these areas. The area under cultivation is estimated at present to be of the order of 1,000 hectares. The Gibb - Hunting Report [24] in 1970 estimated that about 750 hectares were then under cultivation and that there were approximately another 6,500 hectares of land around Al Ain moderately suitable for irrigated agriculture.

Land ownership lies solely within the hands of the Abu Dhabi nationals. It is illegal for any non-national to own land. Traditionally the agricultural holdings around Al Ain were date gardens with a few fruit and vegetable crops grown between the palms. The ownership of a date garden has always commanded prestige, hence the owners tended to be Shaiks, merchants and other influential people. The pattern of ownership has recently changed with the introduction of a scheme to settle Bedu on small horticultural holdings in the area. It is estimated that 600 - 700 individuals have joined the scheme and own plots of about 7 donums (0.7 hectares) in size. It is common knowledge that the 'Ruling family' also own large farms just outside the oasis with a total area of about 800 hectares. In addition the Ministry of Municipalities and agriculture owns and operates the Al Ain Experimental farm which extends over an area of 800 donums (80 hectares).

The crops grown on the agricultural holdings include: dates, fruit trees, vegetables and fodder, unfortunately there is no up-to-date information on a crop acreage. It was estimated in 1970 that about 50 per cent of the

WATER BALANCE 1970
AL OASIS



LEGEND

FLOW (DATES AND VEGS.) ———

FLOW (AFLAJ) - - - - -

WATER STORAGE = 398 ha.

CULTURE = 252 ha.

July Aug Sept Oct Nov Dec

IT = 15.63 mcm / yr

6.30 mcm / yr

REPORT(24)

cultivated areas were date gardens. Amidst the date palms and in separate orchards figs, pomegranates, guavas, grapes, limes, lemons and oranges were grown. In addition about 30 per cent of the cultivated area was under lucerne or other fodder crops. and the remainder devoted to vegetable cultivation during the winter. Only half the area under winter vegetables was used for the cultivation of vegetables in summer. The main vegetable crops included tomatoes, eggplants, cabbage, cauliflower, carrots, beet root, onion, spinach, melons, okra, peppers, potatoes and cucumbers. Since 1969 it is estimated that the area under vegetable and fodder crops has increased as a result of new farms and horticultural holdings being established. New varieties of dates, fruits and vegetables are being tried out on the Al Ain Experimental farms but no reports on the success or failure of the experiments have yet been published.

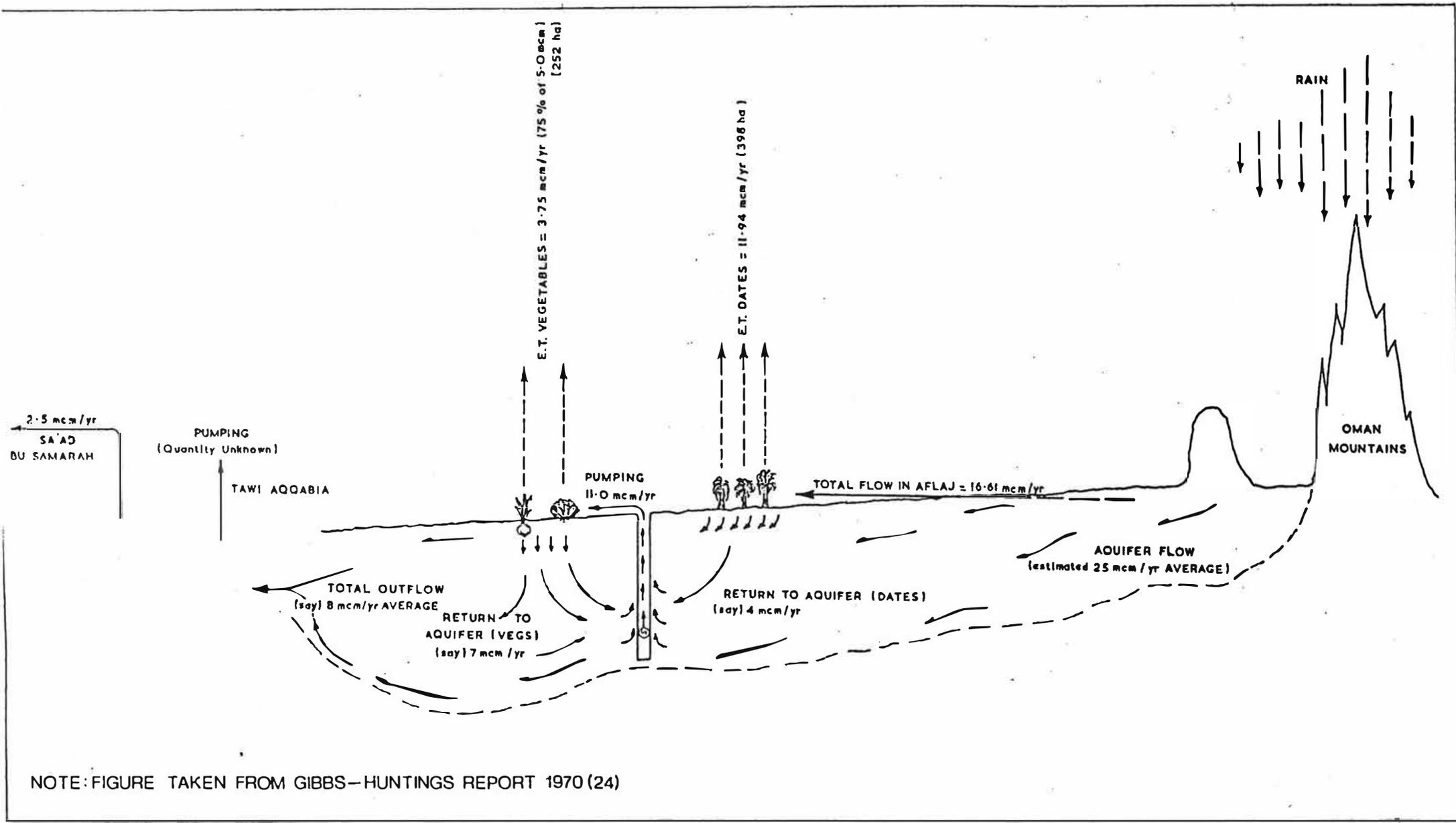
The old date gardens in the nuclei of the settlements are usually small (less than one hectare), densely planted with palms, and relatively unproductive. The low yields are attributable to four main factors:

- (i) The density of the palms creates such competitive conditions that the yields and quality are depressed.
- (ii) Many of the gardens only contain old palms which are past their productive peak.
- (iii) Irrigation water, supplied frequently by falaj and unlined canal, is excessive. This causes the palms to grow vegetatively at the expense of fruiting.
- (iv) The choice of palm variety appears to be based on the local preference for yellow dates which are suitable for drying. Unfortunately the chosen varieties have low yields.

The owners of the date gardens are not apparently concerned about low yields and the waste of water because they have other sources of income and only require the fruit for their own consumption.

In 1969 it was calculated that the depth of irrigation water applied to the date palms need not exceed 300 cm per year, yet it was found that in some gardens over 600 cm per year were being applied. The sharing of the aflaj water is on a cooperative basis and flood irrigation is practised. The transmission of water along unlined channels lead to excessive losses through infiltration, and some of the date gardens at the lower end of the channel system only received 150 cm of water per year. It was therefore

WATER CONSUMPTIVE-USE FLOW SHEET - 1970 AL AIN-BURAIMI OASIS



NOTE: FIGURE TAKEN FROM GIBBS-HUNTINGS REPORT 1970 (24)

recommended that channels should be lined and that the water should be applied to separate circular bunds around the base of each palm trunk. It is believed that these recommendations have only been partially put into effect.

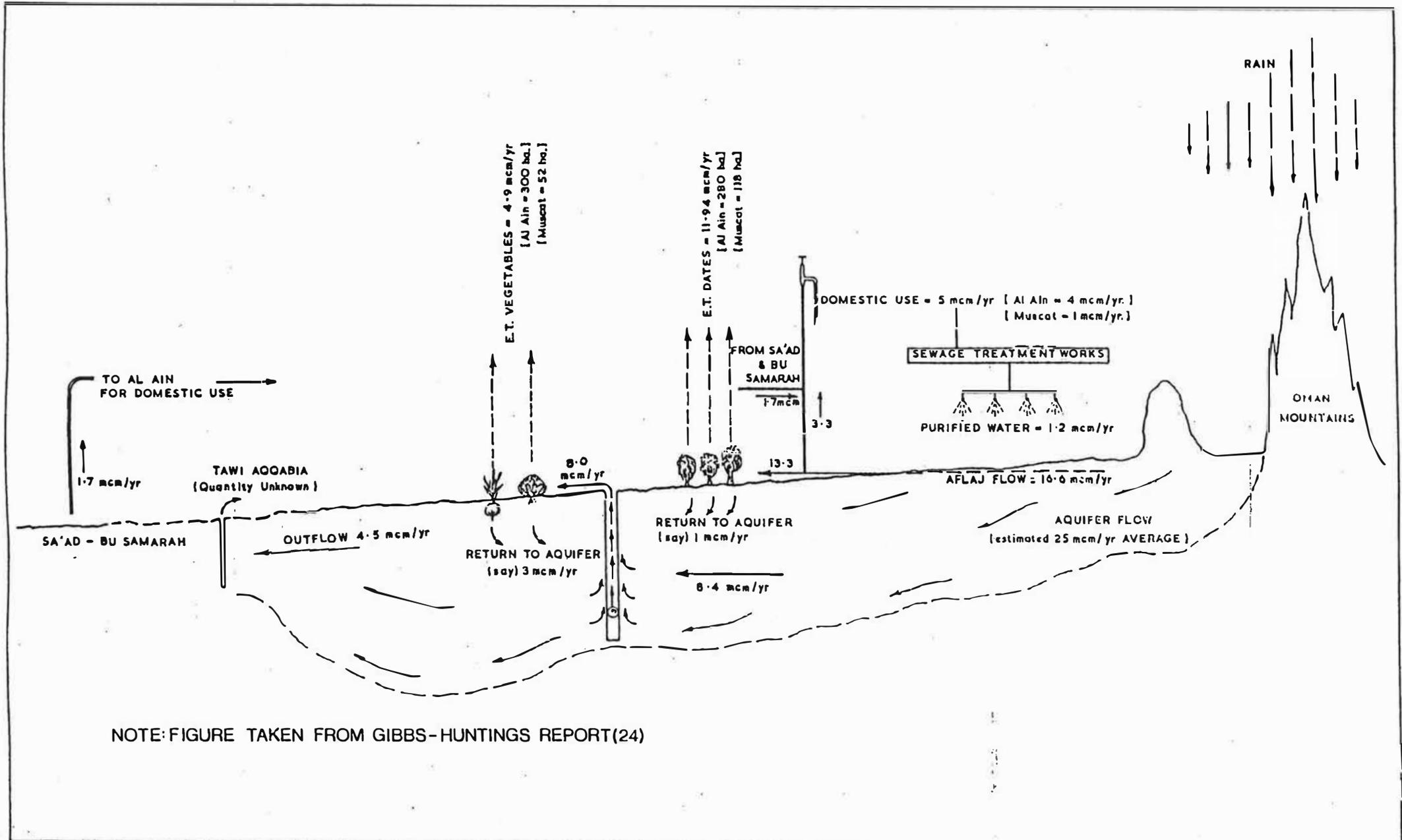
During the last twenty years many smallholdings have been set up around the oases. These have concentrated on the cultivation of fruit trees, fodder crops and vegetables. The field pattern in the holdings tends to be regular and the crops have been arranged for either furrow or flood irrigation. The water for irrigation is provided by a well and diesel powered pump. Recently there has been a tendency to concentrate more on fodder crops and vegetables and less on tree crops.

The main fodder crops are Lucerne (*Medicago Sativa*) and Lubra (*Dolichos Lablab*) with some barley and wheat. There has always been a great shortage of fodder for the animals kept both in the villages and surrounding desert areas. Lucerne and Lubra is grown in small basins each about 30-40 square hectares in area. The crop is irrigated once every 3-7 days depending upon the season; the basin being flooded to a depth of 8-10 cm. The crop is usually left in the ground for 6-7 years but after 3-4 years, growth tends to become very uneven and yield tends to decline. The crop is usually cut every month throughout the year and yields per hectare vary between 15 and 140 tonnes per annum (Stevens [32] depending upon the age of the crop. A yield of 95 tonnes green matter per hectare per annum appears to be about average.

The cultivation of vegetables has increased in response to demand from an increasingly affluent urban population. In 1970 the demand outstripped production at certain times of the year and this is probably still the case. The majority of the wide range of vegetables are grown in the winter in small flood basins. High summer temperatures and evaporation provide unsuitable conditions for most vegetables except melons, squash, eggplant and okra. The method of irrigation is usually to flood the shallow basin during the winter once every week and during the summer every 2-3 days. Melons and squash are irrigated on the ridge and furrow system. At present there is no available information on crop yields.

The application of fertilisers is wide-spread throughout the oases. In the past organic manure consisted either of dung of camels and goats or dried fish from the coast. Very little mineral fertiliser is applied to

FUTURE WATER CONSUMPTIVE-USE FLOW SHEET (AS ESTIMATED 1970) AL AIN-BURAIMI OASIS



NOTE: FIGURE TAKEN FROM GIBBS-HUNTINGS REPORT (24)

FIGURE 2-11

the date palms though they may indirectly benefit from the application of fertilisers to lucerne undersown in the gardens. On one farm surveyed in 1969, fifteen tons/hectare/annum of organic manure were applied to the date palms. The application of fertilisers to fruit trees is minimal. Fodder crops receive both organic and mineral fertilisers. The department of Municipalities and Agriculture used to supply free phosphatic fertiliser to any farmer growing lucerne at the rate of 250 kg/ha. Apparently application averages about 300 kg/ha. The bulk of the fertilisers are applied before planting but are not dug in, as a result the influx of irrigation water tends to wash the fertiliser to the far end of the basin. This leads to very uneven plant growth. Phosphatic fertilisers are occasionally applied after every alternate cutting of the crop.

Organic and mineral fertilisers are applied to the vegetable crops. Sulphate of ammonia is commonly applied at the rate of 300 kg/ha generally in one application. Organic manure is applied at approximately 10 tonnes/hectare.

The Experimental farm in Al Ain is currently trying, by means of its extension programme, to encourage the use and sensible application of fertilisers on all crops in the area. In many cases, in particular the new Bedu horticulturists, fertilisers were supplied free of charge. It has recently been reported that this practice has ceased.

The recent trends in agriculture in the oasis have meant that farmers are planting more extensive areas, particularly vegetables and fodder crops. The warm humid conditions created by frequent irrigation has exposed the crops to infestation by pests and diseases. For example the F.A.O. mission in 1973 [39] observed that tomato yields in the oases were not as high as they could be because of problems with blight, root-knot nematodes, and mites. The areas sown to Lucerne, and Cucurbitaceae are prone to attack by similar pests and diseases. The local ministry and farmers both attempt to control the problem, however there are no plant pathologists available and expert advice is lacking.

The labour situation has changed considerably during recent years. Before the great upsurge in the economy labour was cheap and readily available, whether from the family or from the community at large. The improvements and increase in education and training plus enhanced employment opportunities in Government and the construction industry has meant that agricultural labour is now both difficult to obtain and expensive to employ.

In addition the traditional system of a son helping his father with his land and then inheriting it on his fathers death, is breaking down. The competition for labour is such that the present average weekly wage is about 2-300 Dirhams (£20-£30). This has tended to curb the cultivation of labour intensive crops such as vegetables. It has also lead to an increase in demand for labour saving machinery, but mechanisation is limited by the availability of suitable machinery, and the fact that the cultivated plots are really too small for conventional machinery. The recent constraints on labour intensive agriculture has tended to encourage farmers to grow more fodder crops, which realise a generally higher price than vegetables, moreover fodder can be grown all the year round.

The marketing of agricultural produce in Al Ain is facilitated by a marketing Board and encouraged by a fixed intervention price for produce. A large new market building has recently been opened in Al Ain. The price for local and imported produce appears to be uniform. Unfortunately the guaranteed price for produce has meant that farmers are not encouraged to plant early or late varieties and hence all the harvest of a particular crop tend to mature simultaneously. This leads to periods of glut and shortage. So far the government has not built any storage facilities, and the only way to relieve the surplus is to transport it to the markets in Abu Dhabi town, and perhaps Dubai. Unfortunately there is a shortage of refrigerated trucks and facilities for handling the surplus. The present policy of guaranteeing prices for farmers in Al Ain and throughout Abu Dhabi has caused a certain amount of dissention in the other northern emirates where the Union Ministry of Agriculture cannot afford to provide subsidies.

It is unfortunate that there are no up-to-date estimates of farmers income in Al Ain. Stevens [32] 1969 estimated that an 'average' farmer could obtain over 20,000 Dirhams/hectare/annum for Lucerne (under three years of age), and that vegetable cultivation could earn 15,000 Dirhams/hectare/annum. The recent inflation in all commodities, the introduction of guaranteed prices and the subsidised or free supply of seed, fertiliser, water and pesticides suggests that these figures are now unrealistically low.

Figures 2.12 and 2.13 summarise the recent development that has taken place in Al Ain. The two photographs were taken in 1968 and 1973 and demonstrate how most of the development and growth has taken place in the building and road construction sector. The acreage of old date orchards has not changed, yet there has been an increase in the number of agricultural holdings and an increase in the acreage under cultivation. This is particularly noticeable to the north of Al Ain where new holdings have been established for growing vegetables and fodder crops.

AL AIN AND MU'TARADH NOVEMBER 1968,
(with overlay showing the road network and
agricultural holdings, March 1973).

FIGURE 2.



z ← | ——— SCALE 1:20,000

AL AIN AND MU'TARADH MARCH 1973



SCALE 1:20,000

2.3.2 The Liwa Oases

The state of agriculture in the Liwa Oases (the wide valley) is extremely primitive yet it is the only area outside Al Ain where natural conditions permit some type of husbandry. The area is situated about 90 kilometres south of Tarif on the Gulf and about 40 kilometres north of the border with Saudi Arabia. It comprises a group of largely isolated hollows amidst a sea of very high sand dunes (see Figures 2.1 and 2.3). The sand dunes are still actively moving under the influence of the prevailing winds. The wind has scoured the loose sand from an old partially cemented dune field and has piled it up into dunes of over 100 metres local relief. The oases are located on the northern edge of the interdune hollows where the dune sides are less steep and the water table is closest to the surface.

The soils of the oases were described by Gibbs and Huntings [22] as sterile wind deposited quartz sands. The texture varies from medium to coarse sand. There is no clay fraction and the soils are deficient in phosphorus, nitrogen and organic carbon. Some of the soils tend to be saline.

The water table in the hollows is very close to the surface, (in many places less than one metre) and under the lower dunes about 25 metres. The quality of the water is variable but the concentration of dissolved salts generally ranges from 600-5000 p.p.m. Most of the water has a high salinity and could therefore only be used for irrigation on salt tolerant crops grown on well drained soils. Groundwater is abstracted, for animal watering and human consumption, by shallow hand dug wells.

The only form of successful agriculture is date cultivation for local consumption. The palms have sufficiently deep roots to reach the water table. An effort has been made to cultivate Lucerne and vegetables. Both crops seem to have failed, the Lucerne being inundated by the drifting sand, and the vegetables because of the inert soil and the high salinity of the irrigation water.

The population of the oases is very small and tends to fluctuate with the seasons. Some of the villagers migrate to the coast for the fishing season and Bedu from the areas around move through the oases with their herds of camel and goat. The maximum population is probably 3,000.

At the moment communications between the Liwa and the rest of the state are very poor, should they improve it may be possible to increase the agricultural productivity of the area by introducing salt tolerant crops and transporting the produce by truck.

2.3.3 The Al Ain Experimental Farm and the Bedouin Settlement Scheme

In 1968 the newly formed Ministry of Municipalities and Agriculture acquired between 70 and 80 hectares of land 2 km to the east of Al Ain town, and established an experimental farm. The aim of the farm was to:-

- (a) investigate the suitability of various horticultural crops for cultivation in Al Ain and the rest of Abu Dhabi;
- (b) develop the most suitable varieties and distribute the seeds or young plants to the local farmers;
- (c) establish demonstration plots in order to provide an example of methods of husbandry and irrigation for the local farmers.

By 1970 a small area of the farm had been cultivated and a start was made in demonstrating new methods of husbandry. By 1972 the FAO [39] commented that 45 out of the 80 hectares were under cultivation and the farm was producing or propagating all the fruit and forest trees, seeds and seedlings required by the local agricultural community. In addition the experimental trials for adaptability and selection of immune and resistant varieties were achieving some excellent results. It is understood that the Experimental Farm was set up to provide the same agricultural development support as is provided by the older Digdagga farm in Ras Al Khaima. Unfortunately the Al Ain farm appears to be seriously understaffed (in 1972 there was one Manager and six field assistants) moreover the results and progress reports on the farms work have not been published.

In the late 1960's a scheme was devised by the ministry to encourage local nationals to establish new farms. This scheme was particularly designed for those Bedu pastoralists, who desired to become arable farmers. The scheme, worked in conjunction with the Al Ain Experimental Farm and the agricultural extension services, has succeeded in its prime aim, and about 6-700 new smallholdings have been established. From the outset the inducements were very generous. The new smallholder is given at no cost the following: 7 donums (0.7 hectares) of arable land, farm machinery, seeds, seedlings and young trees, a well and pump, and a maintenance grant of 300 Dirhams per month for the first two years.

Apparently these inducements have succeeded in persuading the older Bedu to settle, but have not had much success with the younger generations. Many of the new smallholdings have been established for over five years and are integral parts of the agricultural sector in Al Ain. The FAO [39] commented that the subsidies and free equipment and plants appeared to be creating a 'parasitic farming community' in Abu Dhabi.

2.3.4 Afforestation Scheme

In 1969 a french firm of Consultants, (Sogreah) was awarded a contract valued at £4.5 million to plant 250,000 trees along the new Al Ain - Abu Dhabi desert highway. The total area was envisaged to be about 650 hectares. By 1970 600 hectares had been successfully planted but in 1971 with the recession in government expenditure the contract was terminated.

In early 1973 a British firm Agricultural Planning Associates Limited was awarded a contract to complete and extend the work started by Sogreah. The afforestation of the Al Ain - Abu Dhabi highway has been completed and work is in progress to plant a further 1,000 hectares in the oil centres of Tarif and Jebel Dhanna, in addition to the planting along the new Dubai-Abu Dhabi highway.

This policy of afforestation has been promoted in order to
“transform a not inconsiderable part of the landscape in selected areas of Abu Dhabi from sandy, wind-blown desert to green forest, thereby greatly increasing amenities, improving the climate, reducing the severity of dust storms and preventing soil erosion.”

K.G. Fenelon [1]

Apparently a wide variety of trees were used in the initial experiments, but eventually four local hardy varieties were chosen (Al Otaiba [3], records the following varieties: Acacia casorna, “ghaf”, “kart” Tamarix, bamboo and Prosopis). The method of irrigation was modelled on an Australian system of trickle irrigation. The water is supplied either from a specially installed well or by truck to a central feeder tank and from there it is fed to the roots by partially buried plastic pipes. Many of the older plantations have become established and the trees have reached five metres in height.

The incongruity of the plantations is obvious to the casual observer, and even though the reasoning behind the afforestation policy is not entirely scientific, the isolated stands of grey-green trees at least provide amenity value by breaking the monotony of vast expanses of desert.

2.3.5 The Power-Water-Food Facility - Sadiyat Island

In 1969 the University of Arizona Environmental Research Laboratory was given a grant of \$3 million to attempt to grow vegetables in an artificial complex using Abu Dhabi's two abundant natural resources, sunlight and cheap oil. They chose Sadiyat Island as the site for the experimental farm because it was close to Abu Dhabi, and water could be obtained directly from the sea. The project is based on the University's research undertaken at Puerto Penasco in Mexico. The first harvests were marketed in 1971.

The complex comprises the following facilities:-

- (i) Six large diesel generators to provide power - part of the power is used to distill sea water.
- (ii) Adjacent to the power station, 35 acres of specially designed, inflated or rigid, plastic greenhouses were erected. Each greenhouse can only be entered through an air-lock system which means that the pressure and humidity in the greenhouse can be strictly controlled.
- (iii) Vegetable seedlings are bedded in an inert sand matrix, which has a low water retention capacity.
- (iv) Distilled water from the power centre is mixed with soluble nutrients and fed either directly to the root zone by trickle irrigation or sprayed from above in a dense mist from fixed sprinklers. Once the water has passed the root zone it is drained away and recycled.
- (v) During both winter and summer the temperature and humidity is controlled by fans which blow air through an asbestos stack at the end of the greenhouse, which is cooled by spraying sea water over it. The current of air maintains the humidity at 100 per cent. The air leaving the greenhouse is recycled and completes the circuit every two minutes. Carbon dioxide is added to compensate for the depletion caused by photosynthesis. At Puerto Penasco the diesel exhausts provided the source for the extra carbon dioxide.

Apparently 170 different plant types have been tried in the experiment. The most successful are as follows:- tomatoes, cucumbers, radishes, cabbage, broccoli, green beans, lettuce, peppers, aubergines and spinach.

By the summer of 1972 the Sadiyat Island complex was supplying all the daily requirements for Abu Dhabi town. This approximated to one tonne of produce per day. In the winter of 1972/73 tomatoes, aubergines, cucumbers and lettuce were exported by air freight to Beirut where they equalled or undercut the price of local produce. The Financial Times [17] quotes the yields of tomatoes at 71 tons per acre per crop (cf 31 tons per acre per crop in the U.S.A.). Cucumbers 102 tons (12), aubergines 107 tons (8.25), okra 23 tons (5). The Sadiyat Island Annual Report [38] quotes 22.3 tons per acre per crop for lettuces and 252 tons per acre per annum for cucumbers.

The fame of the Sadiyat Island experiment has spread throughout the Gulf region, and the Iranian Government is considering a similar complex on Khary Island off the southern coast. Ideas on the future of the project in Abu Dhabi are mixed. It has been suggested that another complex should be set up either at Al Ain or somewhere on the road between Al Ain and Abu Dhabi. A conference is to be held in 1975 to assess any future expansion. The World Bank Mission in 1973 made the accusation that the complex was futuristic and divorced from the agricultural sector on the mainland. This criticism may be valid in view of the fact that little of the high level technology is being passed on to local nationals. All the scientific staff are expatriate and there appears to be little training within the scheme. At least one fact overrides the recent criticism: the Power-water-food complex is now on an economic footing and is able to supply in whole or in part the local demand for high quality fresh vegetables throughout the year.

2.4 Livestock Production

Livestock are found in the settled areas, either on the outskirts of towns and villages or in backyards. Relatively large numbers of goats and camels are owned by the Bedu, who lived a transhumant existence from the outskirts of Al Ain and Abu Dhabi into the desert. The Bedouin settlement scheme has induced many of the Bedu to become horticulturists near Al Ain, yet they have retained their animals. The animals are either herded

on scrub land near Al Ain or they are left to scavenge unattended. Stock may be fed Lucerne, dates and bran, dried fish or dried grass and weeds.

The livestock population is made up of goats, sheep, cattle, camels, horses and donkeys. The goats are black, small, long haired varieties. The sheep are very few in number, predominately the small thin-tailed type. Cattle are of the indigenous fawn coloured Omani type characterised by a small frame. In spite of being kept in a generally adverse environment, the cattle maintain remarkably good condition. At Digdagger Experimental farm in Ras Al Khaimah there is a milking herd of imported Friesian Cattle, now numbering over 80. Some members of the Ruling family maintain herds of exotic cattle on their estates including Zebu, Red Sindhi, Sahiwal or Sudanese cattle.

Poultry are found in the urban areas, they appear to live on a scavenging basis. In Al Ain a private consortium, has established a successful 32,000 broiler and 8,000 layer enterprise. The stocks are maintained by importing hybrid chickens. The feed is also imported. This enterprise supplies the Abu Dhabi and Al Ain demand for poultry (about 4,000 birds per week) and eggs.

The standard of animal husbandry outside the research station in Ras Al Khaimah and the poultry enterprise in Al Ain, is generally poor. Most of the animals are kept for home consumption and are not slaughtered for the general market. The demand for meat is not as high as would be expected, because the protein requirement is in part supplied by cheap fish from the coastal towns. The standard of livestock husbandry tends to be depressed by the fact that herding and general husbandry is regarded as a woman's work. Men who care for animals tend to lack prestige.

The most important diseases in the area so far diagnosed are; infectious pleuro-pneumonia of goats; mange of camels and goats; trypanosomiasis in camels; foot and mouth disease and theileriasis in cattle; Newcastle's disease in poultry and mastitis in dairy cattle and goats. There is only one veterinary centre at Al Ain, which is mainly concerned with administering injections (free) to goats to prevent pneumonia (in the nine months of 1973 the veterinary service injected 45,000 animals against pneumonia, cowpox and outbreaks of foot and mouth disease.)

There are no diagnostic laboratory facilities in Abu Dhabi or Al Ain. In the budget for 1972-1973 2,500,000 Dirhams (£250,000 approximately) was allocated for a proposed Experimental Station Dairy Herd and Milk Plant Demonstration Project in Al Ain. By 1974 there was no evidence to show that this project had been started.

At present the main source of meat for the open market is either frozen beef from Australia and New Zealand or locally slaughtered Sudanese, Iranian or Somali goats and sheep. No statistics on annual livestock imports are available for Abu Dhabi.

2.5 Institutional Support Services for Agriculture

As stated in the introduction, Abu Dhabi has maintained its own ministries in the fields of agriculture, water and power. The ministries set up at the time of the federation are solely responsible for the Northern Emirates.

The Abu Dhabi Ministry of Municipalities and Agriculture has two centres, one in Abu Dhabi, the other in Al Ain. The agricultural work within the Municipalities section is mostly concerned with planting road side trees, landscape design, and care and maintenance of urban parks gardens and slaughter houses.

The Ministry is divided into two departments, one for administration and finance, the other for agriculture and animal production. The Department of Agriculture and Animal Production is further divided into four sections:

1. The Agricultural Development Section
 - (a) The Al Ain Experimental Farm.
 - (b) Forestry Service.
 - (c) Soil Service.
2. The Agricultural Extension Section
 - (a) Agricultural Marketing Service.
 - (b) Mechanical Engineering and Maintenance Service.
 - (c) The Agricultural Extension centres (four functioning and one under formation.)
3. Plant Protection Section: Staffed by four field officers who are also the four Agricultural Extension Agents working in the four Agricultural Extension centres in Al Ain.

4. Animal Production Section. (Started in 1972 and had not been staffed at that time.)

The majority of the technical staff in the above departments are expatriate (Egyptians, Kuwaitis, Palestinians and Bahrainis). In 1972 there were only six nationals including the Minister (Shaik Tahoun) out of a total technical staff of 19. The ministry was severely understaffed in the higher technical grades. The total budget for 1972-1973 was 33 million Dirhams of which 25 million Dirhams was allocated to agricultural development.

Owing to this staff shortage many of the above departmental service sections are not functioning. The main support service to the agricultural community is from the Agricultural Extension Section. The Extension service (as already stated in section 2.3.1) provides free land, land levelling, ploughing, ditching etc., planting of trees provision of seeds and seedlings, plant protection, spraying and dusting, a living allowance of 300 Dirhams per month to new farmers, borehole installation and provision of pumps. In addition the four extension centres have a plot of about five hectares and a well to provide irrigation water. These centres have a store of equipment machinery and transport. It appears that the Extension Section also provides labour, management and machinery for the large farms owned by Shaik Zayed and his family.

Other services include a veterinary clinic, manned by one officer, and the Agricultural Marketing Service.

FAO [39] commented that the extension service was adequate for a small horticultural community but suffered from inadequate planning. The mission also noted that there was no agricultural training scheme, or college facility for educating the younger generation in modern agriculture.

3. PROBLEMS AND CONSTRAINTS ASSOCIATED WITH THE DEVELOPMENT OF AGRICULTURE

Agricultural development in Abu Dhabi is limited by a number of problems and constraints, most of which have already been referred to in the preceding section. For ease of reference these may be summarised as follows:

1. Natural Resource Constraints

- (a) Poor Soils: soil development throughout Abu Dhabi has been minimal. At present most of the country is covered by either sand dunes, sabkha, or gravel plains.

The sand dunes are inert aeolian quartz sands. The sabkha may contain areas of clayey material mixed with sands but high salinity prevents any form of plant growth. The gravel plains do contain some areas of primitive silty soil. These can only be utilised where there is no salinity hazard and where groundwater can be supplied for irrigation.

- (b) Arid Climate: Abu Dhabi suffers from high mean temperatures throughout the year, and a very low and unpredictable rainfall. Potential evaporation, and hence evapotranspiration, is very high. It is only close to the coast where the soils are poor and groundwater is unavailable or of unsuitable quality that the humidity is high and evaporation low.
- (c) Shortage of Water: there is no surface drainage in Abu Dhabi. All water supplies depend upon recharge of shallow aquifers on the desert foreland. The major source of recharge is rainfall in and around the Oman Mountains which seeps into the aquifers at the base of the mountains. Groundwater movement is towards the gulf. The water generally becomes more saline closer to the coast. In the majority of areas the groundwater is too saline for irrigation.

2. Human Constraints

- (a) Lack of Knowledge concerning the Country's Basic Natural Resources: though it is possible to discuss the basic natural resources, (soil, water, climate,) of the country in broad terms there is at the present insufficient detailed information for rational planning of agricultural development.
- (b) Shortage of Knowledge about the Present Role of Agriculture: the collection of basic human statistics is poorly developed in Abu Dhabi. It is particularly difficult to formulate realistic plans for comprehensive agricultural development unless reliable information is available relating to population, agricultural holdings, crop areas, crop yields, successful crop varieties, livestock numbers, food supplies, and food demand.
- (c) Lack of Trained Personnel: Abu Dhabi is a newly developing country; until ten years ago there was not even a modern school in its territory. It is not therefore surprising that there exists a chronic shortage of trained or skilled personnel

throughout all sections of the community. The shortage of trained personnel in agriculture is in both the technical and administrative sectors. It is notable that only one Abu Dhabi national in the Department of Agriculture in 1972 possessed any formal academic qualifications.

- (d) Social Stigma: there is a traditional social stigma attached to animal husbandry; in that the practical aspects of husbandry are considered to be carried out by women. Conversely there is much social prestige to be gained from being the owner of a beautiful garden or a large date orchard, however it is not socially prestigious to actually work in the garden, or to work on a smallholding. Almost invariably Abu Dhabi nationals try to either hire immigrant labour or employ members of the family.
- (e) Trend towards Urban Living: the upsurge in the economy has created many opportunities for Abu Dhabi Nationals and others to obtain high remuneration either in commerce, the construction industry or administration. The incentives to work in the towns rather than the fields has depleted the labour supply for agriculture. Should this trend continue the number of people willing to farm the land could conceivably fall to a serious level.
- (f) Importation of Food Supplies: with the increase in per capita income there has been a marked tendency to import foreign produce, rather than foster local production.
- (g) Poorly Developed Infrastructure in the Agricultural Sector: there has been a phenomenal increase in the construction of roads, offices, schools, hospitals and houses but as yet there is little evidence of the provision of infrastructure to serve agriculture.
- (f) The Decision Making Process: Traditionally the Shaik or the Ruling family have made all decisions which related to their people's welfare. In the past the Shaik was readily accessible and he had time to hold council and receive the petitions of his subjects. Surprisingly this process of government is still followed. All members of the Ruling

family have expatriate advisers, (mainly Palestinians, Jordanians, Egyptians or Kuwaitis.) Some responsibility for the everyday running of the government departments has been transferred to them, yet on many occasions the advisers still have to refer back to the Shaik, in charge of the ministry or department, even for quite minor decisions. All major decisions are still made by the Sheiks and often these decisions appear to be made with little reference to their advisors. The policy of the department is often the policy of one man; unfortunately the policy is often based upon intuition or personal judgement either because the facts are unavailable or because he chooses to ignore them. These methods of government are traditional and will take time to change. In some respects they must be recognised as a potential constraint to development, yet the method can also be advantageous, in that once the Shaik decides upon a policy then all those involved in the implementation of policy are unlikely to question or frustrate the decision.

4. SUGGESTIONS FOR ASSISTANCE TO IMPROVE AND ACCELERATE EXISTING AGRICULTURAL DEVELOPMENT SCHEMES

4.1 General

Agricultural development schemes in Abu Dhabi are small, in terms of area, proportion of the population involved and percentage of the annual development budget. It is universally accepted that Abu Dhabi does not need financial assistance, on the contrary the State makes financial aid available to other countries. Similarly Abu Dhabi unlike some other underdeveloped countries does not have a large poverty-stricken agrarian population. As far as can be ascertained the Government appears to be thinking in terms of a small scale development of agriculture concentrated on the Al Ain area. Having regard to this aim and within the context of existing development schemes, the scope for realistic external assistance is extremely limited. On the other hand if 'new' development schemes were to be established the need for technical assistance would be increased appreciably.

4.2 Technical Assistance Within the Context of Existing Schemes

Accepting that the country has the necessary resources to provide capital works, machinery and the like, the most necessary form of assistance will

be in the fields of planning, improved technology and implementation of agreed projects or techniques.

At present there probably exists a further 6-7,000 hectares of land moderately suitable for irrigated agriculture in the vicinity of Al Ain and Buraimi. This land cannot be developed until additional water supplies are made available. The water shortage problem can be tackled in two ways.

- (i) Locate new sources of water.
- (ii) Rationalise and improve the existing irrigation practice in Al Ain.

Assistance could be provided in the form of expatriate personnel who would:

- (a) Carry out: a comprehensive and long term study of the existing water abstractions in the area and the effect on the water table; an investigation of run-off and recharge from the Oman Mountains and the extent of safely exploitable groundwater resources to the north and south east of Al Ain.
- (b) Advise and provide demonstrations to the Ministry of Municipalities and Agriculture on the steps needed to curtail the wastage of water under existing practices.

Data collection and compilation is another field in which assistance could be supplied. At the moment it is difficult to assess and monitor the progress of development schemes at Al Ain because little or no statistics have been collected in any branch of the programme. Therefore the establishment of a statistical data collection section, would provide information as a basis for further assistance in specific fields.

It is evident from the preceding sections of this memorandum that there are shortfalls in the work and staffing of the development schemes, hence technical assistance and local or overseas training opportunities could be provided in the following fields.

- (1) Plant pathology.
- (2) Veterinary Science.
- (3) Soil management.

- (4) Farm Management.
- (5) Extension Services.
- (6) Crop Production.
- (7) Cooperatives.
- (8) Marketing Services.
- (9) Animal Husbandry.
- (10) Meat Marketing.

It may be possible to link or combine technical assistance in the disciplines listed above with training schemes by establishing an Agricultural Training Centre at Al Ain, perhaps in close proximity to the existing Experimental Farm. At the moment there is no university or tertiary education centre in Abu Dhabi. If such a training centre was set up then it could combine with a central analytical laboratory for soils, water, public health, plant pathology and veterinary science. This form of project may seem ambitious in the context of the present status of the agricultural sector, however in the future, the agriculture of Abu Dhabi, the U.A.E. and Western Oman is likely to expand and the demands for such a centre and pool of support facilities will become increasingly important.

Though there is an obvious need for the improvement and acceleration of agricultural development, technical assistance may be difficult to implement. Expatriate personnel would need to speak arabic and would need to be able to fit in with the present system of work in the Government, yet have sufficient authority and responsibility to carry out an agreed programme of work.

The opportunities for assistance to improve and accelerate the Sadiyat Island project and the afforestation scheme are minimal as both these schemes are already staffed and operated by experienced consultants.

5. GENERAL COMMENTS ON POSSIBLE FUTURE DEVELOPMENT AND ORGANISATIONAL ASPECTS

As stated earlier the developable natural resources in Abu Dhabi are limited and the present economy is almost wholly dependant upon oil revenues. Although it is difficult to foresee the time when oil reserves become depleted, the fact remains that oil is a non-renewable resource and it would seem sensible that the Government of Abu Dhabi should give consideration to the development of other resources, if only as a means of diversification resulting in the provision of additional employment opportunities and the achievement of a degree of self-sufficiency in food supplies.

At present the organisation of agricultural development both in Abu Dhabi and the U.A.E. is uncoordinated and lacking in a unified policy. It would be logical for the Ministry of Agriculture and Water for the Northern Emirates to merge with the Abu Dhabi Ministry for Municipalities and Agriculture. Assuming that this change did not take place in the foreseeable future, Abu Dhabi could take steps to facilitate development by rationalising the Ministries responsible for natural resources and agriculture within its own territory. The prime area for new projects is in the field of soil, water and climatic surveys. The most important field of study is that of the groundwater resources, since this is the most limiting factor. Once this resource has been assessed then the exploitation of groundwater should be controlled in accordance with predetermined criteria. Unfortunately it is unlikely that the control required could be exerted by the three ministries, presently involved in exploiting the same resource, each for different purposes. The establishment of a central water authority would conceivably provide a solution to this problem. The authority would have control over all water affairs including desalinisation, use of sewage effluent, industrial and domestic requirements.

Since the recharge of aquifers within Abu Dhabi is largely dependant upon rainfall in catchments in the Oman mountains, any evaluation of the long-term underground water resources presupposes a study of the catchments. This would of course necessitate agreement with Oman on a joint investigation which would have mutual advantages. However, the political problems and implications of such an arrangement are beyond the scope of this memorandum.

It was stated in the Introduction that the formation of the U.A.E. resulted in the establishment of a number of ministries which have jurisdiction in the northern Shajkdoms - Abu Dhabi maintaining its own corresponding ministries. Whilst this situation may have certain advantages to Abu Dhabi, the development of agriculture can best be achieved within the U.A.E. as a whole since in a situation where basic resources are limited, development should be concentrated in the most promising areas and at the same time provide for a higher degree of diversification. For example the gravel plains of Ras al Khaimah, Sharjah and Dubai have a higher potential for development than lands in Abu Dhabi and it would be logical to supply these areas with such irrigation water as is available as a first priority.

No attention appears to have been given to the improvement or development of agriculture in the Liwa Oases. Gibbs and Huntings [22] suggested in 1969 that further work should be carried out to assess the chances of establishing salt tolerant crops and the diversification of the present very limited cropping regime.

Abu Dhabi island may have a potential for horticulture once the new sewage system has been installed. Part of the treated effluent could be profitably used for irrigation provided the land was adequately drained. Brian Colquhoun and Partners, the Consultants on the scheme, have apparently considered this aspect.

Whilst it is unlikely that the quality of the range land in the rugged grazing areas of Bainunah, Al Hamra and Al Dhafra in the south and centre of the State have a significant potential, never the less an assessment of the quality and livestock carrying capacity of such areas would be worthwhile, even assuming that the results were unfavourable. At the present time these areas are used by those remaining Bedu who have not taken up sedentary occupations.

5.1 Capacity for Implementation

The building and construction industry has expanded dramatically over the past five or six years with the building of hotels, offices, houses and flats in addition to the construction of the dual carriageway road to Al Ain and major harbour works. It is believed that virtually all the building and construction capacity is foreign. There appears to be no shortage of contracting firms, hence any civil works in the agricultural sector could be implemented without undue delay.

6. FISHERIES

6.1 General Situation

The 300 miles of coastline along the Arabian Gulf provide the State with an opportunity for diversification of employment and industry away from sole reliance on the production of oil. Abu Dhabi is situated close to two of the most productive water masses in Asia, namely the Arabian Gulf and the Gulf of Oman. The Arabian Gulf between Iran and the U.A.E. is highly productive on account of the biological enrichment of the water between September and March. The colder, less saline and more fertile water from the Gulf of Oman sweeps for nearly 100 miles into the Arabian Gulf through the Straits of Hormuz. This influx of water carries with it vast quantities of pelagic fish particularly tuna, sardine, mackerel and allied species. The Gulf of Oman is highly productive because it has a high organic content. This is maintained by an upwelling process which continually enriches the surface waters with abyssal nutrient salts. At present the major centres for fishing in these waters are Ras Al Khaimah, Fujairah, Sharjah, Ajman and Um Al Quwain. In the latter two emirates fishing is the major occupation and source of income. In Ras Al Khaimah, Fujairah and Sharjah fishing ranks equal in importance with agriculture. Dubai has the largest and most sophisticated fishing fleet (Table 6.1) but its importance in comparison with the entrepôt trade and oil industry of the port is small. In Abu Dhabi the present importance of fishing is minimal, this is largely because all other activities have been eclipsed by the oil and construction industries. Abu Dhabi however has always been a small fishing port and achieved some degree of importance during the height of the pearl fishing industry between 1906 and 1930. In 1930 the Japanese cultured pearls industry captured much of the world market and this brought about a collapse in the pearl industry in the Gulf.

Currently the main activity and investment in the fishing industry is in the northern emirates. Table 6.1 gives information relevant to fisheries in the northern emirates. The development of fisheries in these areas is being financed largely by funds from Abu Dhabi. Capital investment is in:-

- (i) Boats and fishing equipment.
- (ii) Loans and grants to fishermen for engines.
- (iii) Marine workshops.
- (iv) Cold storage and ice factories.
- (v) Fish markets.

TABLE 6.1 Fishing Industry in the Northern Emirates - Selected Statistics

Emirate	Number of fishing boats	
	Motorised	Non-motorised
Dubai	328	10
Ajman	109	17
Um Al Quwain	104	13
Ras Al Khaimah	135	111
Sharjah	175	208
Fujairah	17	299
Total	868	658

Item	Emirates on	
	Arabian Gulf	Gulf of Oman
Number of fishermen	3,288	2,725
Investment in boats and fishing equipment Dhs.	10,208,270	580,330
Total catch in tons	17,214	23,660
Value in Dhs.	18,391,250	7,695,720
Approximate annual earning of fishermen in Dhs.	2,500	1,400
Average price of fish per pound Dhs	.50	.16

Emirate	No. of fishermen (nationals)	Total annual catch (tons)	Annual earning per crew in Dhs.	Value of catch in Dhs.
Ras Al Khaimah	1,404	6,452	1,760	3,871,200
Um Al Quwain	328	1,782	2,175	1,425,600
Ajman	665	1,494	3,210	1,994,000
Sharjah (Gulf of Oman)	1,180	9,962	1,520	3,586,320
Sharjah (Arabian Gulf)	503	2,976	3,255	3,273,600
Dubai	820	4,510	3,300	5,412,000
Fujairah	1,545	13,698	1,330	4,109,450
Total	† 6,445	40,874	16,550	22,592,170

† This figure includes 432 fishermen who are fishing outside the U.A.E.

In addition the Department of fisheries provides assistance and advice for fishermen, and maintains a fishery Research Vessel 'Majed' which carries out surveys in the Arabian and Oman Gulfs.

At the moment the loan schemes for boats, fishing equipment and engines are progressing well. Investments by the fishermen through government and private finance were estimated by White and Barwani [4] to be 10,788,600 Dhs. distributed as follows:-

	<u>Dirhams</u>
Dubai	2,225,400
Ajman	3,255,200
Um Al Quwain	578,300
Sharjah	2,408,350
Ras Al Khaimah	2,536,600
Fujairah	580,330

In 1972 marine workshops were in existence or proposed at the following towns:-

- Khor Fakkan - 1 senior mechanic, 2 mechanics
- Sharjah - 1 senior mechanic, 2 mechanics
- Ajman - 1 senior mechanic, 2 mechanics
- Um Al Quwain - 1 senior mechanic, 3 mechanics
- Ras Al Khaimah - to be completed in 1973, 1 senior mechanic, 2 mechanics
- Fujairah - to be completed in 1973, 1 senior mechanic, 2 mechanics
- Dibba - proposed to be established in 1974 will require 1 senior mechanic and 2 mechanics

In 1972 an ice factory and cold store was nearing completion at Khor Fakkan, and it was proposed that the following ice factories and cold stores would be established:-

- Ras Al Khaimah - 1974
- Dibba - 1974
- Fujairah - 1974
- Sharjah - 1975

In 1972 there were fish markets in Ras Al Khaimah, Um Al Quwain, Ajman and two in Dubai. The F.A.O. [39] recommended that further fish markets should be set up at Kalba, Gurfa, Khor Fakkan and Dibba in order to revive the fresh fish industry in ports along the Gulf of Oman. The demand for fish locally is very high. It is estimated that the per capita consumption of fresh and dried fish is about 30 kgs/annum.

6.2 Further Development of Fisheries

It is suggested that the Gulfs of Oman and Arabia contain very large fish stocks and that at present the fishing of these resources is poorly developed. The recent development of fisheries in the northern emirates is a step in the right direction yet the fishing industry in this area could be further intensified. At present there is unnecessary wastage through lack of handling, storage, processing and marketing facilities. The fishing industry of the U.A.E. could expand beyond the scope of supplying the home market with fresh fish. There is an opening for large scale deep water fishing fleets which aim at exploiting the stocks of tuna, mackerel, sardine and other shoaling fish. The catch of these fleets could then be chilled, frozen or processed and exported to the Middle East, Mediterranean, Western Europe or even the U.S.A. If the U.A.E. does not develop its industry there is a grave likelihood that Iranian, Omani, Japanese, or other fishing fleets may soon dominate these waters. The Iranians and Omanis in particular are well placed to intensify their fishing activities in the area. Japanese and other non-local fleets could exploit the area but they would need factory ships which could store or process the fleet's catch.

It is suggested that Abu Dhabi could seize the opportunity to intensify the fishing of the area by undertaking the following developments utilising the traditional interest in fishing plus the country's adequate financial resources.

1. Development of Handling and Processing Facilities

In order to expand the fishing industry it will be necessary to build facilities to take the catch from the fishing boats either to the market or processing plants. Therefore new facilities such as wharves, cranes, conveyor belts, and suction lift devices will be needed. Once on shore the following processing plants will be needed:-

- (a) Ice factories and cold stores for handling fresh fish to be sold locally or exported.
- (b) Freezer plants in order to freeze fish for export.
- (c) Canneries for canning such fish as tuna, mackerel, sardine and anchovy for export.
- (d) Fish meal factories for processing the "trash" fish and offal into fertilizers, animal fodder and fish oil. These by-products could be used locally or exported to neighbouring countries.

2. Expansion of the Fishing Fleet

In order to undertake this increased fishing activity a standard boat of about 15 to 25 metres overall length would be needed fitted with an engine of about 200 to 400 horsepower, together with on-board storage and chilling facilities. This size of vessel could stay at sea for some time whilst it fished the waters in the Straits of Hormuz and the Gulf of Oman.

3. Research and Support Facilities

Large scale fishing fleets need on shore support in the form of fuel, water, food and ice facilities. Abu Dhabi has one great advantage in that it can provide cheap oil fuel for local and foreign vessels.

In addition, if the exploitation of the fish resources in the Gulfs is to expand then a continuous programme of research into fish stocks, shoal migration patterns, and nutrient supplies must be undertaken. The Department of Fisheries research vessel, Majeb, is already doing this in a small way, but there would need to be an expansion of the research effort including technical manpower in the ministry. The research and development of fisheries could be undertaken jointly between the government and outside interests. For example in the Oman, Mardela International (California), F.M.C. International, and Del Monte International, are involved in joint venture projects with the government to develop fisheries in the north west Indian Ocean. These projects involve expatriate instructors to improve fishing techniques, schemes for processing plants and canneries, and a vessel and installations to explore the potential for deep sea and coastal water fisheries [19].

7. CONCLUSIONS

When compared with other newly emergent developing countries, Abu Dhabi is in a unique situation on account of the following factors:-

- (i) Very limited natural resources (excluding oil).
- (ii) Generally unfavourable climatic conditions for crop and animal husbandry.
- (iii) Limited human population, which is characterised by varying degrees of affluence.
- (iv) Availability of almost unlimited financial resources for development.
- (v) A declining rural population, particularly those actively engaged in agriculture.
- (vi) Chronic shortage of indigenous technical and administrative manpower.
- (vii) Lack of basic information relating to the agricultural sector.
- (viii) Inadequate institutional facilities and support services.
- (ix) Existence of social constraints which adversely affect agricultural development.
- (x) Continuation of the elements of feudal type of administration within the framework of an otherwise conventional type of administrative machinery.

Notwithstanding the availability of adequate financial resources, the scope for the improvement and expansion of the agricultural sector is very limited, moreover any improvements to the existing state of agriculture are unlikely to be spectacular. It is suggested that present-day agriculture could be improved by:-

- (a) The provision of training facilities for both farmers and technical advisory staff.
- (b) Provision of suitably qualified and experienced expatriate personnel in key posts to guide and supplement the activities of local nationals.

- (c) Conservation and better utilisation of existing water supplies by reduction of transmission losses (lining of channels) and improved field efficiency.
- (d) The introduction of early and late vegetable varieties in order to obviate a glut.
- (e) Provision of cold stores and refrigerated vehicles to accommodate production surplus to local requirements.
- (f) Institution of agro-economic surveys to obtain basic information on the extent and nature of existing systems of agriculture and to facilitate monitoring and planning thereafter.

The scope for "new" projects or activities is again somewhat limited, however the following suggestions are considered to be worthy of consideration and may be favourably received by the Abu Dhabi authorities:

- (a) Hydrogeological surveys to ascertain underground water resources and to monitor the characteristics of existing abstractions, particularly in areas where the water table is declining.
- (b) Subject to the findings in (a) above, development of additional lands to the extent of the safe yield of the aquifers in the Al Ain area.
- (c) Establishment of an agricultural training centre, possibly adjacent to or in close proximity to the existing experimental farm at Al Ain to accommodate the training requirements for both farmers and advisory staff. Such a centre could combine a central analytical laboratory for soils, water and public health; plant pathology and veterinary science.
- (d) Agricultural and hydrogeological surveys in the Liwa area to ascertain whether there exists any scope for improving or extending the present area under cultivation.
- (e) Duplication of the Sadiyat Island Power and Water Project should the export demand for fresh vegetables increase to a marked extent.
- (f) Establishment of fish handling, storage and processing facilities coupled with fuelling and victualling services to serve offshore activities being undertaken by other members of the U.A.E.

APPENDIX I

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APPENDIX I

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APPENDIX II

PREVIOUS INVESTIGATIONS INTO SOIL AND WATER

RESOURCES OF THE UNITED ARAB EMIRATES

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PREVIOUS INVESTIGATIONS INTO SOIL AND WATER RESOURCES
OF THE UNITED ARAB EMIRATES

II.1 Sir William Halcrow (1965-1968)

This is the most comprehensive work on Water Resources Survey carried out for the Trucial States. The survey work extended over a period of three years (1965-1968). Three hydrological year-books (for 1965/66, 1966/67 and 1967/68) were published which described the progress of the survey and set out the basic hydrological data recorded.

The final report dated 28th February 1969 incorporates all the results of the three years' study. It is in three volumes and includes logs of 105 boreholes, the results of 90 pumping tests and over 180 chemical analyses of water. Volume I comprises the main text of the report, while Volume II contains the schedules, i.e. hydrological observation sites, chemical analysis of water samples, borehole logs and pumping tests. Volume III, on the other hand, contains 43 drawings and charts.

The work gives a good picture of the climate, hydrology, surface flow, groundwater quality and quantities, and water balance. A network of meteorological stations, hydrological stations and measurement of underground water levels and the changes of salinity level in the same has been installed. This work was taken over by the Trucial States Council from the consultants and a Hydrological Year-book for 1968/69 has been published in July 1970. This work is now the responsibility of the Rural Water Section in the Federal Ministry of Agriculture and Fisheries. The collection of the data has been continued with some expansion, but no reports have been published yet. At the time of the F.A.O. Mission's visit to the country, the Rural Water Section was beginning the process of compiling the data for publication in a Hydrological Year-book to cover 1969/70, 1970/71 and 1971/72. There is a need for outside help to see that the collection of these data is maintained and improved upon.

The main conclusion of this report is that the resources of good quality water are limited and while further exploitation is possible, it should be undertaken with caution and regard to the safeguarding of important existing sources of supply. The recent and continuing expansion of commerce and growth of population in this area has been accompanied by a correspondingly rapid increase in the demand for water. Careful and flexible planning of future exploitation projects coupled with systematic monitoring of the behaviour of existing well fields is recommended. There is a danger that without such continuing control, existing projects may be unexpectedly rendered obsolete by events.

II.2 Sir Alexander Gibb and Hunting Technical Services Ltd. (1968-1970)

This work is based on three years (1968-1970) survey of the resources of water in the State of Abu Dhabi. A general reconnaissance of the water resources of the entire State was proposed in the study together with detailed investigations in the Buraimi area, the Liwa and other known or likely new groundwater areas.

An Interim Report was prepared in April 1969. This report recorded the results of a general reconnaissance over the whole of the State; geology, climate, topography and distribution of population were reviewed. A description of the origin and sources of surface and underground water was given.

As a result of the reconnaissance it became evident that groundwater in quantity and quality worth exploiting existed in only two districts: Al Ain and to a much smaller extent, in the Liwa. No other known or likely new groundwater areas were recommended for detailed investigation.

The Interim Report included details of the soils' survey carried out and the land classification maps prepared for Al Ain and the surrounding district. The land classification indicated that there are some 6,500 ha of land suitable for cultivation in and around Al Ain.

A scheme for detailed investigations in the Liwa was submitted to the Government but the Government decided not to proceed with it.

At Al Ain a programme of drilling and pumping involved the drilling of about 35 holes to a depth of 100 metres together with four holes going down to a depth of 600 metres. To obtain additional information about water

quality and the extent of permeable and impermeable strata, an electrical resistivity survey was carried out covering the area over which the boreholes had been put down.

The main conclusions of this work are as follows:-

1. No deep fresh water aquifers exist in the Al Ain district nor in any other part of the State.
2. The present shallow aquifer underlying Al Ain is being over-exploited.
3. The results of a soil survey in and around Al Ain identified 6,500 ha of land which is suitable for cultivation. However, the development of all or part of this area is limited due to the scarcity of underground water. The establishment of any new major irrigation scheme based on groundwater does not appear to be possible. This is so as the demand for domestic water is increasing due to the rapidly expanding town of Al Ain. Consequently, the limiting factor for the development of agriculture in Al Ain was seen to be water and not suitable land.

However, although there is insufficient water to permit the establishment of a new irrigation scheme, there appears to be some scope for the extension of small-scale cultivation by the use of water that can be saved by economies in present systems of irrigation methods.

4. Water supply of Abu Dhabi Island should eventually come from desalination plants. The present supply from the Saad and Bu Samarah well fields (from Al Ain area) is about 1.7 MCM/year should in the future be re-routed to augment the supply to the Al Ain area.
5. Two charts showing the consultants' assessment of the present and future water balances for the Al Ain Oasis are included in the report. These charts illustrate pictorially the very delicate balance between the available water and the amount now being used and indicate the vital need to control the development of wells and to economise in the use of water.

6. Emphasis is laid on the importance of co-operation with the adjoining Sultanate of Oman. It is normal for countries which draw their water from the same river to agree on a system of sharing the available flow; similar agreement is even more desirable for countries which share a very limited supply of water from the same underground source.
7. It is pointed out that future development of Al Ain must take into account similar developments in the Oman villages at Buraimi. It is also indicated that the water which flows from the hills towards the Northern Dune area and to the Southern Jaww Plain could be most economically extracted in Oman territory for the benefit of both States.
8. Two meteorological stations were established in 1970: one in Al Ain Agricultural Farm and the other on Abu Dhabi Island. Observation on the flow in the aflaj, and water levels in control wells have been established. This work has been continued and is being carried out by two technical foremen attached to the Ministry of Public Works.

II.3 Durham University (1967-1968)

Three reports were prepared by teams from Durham University. The first was a reconnaissance survey (1966/67) of soils and agricultural potential in the Trucial States. The second was a semi-detailed soil survey in 1967 of two potential development areas in the central gravel plains. These included Mileiha Development project of about 120 ha and Hamraniyah Development area in Jiri Plain of about 1,200 ha. The third report was by J.H. Stevens in 1969 on "The Soils and Agriculture of the Al Ain Oasis, Abu Dhabi". It describes the soils, irrigation methods and cultural practices in the old and new orchards.

