IV METEOROLOGY AND HYDROLOGY

Meteorology

4.01 Depending on the topographical conditions, which are already described in Chapter II, Hajjah Province is divided into three geographical regions; coastal lowland, midland and highland.

4.02 No long term meteorological data are available in the Area. Systematic observation has been carried out only at the Chinese Farm in El-Bahana since 1976. The Chinese Farm is located northeast of Shahara and the elevation is around 1,200 meters above the sea level. The observation data represent the midland climate. No meteorological stations exist in the coastal lowland and the highland. The climate conditions in the coastal lowland and the highland were esti estimated from the observation data at the adjacent meteorological stations, i.e., Al-Zuhra and Sana'a respectively. The locations are shown in Fig. 4.1. The climatic data at these stations on temperature, relative humidity, actual sunshine hours, rainfall, evaporation and wind velocity are shown in Table 4.1. The representative patterns of rainfall and temperature in each geographical region are given in Fig. 4.2.

4.03 The coastal lowland has a tropical arid climate and is extremely hot except in winter season. The mean monthly temperature range from 26°C in December to 34°C in June. The mean monthly minimum temperatures range from 19°C to 29°C and mean monthly maximum temperatures range from 32°C to 40°C. The area generally receives less than 300 mm annual rainfall which concentrates in the periods between May and October. The average relative humidity is 60 to 80 percent and especially high in the morning. Strong winds blow frequently from the southwest to northeast causing sand dune movement.

4.04 The midland has subtropical climate. The mean monthly temperatures range from 21°C in January to 29°C in June. The mean monthly minimum temperatures range from 6°C to 15°C and mean monthly maximum temperatures range from 23°C to 30°C. The annual rainfall is over 300 mm in the foothills and it increases by altitude reaching 600 mm with two peaks in April/May and July/August. Annual rainfall decreases from southwest to northeast ranging 950 mm at At Tur to 520 mm at El Bahana near Shahara. Main wind direction is east in winter and spring, and west in summer and autumn.

4.05 The highland, comprising mountainous area above 1,500 m in elevation, extend around Al Mahabisha and Shahara. The climatic conditions are similar to those of the midland. The annual mean temperature go down by altitude as illustrated in Fig. 4.3. The annual rainfall reaches to 800 mm in Al Mahabisha and decreases towards the northeast. The temperature fluctuation in a day is considerable. The sunshine intensities are very much affected by the slope directions as illustrated in Fig. 4.4.

River basins

4.06 The project area, in terms of river basins, can be roughly divided into two by the ridge running from north to south in the central part of the Hajjah Province. The one is the Wadi Mawr basin which covers most of mountainous area in the east of the ridge and the other is the basin composed of coastal lowland and midland in the west of the ridge, as shown in Fig. 4.5.

4.07 Wadi Mawr, the largest of Tihama wadis, has a catchment area of about 7,900 km^2 and most of the catchment area lie in the Hajjah Province. It flows away into the Tihama area which is entirely outside the Hajjah Province.

Rainfall

4.08 In the project area and its adjacent area, total 17 rain gauge stations are located as shown in Fig. 4.1. The altitude of the rain gauge stations and periods of observations are shown in Table 4.2. The observation periods are insufficient for hydrological analysis and all the rain gauge stations in the Hajjah Province are located in the catchment area of Wadi Mawr. Several new stations will be required in the coastal lowland and the midland in the west of the ridge. The monthly mean rainfall records at 17 stations are given in Table 4.3. In illustration of the local distribution of annual rainfall, an isohyetal map is shown in Fig. 4.6. The rainfall distribution makes a cone with the center at At Tur, where the average annual rainfall is 950 mm and it gradually decreases toward northeast.

Runoff

4.09 The discharge records of Wadi Mawr are only available runoff data. The observation has been carried out by the Tihama Development Authority especially for the development of Wadi Mawr since 1975. The monthly discharge and the monthly mean are shown in Table 4.4. The specific discharge is extremely small as seen from Table 4.5. The monthly mean specific discharges range from 1.2 mm in February to 3.8 mm in August. The annual runoff coefficient is 5.4 percent. The relation between average rainfall and specific discharge are illustrated on Fig. 4.7.

Sediment

4.10 The sediment runoff data of Wadi Mawr are available. Due to the high intensity of rainfall and the steep slope of the river course, Wadi Mawr is a swift running stream, and a considerable amount of sediment is carried by the surface runoff. The river bed of Wadi Mawr is composed of pebble

and cobble and rock in some portion. It gives little sediment. Most of the sediment is supplied from erosion of uncultivated hillslope through the tributaries. The daily sediment load has been estimated for the period of April 1975 through December 1976 by the Tihama Development Authority. The average concentration is 5,700 ppm.

Ground water

4.11 The subsurface of the Tihama coastal plain, which is composed of alluvial deposits, constitutes groundwater aquifer. The seepage from the wadis and the infiltration of rainfall from land surface replenish the groundwater. Unconfined groundwater table can be found in most of the Tihama coastal land. The depth from the land surface to the water surface ranges from less than 5 m to 30 m. Shallow hand-dug wells for domestic use are found near the villages everywhere in the Tihama coastal land. These wells are insufficient in yield capacity, some of which dry out during dry season. Deep drilled wells were perforated into semi-confined aquifer and confined aquifer in Harad and Abs for the purpose of potable water and irrigation water. The groundwater development can be expected in the vicinity of wadis, though the further comprehensive study is required.

Water quality

4.12 The results of water quality analysis for well, wadi and spring are given in Table 4.6. The water quality does not vary much in different water-sources. The specific electric conductivity is below 1,000 micromhos/cm and pH values range from 7.7 to 8.2, which will be acceptable for both irrigation and drinking purposes. The values of sodium absorption ratio (SAR) range from 1.3 to 2.1 and the water can be applied without any restriction to almost all the types of soils and crops.

Water right

4.13 The water rights for streams are administrated under Islamic Law 'al ala falala', whereby the higher lands have priority to the lower land. The priority of a main canal is related to the point of diversion on the wadi, and that of the secondary canal, on the main canal. The field nearest to the canal head has highest priority. The priority is nullified when the diversion structures are damaged or destroyed by floods. A water master is assigned to each canal, and he operates the water distribution. He often re-arranges the field priorities in order to deliver water when needed.

Table 4.1 Meteorological Records
at Al Zuhara, El Bahana and Sana'a

Monthly Mean Evaporation

Unit: mm/day

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual mean
Al Zuhra	6.2	6.4	7.0	8.8	10.3	10.5	10.6	10.1	9.2	7.9	7.1	6.5	8.4
Bahana	6.4	8.5	8.6	8.6	8.4	9.3	6.6	6.3	7.4	7.5	7.7	7.1	7.7
Sana'a	5.1	5.5	7.4	6.8	6.6	10.0	7.8	5.7	9.4	5.4	4.6	5.0	6.6

Monthly Mean Wind Velocity

Unit: m/sec

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual mean
Al Zuhra	2.1	2.3	2.4	2.2	2.2	2.3	2.8	2.5	1.9	1.8	1.9	2.1	2.2
Bahana	2.0	2.7	3.1	1.8	1.4	2.1	1.9	1.3	1.1	2.0	2.6	2.0	2.0
Sana'a													

- to be continued -

Monthly Mean Temperature

Unit: Centigrade

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual mean
Al Zuhra	25.7	26.3	28.0	30.6	32.8	34.1	33.7	33.7	32.1	31.2	28.6	26.4	30.3
Bahana	20.8	22.2	24.7	26.1	27.2	29.2	27.1	26.5	26.5	25.0	22.9	21.5	24.9
Sana'a	14.7	13.0	16.9	19.4	19.4	21.0	22.4	20.3	20.3	17.1	14.2	14.7	17.8

Monthly Mean Relative Humidity

Unit: percent

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual mean
Al Zuhra	79	78	77	72	65	67	65	68	70	72	73	77	72
Bahana	54	44	48	52	53	49	63	71	60	52	46	49	53
Sana'a	59	40	47	47	46	39	45	52	38	50	52	42	46

- to be continued -

Monthly Mean Actual Sunshine Hours

Unit: hours/day

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual mean
Al Zuhra	5.9	6.2	7.9	9.3	8.6	7.8	6.7	6.7	7.3	8.2	8.6	7.9	7.6
Bahana													
Sana'a	8.2	9.0	8.2	8.5	7.2	8.2	5.4	6.2	8.1	6.2	9.2	9.1	7.8

Monthly Mean Rainfall

Unit: mm

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual mean
Al Zuhra	5.2	4.7	0.5	1.6	9.8	4.7	38.4	34.1	13.2	42.9	8.9	0.1	164.1
Bahana	12.8	4.8	47.9	36.1	77.6	28.1	137.5	115.3	38.8	23.4	7.6	0	529.9
Sana'a	1.7	1.0	18.1	47.3	38.9	2.3	27.3	63.3	3.4	24.5	6.7	1.1	235.6

Table 4.2 Location and Observation Period of Rain Gauge

Station	Location		Elevation (m)	Period of Observation
	Latitude	Longitude		1972 1973 1974 1975 1976 1977 1978
Sakain	16°50'N	43°27'E	2,230	
Bani Uwair	16°46'N	43°41'E	2,100	
Washhah	16°26'N	43°21'E	500	
Huth	16°14'N	43°58'E	1,850	
Shaharah	16°11'N	43°42'E	1,300	
Al Mahabishah	16°00'N	43°30'E	1,600	
Khamir	16°00'N	43°58'E	2,350	
Shibam	15°31'N	43°54'E	2,650	
Mahweet	15°29'N	43°36'E	2,100	
Hajjah	15°41'N	43°36'E	1,650	
At Tur	15°35'N	43°24'E	200	
Al Mikras	15°39'N	43°16'E	260	
Al Zuhra	15°44'N	43°01'E	70	
Gebel Al Milh	15°41'N	42°49'E	20	
Surdud	15°15'N	43'15'E	250	
Bahana	16°15'N	43°50'E	1,200	
Sana'a	15°21'N	44°12'E	2,300	

Table 4.3 Monthly Mean Rainfall

Unit: mm

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total
Sakain	0	5.2	53.9	124.7	30.2	16.8	37.4	113.8	8.3	0	0	0	390.3
Bani Uwair	0	0	9.5	73.6	29.0	4.0	22.0	72.0	10.0	0	0	0	220.1
Washhah	48.3	ND	11.6	117.3	64.7	8.5	13.3	2.4	38.4	ND	ND	ND	ND
Huth	3.5	15.2	38.1	71.4	9.2	1.5	0	48.5	32.7	0	0	0	220.1
Shahara	0	0	44.6	62.3	19.5	43.4	107.0	91.7	99.3	0	0	0	467.8
Al Mahabisha	35.1	23.4	37.5	238.7	100.7	38.0	51.1	137.5	51.6	37.2	23.4	19.5	793.7
Khamir	2.4	1.0	36.9	126.2	39.5	14.0	58.6	105.4	2.6	0	0	7.7	394.3
Shibam	16.7	1.3	42.5	81.0	69.3	34.7	104.7	168.3	15.0	23.8	16.8	2.8	576.9
Mahweet	0	16.3	8.7	98.1	65.3	42.2	72.6	234.4	98.2	65.0	16.4	0	717.2
Hajjah	0.1	6.7	36.6	153.8	79.3	19.5	87.4	149.8	62.2	3.1	0.4	7.7	606.6
At Tur	9.1	1.0	18.7	125.2	115.9	106.5	85.5	235.5	127.0	88.9	34.4	0	947.7
Al Mikras	0	0	ND	ND	ND	ND	ND	59.0	44.4	8.2	0	0	ND
Al Zuhra	5.2	4.7	0.5	1.6	9.8	4.7	38.4	34.1	13.2	42.9	8.9	0.1	164.1
Gebel Al Milh	5.3	0	0.1	0	0	0	1.3	36.8	0	12.0	ND	ND	ND
Surdud	0	17.9	8.0	1.1	57.4	21.7	30.4	124.7	97.5	70.5	37.2	3.9	470.3
Baitna	12.8	4.8	47.9	36.1	77.6	28.1	137.5	115.3	38.8	23.4	7.6	0	529.9
Sana'a	1.7	1.0	18.1	47.3	38.9	2.3	27.3	63.3	3.4	24.5	6.7	1.1	235.6

Table 4.4 Monthly Water Discharge of Wadi Mawr

Drainage Area 7,912 sq.km
Unit: million cubic meters

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total
1975	6.9	5.4	6.3	19.6	8.2	24.2	25.0	27.4	17.8	9.8	5.1	6.4	162.1
1976	4.4	4.0	6.4	22.8	18.0	13.3	23.8	33.3	24.0	11.8	11.0	10.4	183.2
1977	11.6	9.0	11.0	38.8	33.8	13.1	12.1	9.6	14.3	27.8	18.3	16.6	216.0
1978	20.7	19.3	17.4	20.1	40.1	20.3	36.1	50.6	42.9	27.5	28.3	21.1	344.1
Mean	10.9	9.4	10.3	25.3	25.0	17.7	24.3	30.2	24.8	19.2	15.7	13.6	226.4

Table 4.5 Monthly Specific Water Discharge of Wadi Mawr

Unit: mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total
1975	0.9	0.7	0.8	2.5	1.0	3.1	3.2	3.5	2.2	1.2	0.6	0.8	20.5
1976	0.6	0.5	0.8	2.9	2.3	1.7	3.0	4.2	3.0	1.5	1.4	1.3	23.2
1977	1.5	1.1	1.4	4.9	4.3	1.7	1.5	1.2	1.8	3.5	2.3	2.1	27.3
1978	2.7	2.4	2.2	2.5	5.1	2.6	4.6	6.4	5.4	3.5	3.6	2.7	43.5
Mean	1.4	1.2	1.3	3.2	3.1	2.2	3.1	3.8	3.1	2.4	2.0	1.7	28.6

Table 4.6 Result of Water Quality Analysis

Water samples		Hajjah Well	Wadi Masana	Bab el Hal Spring	Wadi Laah	WHO Criteria
PH		7.7	7.9	8.2	8.1	7.0 ∿ 8.5
E.C. Millimhos/cm		0.56	0.48	0.43	0.44	
Ca	meq	2.0	4.8	4.0	5.2	
	ppm	40	96	80	104	75
Mg	meq	4.4	2.8	2.2	0.6	
	ppm	53	34	27	7	50
K	meq	0.01	0.01	0.01	0.01	
	ppm	0.4	0.4	0.4	0.4	
Na	meq	2.8	2.3	2.3	3.5	
	ppm	64	53	53	81	
HCO_3	meq	5.76	5.28	4.48	6.24	
	ppm	351	322	273	381	
CO_3	meq	NIL	NIL	NIL	NIL	
	ppm					
Cl	meq	2.40	1.68	1.92	1.68	
	ppm	85	60	68	60	200
SO_4	meq	0.60	0.55	1.00	1.70	
	ppm	29	26	48	82	200
NO_3	meq	0.22	0.22	0.25	0.21	
	ppm	14	14	16	13	
Sum of Cations	meq	9.21	8.91	8.41	9.31	
	ppm	157.4	183.4	160.4	192.4	
Sum of Ca + Mg	meq	6.4	6.6	6.2	5.8	
	ppm	93	130	107	111	
Sum of Anions	meq	8.98	7.73	7.97	9.83	
	ppm	479	422	405	536	
SAR		1.6	1.3	1.3	2.1	

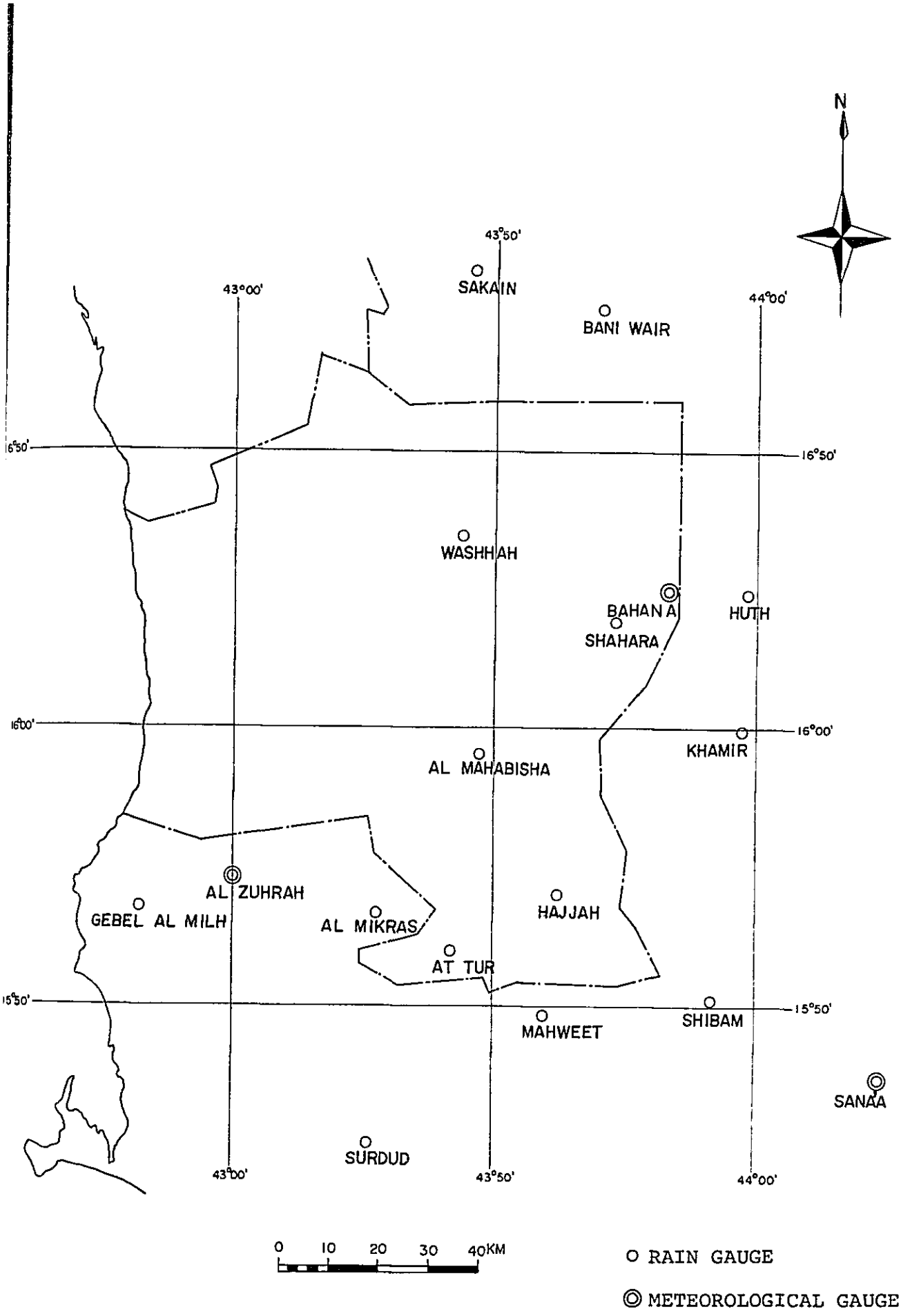


Fig. 4.1 Location of Gauge Station

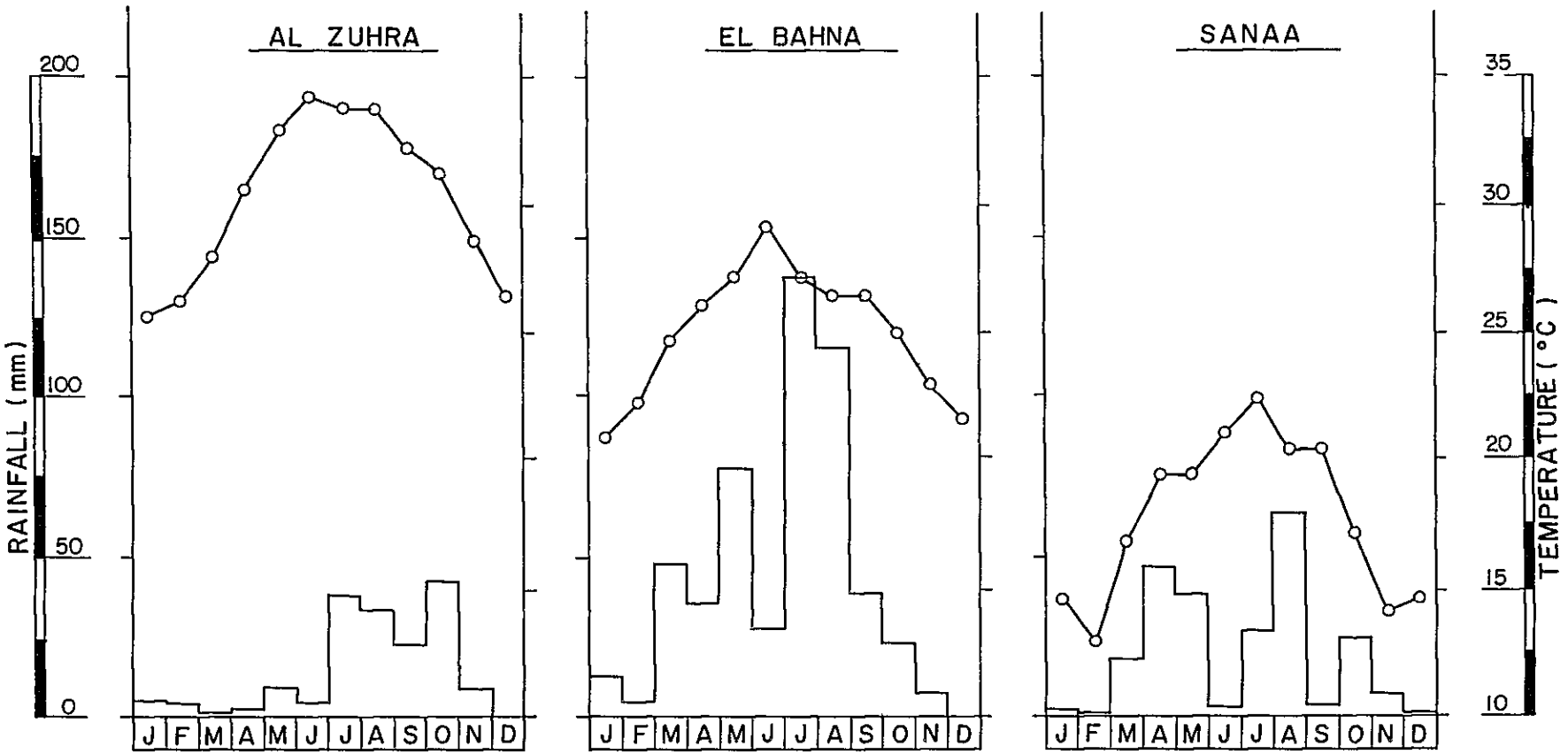
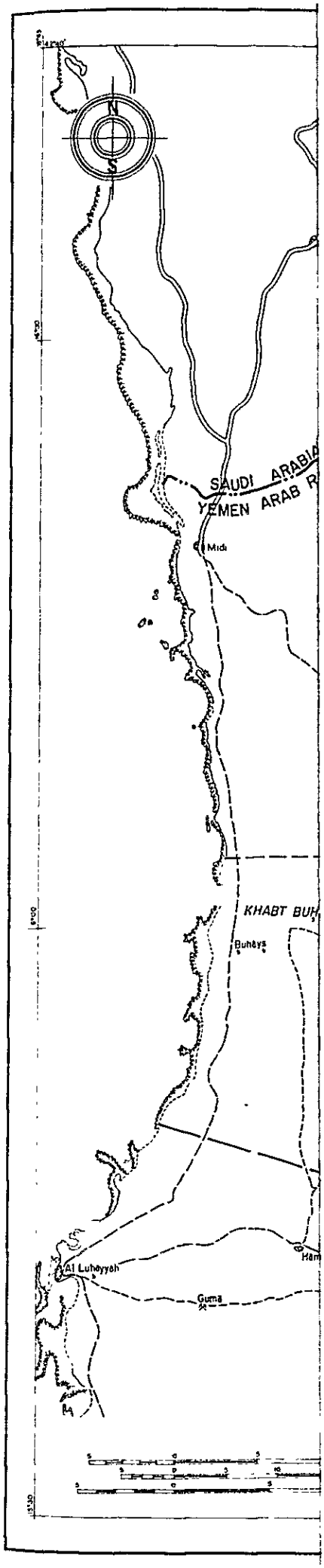


Fig. 4.2 Monthly Rainfall and Temperature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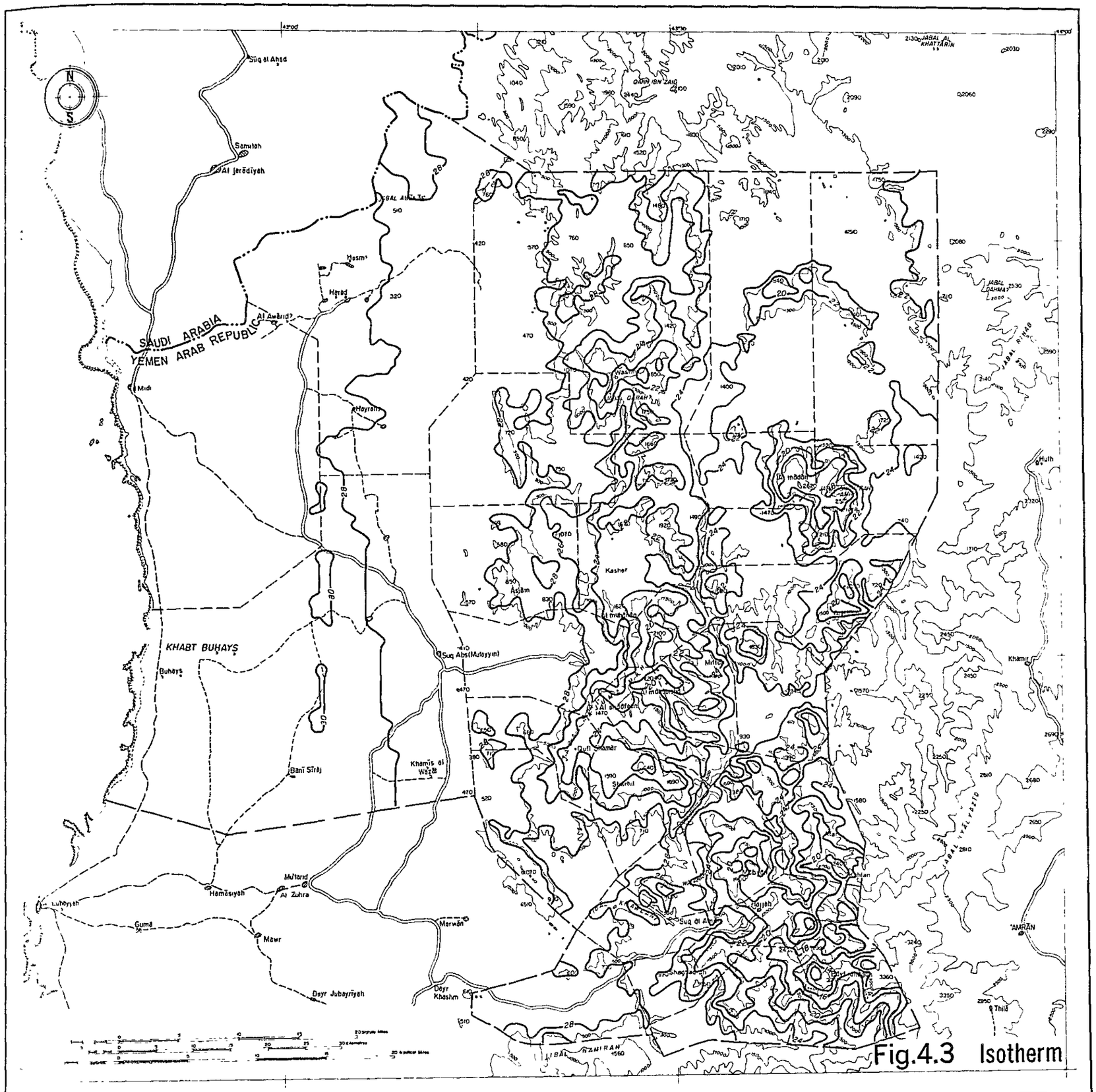
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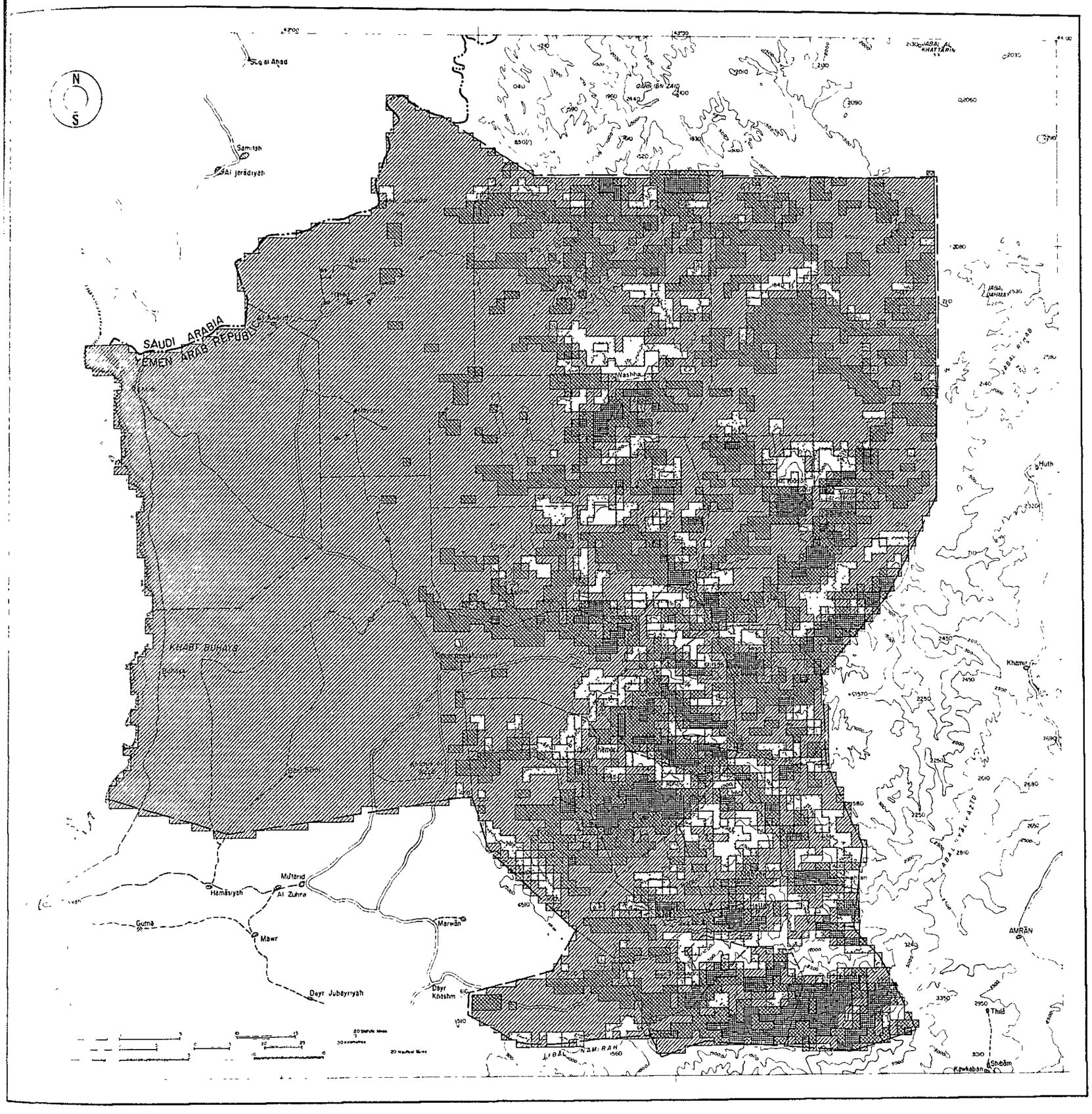
Buḥays
Banī Sīraj
Khamīs al Wāsiṭ
Sūq Abs(Mudayyin)
Kasher
Aslam
Qufl Ḥamdān
Sharīḥ
Mulūnd
Al Zuhra
Ḥamāsiyah
Luḥayyah
Gumā
Mawr
Dayr Jubayriyah
Dayr Khashm
Marwān
Ḥajjah
Sūq al Arbi
Shaghab
Khamir
Thilā
'AMRĀN
Muth
Imādah
JABAL AL KHATTARIN
JABAL DAHMA
JABAL RIKAB
JABAL YAZ YASID
JABAL 'AMRAN
Fig.4.3 Isotherm



LEGEND

	LESS	THAN	50	PERCENT
	50	-	55	PERCENT
	55	-	60	PERCENT
	60	-	65	PERCENT
	OVER	65		PERCENT

Fig.4.4 Sunshine Intensity

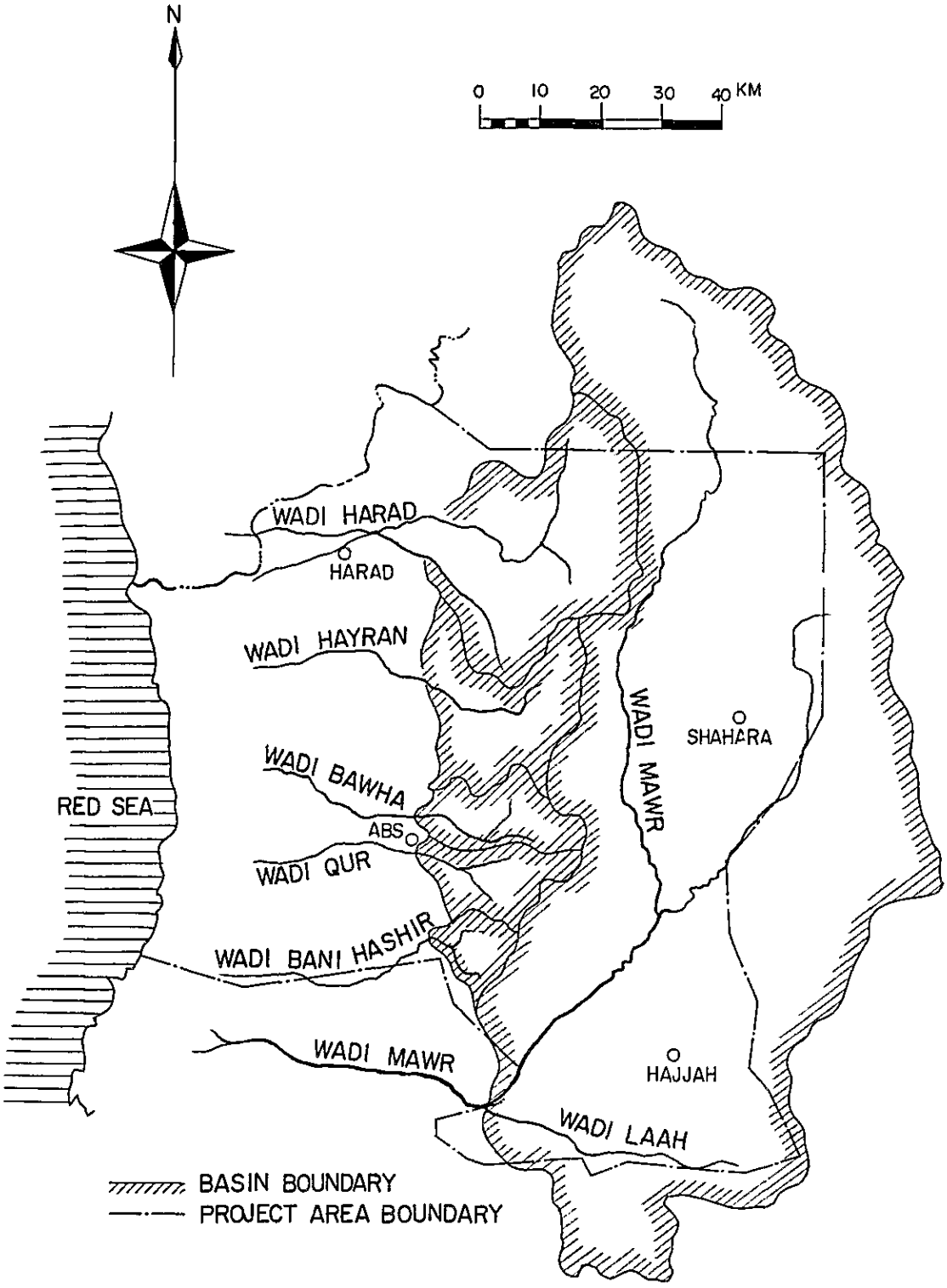


Fig. 4.5 River System and River Basin

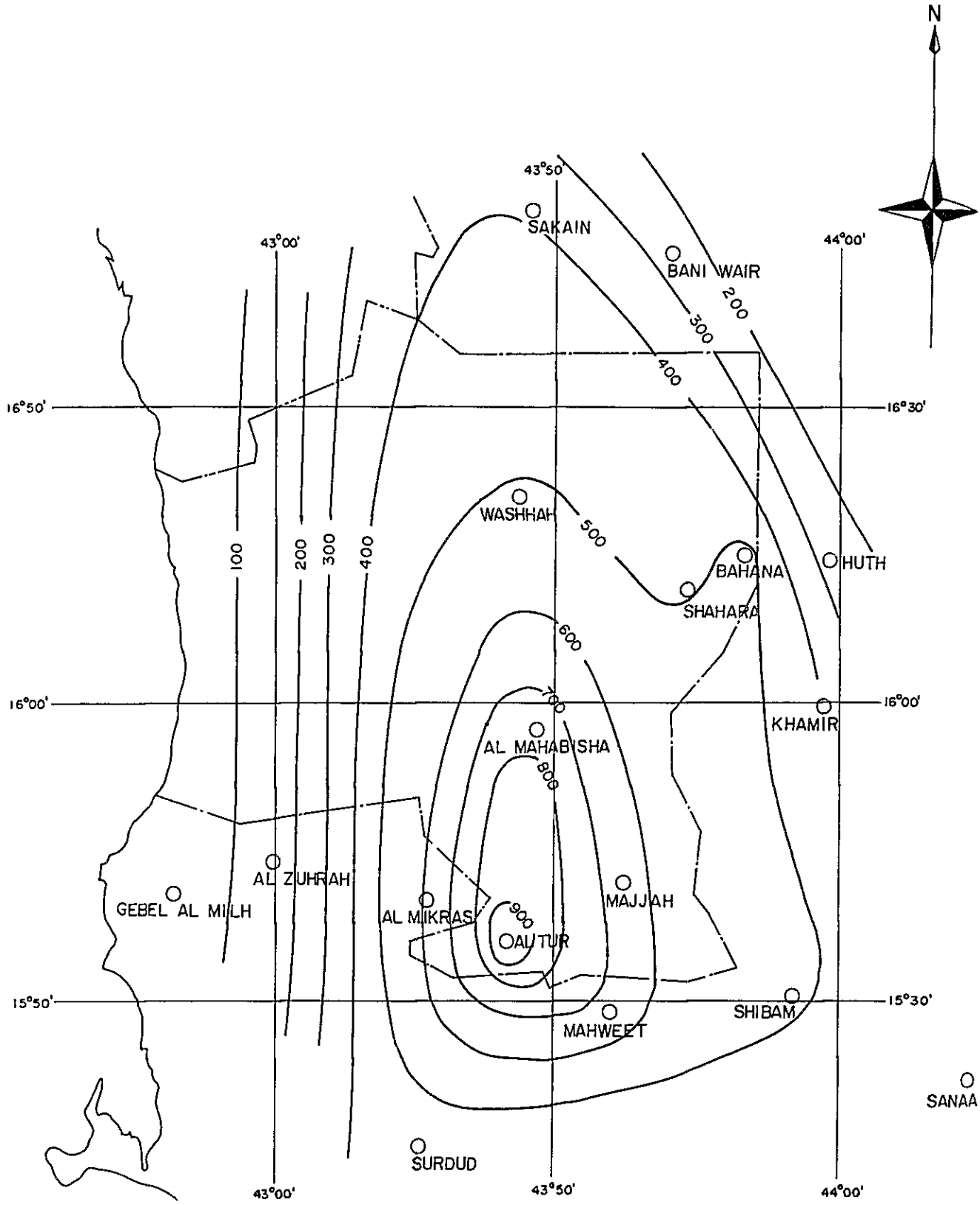


Fig. 4.6 Isohyetal Map

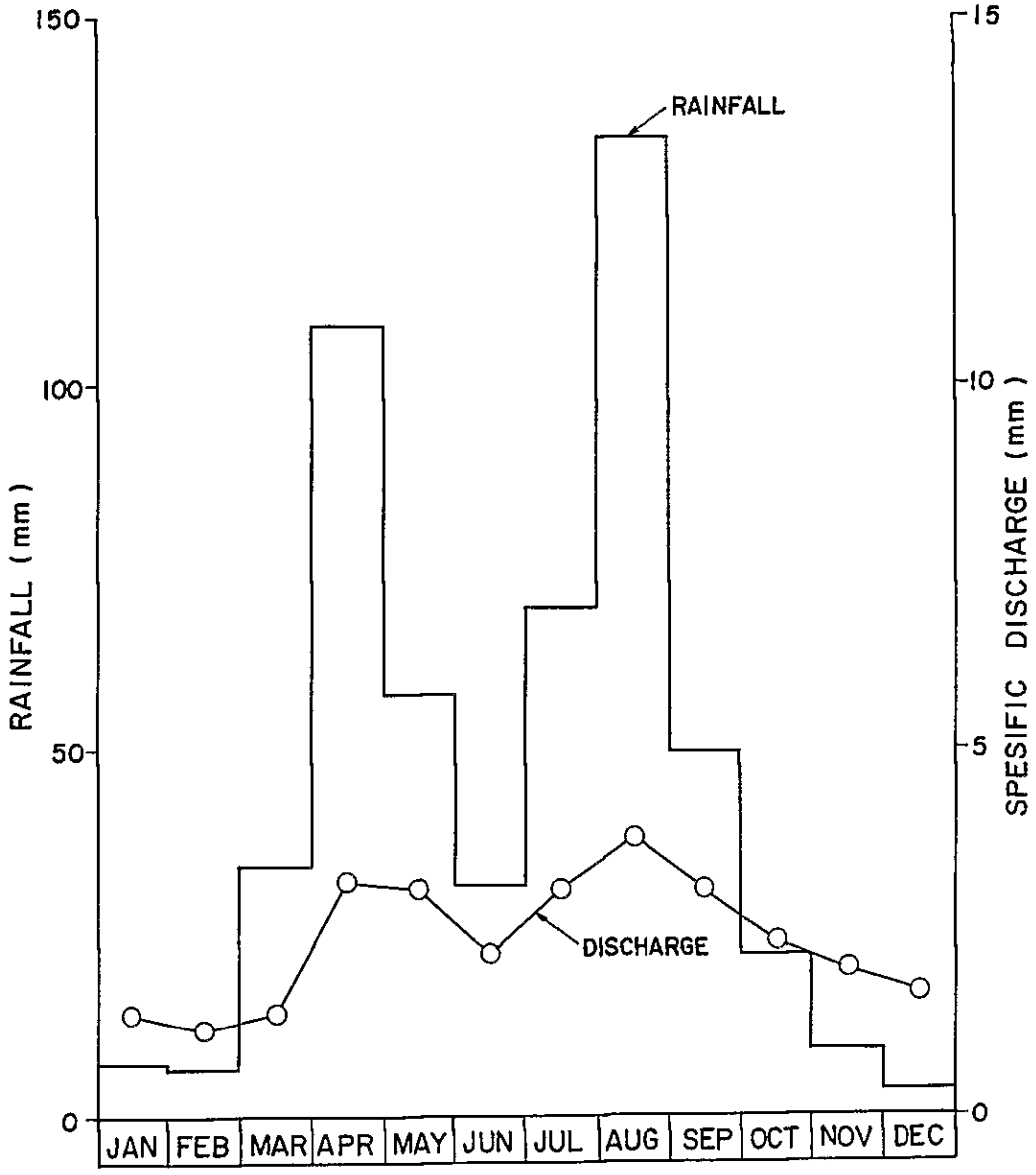


Fig. 4.7 Average Rainfall and Specific Discharge

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V SOIL AND LAND CLASSIFICATION

Tables

Figures

V SOIL AND LAND CLASSIFICATION

(1) General

5.01 There is very limited information available on the soils of the Yemen Arab Republic. Whatever information is available, it is usually the form of generalized reports. Even if detailed information is available, it represents a few specific areas. In Hajjah Province, no systematic soil studies have been made so far and the soil information is quite limited.

5.02 The purpose of the present study is to assess the soil resources that must be better understood so that strategies concerned with rural development programme can be successfully implemented. In order to formulate a master plan as scheduled, the soil study has the important requirement that such data be collected and processed in the shortest possible time. The soil study was, therefore, roughly made on the basis of the findings derived from the interpretation of Landsat imagery and was supported by limited field investigation and background information available from earlier broad soil studies.

5.03 The interpretation was based on Landsat imagery (false-color composites) obtained both during dry and wet seasons at dates ranging from June 22, 1973 to October 25, 1975. Reference was made to the following basic data and maps.

a. aerial photographs taken by the Royal Air Force, UK
b. topographic maps scale 1 : 50,000
c. geology map scale 1 : 250,000 (refer to Chapter III)
d. FAO/UNESCO Soil Map of the World

(2) Physiography and Soils

5.04 On the basis of topographic structure, the YAR could be conveniently divided into four physiographic regions, each having its distinct climatic and vegetational characteristics. These are:

a. Tihama coastal lowland
b. Foothills and middle heights
c. Central highlands
d. Eastern semi-desert plateau

The physiographic features of the Hajjah Province are well conformable to this country-wide stratification and the first three physiographic regions are recognized in the province.

5.05 The general features of each physiographic region are briefed as follows:

a. The coastal lowland forms a 40 km-wide belt along the Red Sea. The elevation ranges from sea level to about 500 m. It is level or slightly undulating and intersected by shallow-wide wadis draining from the eastern mountains towards the Red Sea. The region generally receives less than 400 mm rainfall annually. The mean monthly temperature is over 22°C all the year round and the relative humidity is high. Strong winds generally blow from the southwest to northeast causing coastal sand dune movement and inland soil erosion. Drifting sands and sand dunes alternate with cultivated fields. Salt-impregnated flats are common along the coast.

b. The midland region ranges from 500 to 1,500 m in elevation between the coastal lowland and the

highland. The landscape is generally rugged, cut by deep wadis through narrow gorges which drain to the coastal lowlands in the west. Average annual rainfall varies with altitude to between 500 and 900 mm. This region has various types of mountain scarpments or cliffs which are a major orographic obstacle to southwest monsoons and also to dust blown from the coastal lowlands. Water erosion is vigorous. Pre-cambrian and metasedimentary rocks are common in the south and southwest. Metavolcanic rocks predominate in the north-eastern part. Jurassic limestone mantles the central part with some marl and shale.

c. The highland region comprises higher mountain areas exceeding 1,500 m in elevation. The topography is generally very rugged. The annual rainfall is over 900 mm. In general, the rainfall decreases eastward and northward. The temperature differences between day and night are considerable. This region, with its rugged and complex topography and stream valleys 600 to 1,500 m in depth, reflects the degree of dessection and wide varieties of rock types exposed in the area. Volcanics of Tertiary age covers most of the highlands in the north. Pre-cambrian rocks, mainly granite and gneiss, are common in the southern highlands.

5.06 The first step using Landsat imagery was to demarcate easily distinguishable physiographic units, taking these physiographic characteristics into consideration. A subsequent physiographic analysis of Landsat imagery recognizes several terrain units on the basis of differences in some image characteristics (shape, size, tone, color, texture, etc.) exhibited by various physiographic segments. In

delineating these segments or terrain units, the soil-forming factors, particularly parent materials, topography, climate and vegetation, are taken into consideration. All the references available are also utilized for the interpretation of Landsat imagery.

5.07 These units were keyed to the information provided by the FAO/UNESCO Soil Map of the World. The soils were classified in terms of soil associations, which are terrain units, occurring in a defined physiographic pattern with defined proportion. The soil associations corresponding to each terrain unit consist of the dominant soil unit covering more than 50% of the surface; associated soil unit occupying an area that vary between 20 and 50%; and the most important inclusions which do not cover more than 20% of the surface. The terrain units and their soil associations are thus identified and mapped (refer to Fig. 5.1 "Physiography and Soils"). The map legend is repeated in Table 5.1 and the key to soil symbols used is given in Table 5.2.

(3) Soil Associations

5.08 The variety of soil associations in the Hajjah Province can be divided into the following three groups occurring in different physiographic region, i.e., (a) soils of coastal lowlands, (b) soils of foothills and midlands, and (c) soils of highlands, and is described below:

5.09 The salt-affected soils occupy a narrow strip along the Red Sea shore lines (Terrain Unit L1). The soils are practically non-cultivable except in some areas where fresh water is available from the wadis. The soils on low dune and sand sheets (L2) are widely distributed in the eastern lowlands and are mostly coarse textured Regosols. Coarse to medium textured Fluvisols occur along the recent wadi alluvium (L3). Coarse textured Yermosols associated with

Fluvisols and some Regosols occupy most of the alluvial plain mainly composed of old wadi alluvium (L4). Gravelly phases of Yermosols dominate on the alluvial fans (L5) extending around the piedmont surfaces. Coarse textured Fluvisols occupy the southern marginal alluvial fans (L7), whilst medium textured Fluvisols northern marginal alluvial fans (L6). In general, northern part of the lowlands has medium textured soils because their parent materials are mainly alluvial deposits of weathered shale and marl, and the soils of the southern lowlands are generally coarse textured due to alluvial deposits derived from weathered granite and gneiss. Medium-textured Yermosols also occupy most of scattered fluvial terraces (L8). Rocky areas and Lithosols occur on isolated hills (L9).

5.10 A variety of Yermosols, Fluvisols, Xerosols and Lithosols are widely distributed on the foothills and midlands (M1, M2, M4, M5, M7, M8). Most of these soils are gravelly and stony because in these places soil erosion has gone on more rapidly than soil formation and/or accumulation. Most of the soils, occupying rugged relief on the midland scarpments (M3, M6) and isolated rock floor (M9), are Lithosols associated with lithic and stony phases of Regosols.

5.11 The soils on the highland scarpment (H1) are mostly Lithosols. Lithic phases of Yermosols occur on the dissected mountain composed of Yemen Volcanics (H2). Medium textured Xerosols associated Fluvisols are widely distributed on the plateau on limestone and shale (H3) which extends around Al Mahabisha. Most of the soils on dissected mountain (H4) extending on south of Hajjah are gravelly Yermosols developed on granite and gneiss. Medium textured Yermosols occur on the inter-mountain plains (H5).

(4) Land Classification

5.12 The land classification was undertaken to evaluate the land resources in the Hajjah Province. The land classes were tentatively defined using basically the system of the U.S. Bureau of Reclamation and specifications were modified to fit the purpose of the master plan study. The land classification was not made to each soil group but to each terrain unit composed of several soil units. The terrain units were then classified into three classes of arable land, Class 1, 2 and 3, Class 4, limited arable land and Class 6, non-arable land.

5.13 Soil texture, soil depth, salinity and topography are important in determining land classification, and each of these factors should be favourable for Class 1 land. Any one factor considered unfavourable could result in changing the land class to a lower class. Non-arable class was given to the lands which do not meet the minimum requirement for other land classes and are not suitable for crop production. In classifying the lands, availability of water for irrigation was not considered as a limiting factor.

5.14 The following are general descriptions of the land classes adopted for the integrated rural development master plan study in the Hajjah Province.

Class 1 - arable : Lands in this class have few limitations that restrict their use. The soils are suited to a wide range of crops, being capable of producing sustained and relatively high yields of climatically adapted crops at reasonable cost. The lands are nearly flat or slightly undulating and erosion hazard is low. The soils are deep, generally well drained, and easily worked. They hold water well and are either fairly well supplied with plant nutrients

or highly responsive to fertilizers. These soils are free from harmful accumulation of soluble salts.

Class 2 - arable : Soils in Class 2 have some limitations that reduce the choice of crops or require moderate conservation practices for their use. The limitations are a few and the practices are easy to apply. They are measurably lower than Class 1 in productive capacity, adapted to somewhat narrower range of crops and more costly to farm. The soils may have a coarser texture with lower moisture holding capacity, lesser permeability or the uneven surface of localized areas may require moderate levelling.

Class 3 - arable : This class comprises those lands that are considered marginally suitable for crop cultivation but are of a restricted suitability because of greater deficiency in soil texture, soil depth, topography and soil salinity than Class 2 lands.

Class 4 - limited arable : Lands included in this class have severe non-correctable limitations that prevent normal tillage of cultivated crops. The lands may be included in this class only after special economic and engineering studies have shown them to be arable. Because of severe limitations, cultivation of the common crops is not feasible but rough grazing and afforestation can be expected.

Class 6 - non-arable : This class comprises the lands that considered to be parmanently non-arable. Sand dune, isolated hills, roads and villages are placed in this class along with other lands having deficiency in soil texture, soil depth, topography and salinity that would make cultivation impractical.

5.15 The results of the classification of lands are shown

in Fig. 5.2. Terrain units in each land class are given in Table 5.3. The total land area of the Hajjah Province is 9,590 km^2, out of which arable lands (Class 1, 2 and 3) are estimated around 3,810 km^2 or 39.7% as summarized below:

Land Class	Lowland (km^2)	Midland (km^2)	Highland (km^2)	Total (km^2)	
Class 1	1,070	-	50	1,120	(11.7%)
Class 2	250	-	360	610	(6.4%)
Class 3	1,370	710	-	2,080	(21.6%)
Sub-total	2,690	710	410	3,810	(39.7%)
Class 4	1,480	1,310	170	2,960	(30.9%)
Class 6	520	2,070	230	2,820	(29.4%)
Total	4,690	4,090	810	9,590	(100.0%)

5.16 Most of the arable lands (71%) extend on the lowland area. The soils of these lands have no serious problems. Limited water availability is only the problem for use. Water-saving farming will have to be studied for future expansion of cultivation, together with exploitation of irrigation water resources. These lands are generally suitable for large scale mechanized production of cereals, cotton and tropical fruits. Small scale vegetable production is also recommendable on the lands where irrigation water is available.

5.17 The Class 3 arable lands in the midland area are very scattered and most of them are presently cultivated under rainfed condition. The lands are mostly terraced and subject to serious soil erosion. The soils of these lands include gravelly phase in general and not very fertile due to soil erosion and continuous cultivation for centruries without replenishment of plant nutrients. In these lands, afforestation should be enhanced for a number of important

purposes including a) tree plantation on the marginal terraced lands that have been abandoned from crop production in order to prevent their further rapid deterioration, b) windbreaks around the fields to be planted with crops subject to wind damages, c) establishment of wood lots which supply rough pole lumber and fire woods and d) in the long run, improvement of moisture retension capacity of crucial watershed areas. In the croplands, a system of mixed livestock crop farming can be employed to enhance the total farm income.

5.18 The highland area is generally endowed in land and water resources. The rainfall is usually over 600 mm per annum. In some areas, spring water is available for pump irrigation. The soils are medium textured and have deep soil depth. In these lands, relatively low-value crops are presently grown, though the soils are suited to a wide range of crops. Vegetables and fruits production would give higher income to the farmers.

Table 5.1 Physiography and Soils

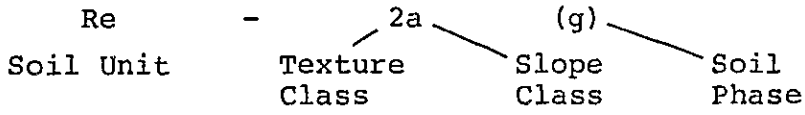
	Physiography/Terrain Units	Dominant 50%	Soil Units Associated 20 - 50%	Inclusions 20%	Land Class	Area (km^2)
L	LOWLAND					
L1	Salty flats	Zg - 2/3a	-	Zt - 2/3a	6	320
L2	Low dunes and sand sheets	Re - 1a	Je - 2a	Yh - 2a	4	1,160
L3	Recent wadi alluvium	Je - 1/2a	Jc - 1/2a	-	2	250
L4	Alluvial plain (old wadi alluvium)	Yh - 1a	Jc - 1/2a(g)	Re - 1a(g)	3	370
L5	Alluvial fan (Piedmont), gravelly surface	Yh - 2a(g)	Yk - 2a(g)	Je - 2a(g)	4	320
L6	Northern alluvial fan, medium textured	Je - 2a	Re - 2a	Yh - 2a	1	700
L7	Southern alluvial fan, coarse textured	Jc - 1a	Rc - 1a(g)	-	3	1,000
L8	Fluvial terrace (old wadi terrace)	Yh - 2a	Je - 2a	-	1	370
L9	Isolated hills	I	-	Yh - 2bc(1)	6	200
						(4,690)
M	MIDLAND					
M1	Piedmont, gravelly surface	Yh - 2a(g)	Yk - 2a(g)	-	4	250
M2	Colluvial slopes and talus	Je - 16(s)	Jc - 16(s)	Re - 1/2b	4	70
M3	Lower midland scarpment	I	Yh - 2b(1)	Yk - 2ab(1)	6	Nil
M4	Dissected upland, coarse textured	Je - 1a(g)	I	Xh - 1b(s)	4	890
M5	Dissected upland, medium textured	Xh - 2ab	Je - 1ab(g)	Xh - 2b(g)	3	710
M6	Higher midland scarpment	I	Yk - 2bc(1)	Yk - 2ab(1)	6	30
M7	Dissected plateau on Yemen Volcanics, gravelly surface	Re - 1a(g)	-	I	4	100
M8	Dissected plateau on inclined limestone and green shale, stony surface	Re - 1bc(1)	I	-	6	1,170
M9	Rock floor on Old Yemen Volcanics	I	-	Je - 1b(1)	6	870
						(4,090)
H	HIGHLAND					
H1	Highland scarpment	I	Je - 1c(g)	-	6	30
H2	Dissected mountain on Yemen Volcanics	Yk - 1ab(1)	Yh - 1ab(1)	I	6	200
H3	Highland plateau on limestone and shale	Xh - 2ab	Je - 2a	-	2	360
H4	Dissected mountain on granite and gneiss	Yk - 1ab(g)	I	-	4	170
H5	Small inter-mountain plain	Yh - 2a	Yk - 2ab	Re - 2ab	1	50
						(810)
						9,590

Table 5.2 Key to Soil Symbols

Soil Units*

R	Regosols	X	Xerosols
Re	Eutric Regosols	Xh	Haplic Xerosols
Rc	Calcaric Regosols	Z	Solonchak
J	Fluvisols	Zt	Takyric Solonchak
Je	Eutric Fluvisols	Zg	Gleyic Solonchak
Jc	Calcaric Fluvisols	I	Lithosols
Y	Yermosols		
Yh	Haplic Yermosols		
Yk	Calcic Yermosols		

Example of Symbol



Texture Class

1. Coarse textured: Sands, loamy sands and sandy loams with less than 18% clay, and more than 65% sand.
2. Medium textured: Sandy loams, loams, sandy clay loams, silty loams, silt, silty clay loams and clay loams with less than 35% clay and less than 65% sand.
3. Fine textured: Clays, silty clays, sandy clays, clay loams and silty clay loams with more than 35% clay.

Slope Class

a. Level to gently undulating (0 - 8%)
b. Rolling to hilly (8 - 30%)
c. Steeply dissected to mountainous (30% -)

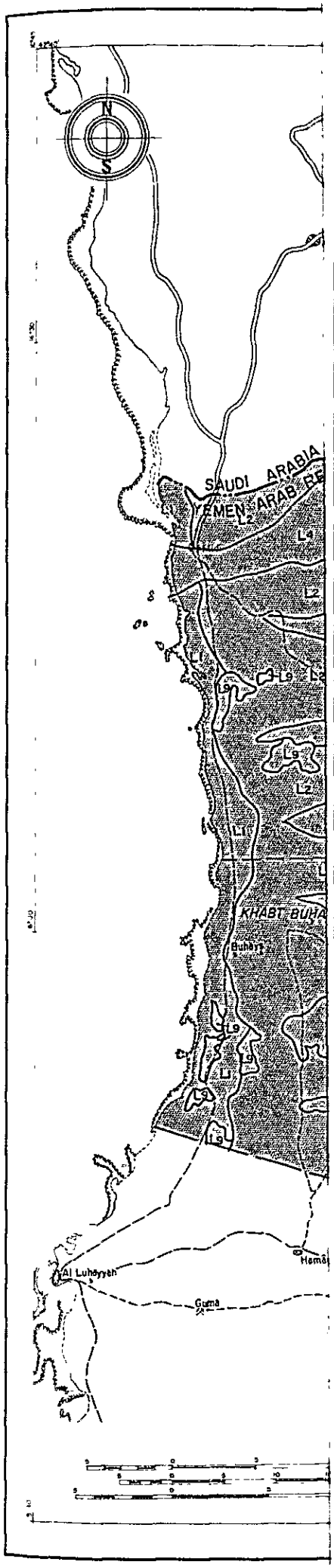
Soil Phase

(g) Gravelly
(s) Stony
(l) Lithic

* Definitions of the soil units are given in Volume I, Soil Map of the World.

Table 5.3 Land Classification

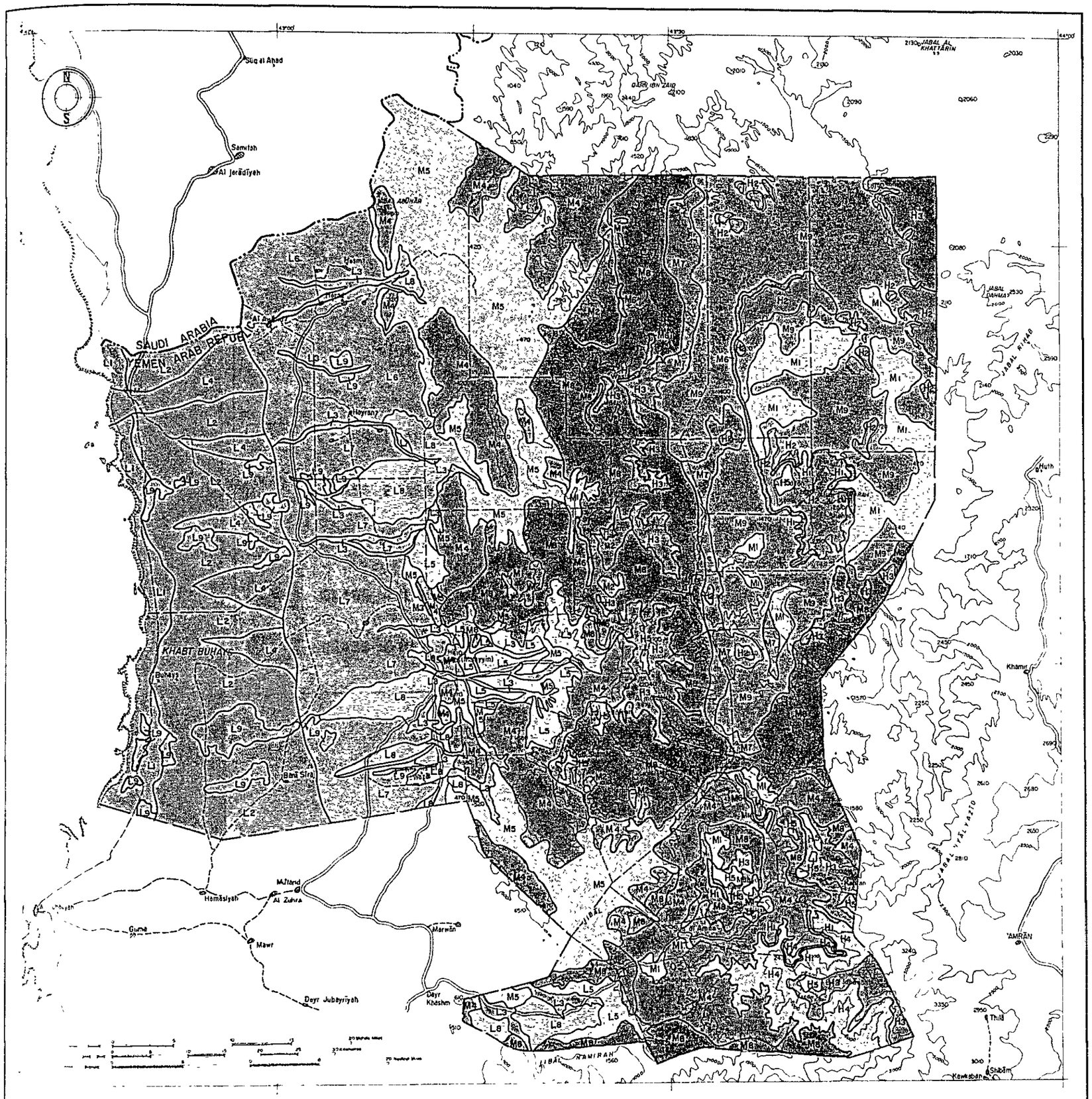
Land Class		Terrain Unit	Area (km^2)
Class 1 (Arable)	L6	Nothern alluvial fan, medium textured	700
	L8	Fluvial terrace	370
	H5	Intermountain plain	50
			1,120
Class 2 (Arable)	L3	Recent wadi alluvium	250
	H3	Highland plateau on limestone and shale	360
			610
Class 3 (Arable)	L4	Alluvial plain (old wadi alluvium)	370
	L7	Southern alluvial fan, coarse textured	1,000
	M5	Dissected uplands, medium textured	710
			2,080
Class 4 (Limited Arable)	L2	Low dunes and sand sheets	1,160
	L5	Alluvial fan (piedmont)	320
	M2	Colluvial slopes and talus	70
	M4	Dissected uplands, coarse textured	890
	M7	Dissected plateau on Yemen Volcanics	100
	M1	Piedmont, gravelly surface	250
	H4	Dissected mountain on granite and gneiss	170
			2,960
Class 6 (Non-arable)	L1	Salty flats	320
	L9	Isolated hills	200
	M3	Lower midland scarpment	Nil
	M6	Higher midland scarpment	30
	M8	Dissected plateau on inclined limestone and green shale, stony surface	1,170
	M9	Rock floor on Yemen Volcanics	870
	H1	Highland scarpment	30
	H2	Dissected mountain on Yemen Volcanics	200
			2,820
		Total	9,590



LEGEND

Physiography/Terrain Units	Soil Units: Dominant >50%	Associated 20~50%	Inclusions <20%	Land Class	Area (10^3ha)
L LOWLAND					469
L1 Salty flats	Zg-2/3a	–	Zt-2/3a	6	32
L2 Low dunes and sand sheets	Re-1a	Je-2a	Yh-2a	4	116
L3 Recent wadi alluvium	Je-1/2a	Jc-1/2a	–	2	25
L4 Alluvial plain(old wadi alluvium)	Yh-1a	Jc-1/2a(g)	Re-1a(g)	3	37
L5 Alluvial fan(piedmont),gravelly surface	Yh-2a(g)	Yk-2a(g)	Je-2a(g)	4	32
L6 Northern alluvial fan, medium textured	Je-2a	Re-2a	Yh-2a	1	70
L7 Southern alluvial fan, coarse textured	Jc-1a	Rc-1a(g)	–	3	100
L8 Fluvial terrace (old wadi terrace)	Yh-2a	Je-2a	–	1	37
L9 Isolated hills	I	–	Yh-2bc(l)	6	20
M MIDLAND					409
M1 Piedmont, gravelly surface	Yh-2a(g)	Yk-2a(g)	–	4	25
M2 Colluvial slopes and talus	Je-1b(s)	Jc-1b(s)	Re-1/2b	4	7
M3 Lower midland escarpment	I	Yh-2bc(l)	Yk-2ab(l)	6	0
M4 Dissected upland, coarse textured	Je-1a(g)	I	Xh-1b(s)	4	89
M5 Dissected upland, medium textured	Xh-2ab	Je-1ab(g)	Xh-2b(g)	3	71
M6 Higher midland escarpment	I	Yk-2bc(l)	Yk-2ab(l)	6	3
M7 Dissected plateau on Old Yemen Volcanics, gravelly surface	Re-1a(g)	–	I	4	10
M8 Dissected plateau on inclined limestone and green shale, stony surface	Re-1bc(l)	I	–	6	117
M9 Rock floor on Old Yemen Volcanics	I	–	Je-1b(l)	6	87
H HIGHLAND					81
H1 Highland escarpment	I	Je-1c(g)	–	6	3
H2 Dissected mountain on Yemen Volcanics	Yk-1bc(l)	Yh-1bc(l)	I	6	20
H3 Highland plateau on limestone and green shale	Xh-2ab	Je-2a	–	2	36
H4 Dissected mountain on granite and gneiss	Yk-1ab(g)	I	–	4	17
H5 Small inter-mountain plain	Yh-2a	Yk-2ab	Re-2ab	1	5
					959

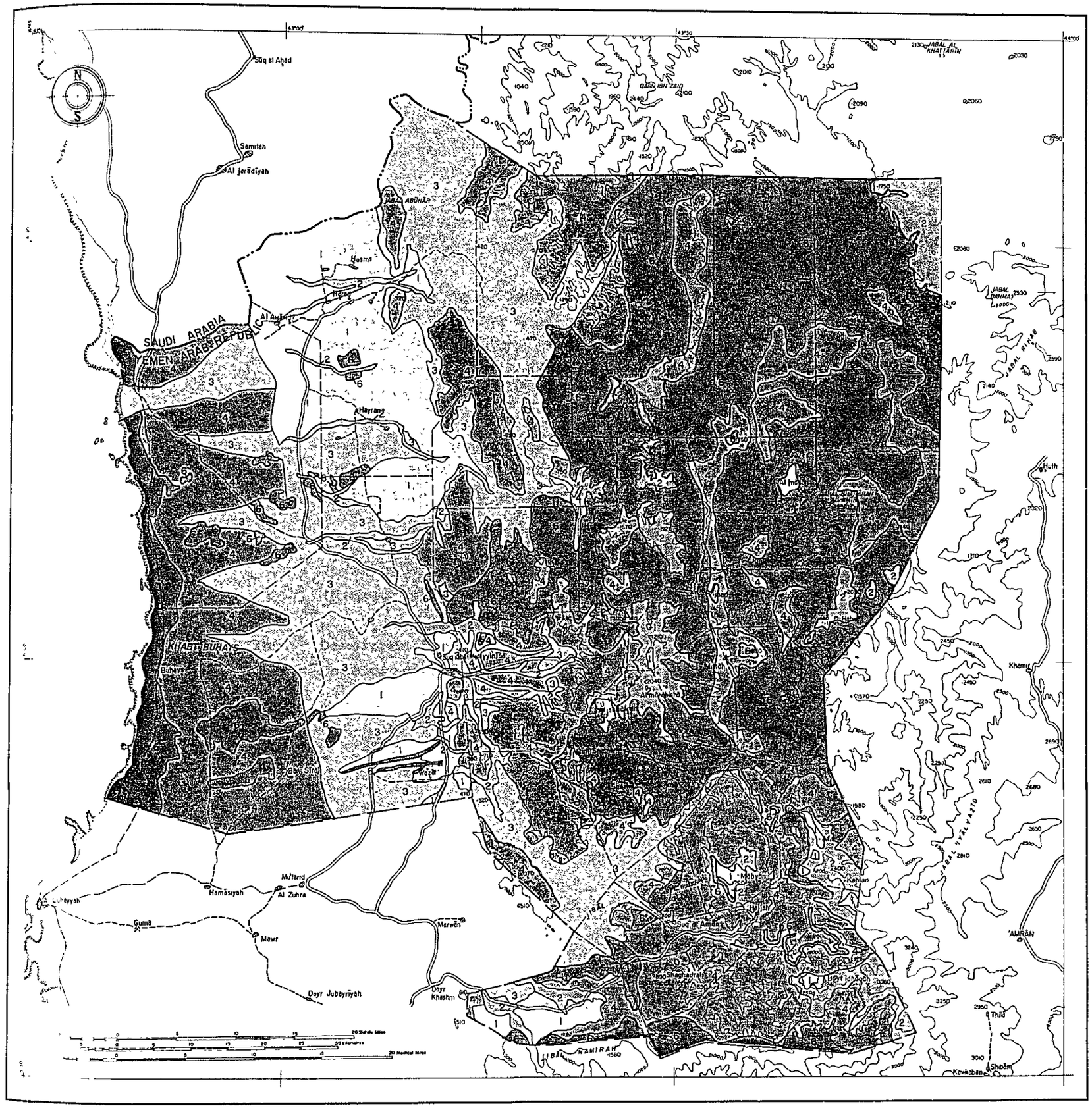
Fig.5.1 Physiography and Soils



LEGEND

Physiography/Terrain Units	Soil Units: Dominant >50%	Associated 20~50%	Inclusions <20%	Rel. Diff.	Area ('10³ ha)
L LOWLAND					469
L1 Salty flats	Zg–2/3a	–	Zt–2/3a	6	32
L2 Low dunes and sand sheets	Re–1a	Je–2a	Yh–2a	4	116
L3 Recent wadi alluvium	Je–1/2a	Jc–1/2a	–	2	25
L4 Alluvial plain(old wadi alluvium)	Yh–1a	Jc–1/2a(g)	Re–1a(g)	3	37
L5 Alluvial fan(piedmont),gravelly surface	Yh–2a(g)	Yk–2a(g)	Je–2a(g)	4	32
L6 Northern alluvial fan, medium textured	Je–2a	Re–2a	Yh–2a	1	70
L7 Southern alluvial fan, coarse textured	Jc–1a	Rc–1a(g)	–	3	100
L8 Fluvial terrace (old wadi terrace)	Yh–2a	Je–2a	–	1	37
L9 Isolated hills	I	–	Yh–2bd(ℓ)	6	20
M MIDLAND					409
M1 Piedmont, gravelly surface	Yh–2a(g)	Yk–2a(g)	–	4	25
M2 Colluvial slopes and talus	Je–1b(s)	Jc–1b(s)	Re–1/2b	4	7
M3 Lower midland escarpment	I	Yh–2bc(ℓ)	Yk–2ab(ℓ)	6	0
M4 Dissected upland, coarse textured	Je–1a(g)	I	Xh–1b(s)	4	89
M5 Dissected upland, medium textured	Xh–2ab	Je–1ab(g)	Xh–2b(g)	3	71
M6 Higher midland escarpment	I	Yk–2bc(ℓ)	Yk–2ab(ℓ)	6	3
M7 Dissected plateau on Old Yemen Volcanics, gravelly surface	Re–1a(g)	–	I	4	10
M8 Dissected plateau on inclined limestone and green shale, stony surface	Re–1bc(ℓ)	I	–	6	117
M9 Rock floor on Old Yemen Volcanics	I	–	Je–1b(ℓ)	6	87
H HIGHLAND					81
H1 Highland escarpment	I	Je–1c(g)	–	6	3
H2 Dissected mountain on Yemen Volcanics	Yk–1bc(ℓ)	Yh–1bc(ℓ)	I	6	20
H3 Highland plateau on limestone and green shale	Xh–2ab	Je–2a	–	2	36
H4 Dissected mountain on granite and gneiss	Yk–1ab(g)	I	–	4	17
H5 Small inter-mountain plain	Yh–2a	Yk–2ab	Re–2ab	1	5
					959

Fig.5.1 Physiography and Soils



LEGEND

		Area (10^3 ha)
1	CLASS 1 (ARABLE)	112
2	CLASS 2 (ARABLE)	61
3	CLASS 3 (ARABLE)	208
4	CLASS 4 (LIMITED ARABLE)	296
6	CLASS 6 (NON ARABLE)	282
		959

Fig.5.2 Land Classification

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VI VEGETATION

Figures

VI VEGETATION

(1) General

6.01 The vegetation cover in the Hajjah Province is generally sparse, and the density of the vegetation cover mainly depends on the climatic conditions. Landsat remote sensing data, with its multitemporal and broad synoptic observations, are useful for studying vegetation cover in the area; and the seasonal changes in vegetation cover and amount of vegetation during several different seasons have been studied. These studies were supported by limited field investigation on vegetation types.

6.02 There is a clear relationship between the amount of vegetation cover (or green biomass) and the difference between the infrared and red spectral reflections of the vegetation collected by Landsat multispectral remote sensing. Seven Landsat scenes recorded between 1975 and 1978 were utilized for this vegetation study in conjunction with the ground truth data acquired during the field survey. The ground truth data used for the calibration included multispectral measurement data of vegetation, agricultural crops, and soils, and vegetation cover data (ground observation and aerial photo interpretation), and vegetation type.

6.03 Landsat data were processed on a digital image processing system and vegetation cover maps were produced as shown in Figs. 6.1 and 6.2. In order to examine the seasonal changes in vegetation cover, the extent and amount of vegetation in the different seasons were also mapped as shown in Figs. 6.3 and 6.4. Vegetation map shown in Fig. 6.5 has been compiled based on these vegetation cover data and limited field survey data.

(2) Seasonal Changes in Vegetation Cover

6.04 Figs. 6.1(a), (b), and (c) show vegetation cover on July 9, October 25, 1975, and January 23, 1976, respectively. Vegetation cover maps compiled by utilizing successive Landsat data of August 25, September 12, October 18, and November 5, 1978, are also shown in Figs. 6.2(a), (b), (c), and (d), respectively. The following facts may be pointed out from these maps:

a) In July (Fig. 6.1(a)), when it is the beginning of rainy season, the areas with some vegetation cover are found at the eastern half of the Hajjah Province where the ground elevation is 500 m or higher. At the same time, areas having relatively denser vegetation cover are concentrated around Hajjah, Al Mahabisha, and Shahara, where elevation exceeds 1,000 m.

b) From August through September (Figs. 6.2(a) and (b)), when the rainy season progresses, the areas of some vegetation cover extend toward lower mountain areas (Aslam and Mustaba districts). While the areas of denser vegetation cover are more likely to be diminishing around Hajjah area. This may indicate that the crops have reached a mature stage.

c) In October (the end of the rainy season, Figs. 6.1(b) and 6.2(c)), the areas containing some vegetation cover are found in the coastal lowlands, especially around the villages of Abs, Harad, Wadi Ayn and Bani Nashir. Vegetation cover is also relatively dense in the midland and highland areas.

d) From November through January (during the dry season, Figs. 6.1(c) and 6.2(d)), areas of some vegetation cover diminish in the midland and highland areas, but

narrow strips along wadis are found to be vegetated in the foothills of the Tihama plain.

6.05 The annual plants germinate, develop, and mature in response to the amount and distribution of precipitation and temperature. The seasonal changes in vegetation cover closely conform to the rainfall patterns in each region.

(3) Vegetation Type

6.06 The regions exceeding 1,500 m in elevation generally have dense vegetation cover at the beginning of the rainy season. In these regions, annual rainfall is over 600 mm. These areas are characterized by the dominance of tree species of Acacia, Buddlea, and Celastraceae, and grass species of Bromus, Aristida and Cenchrus. Trees standing in the cultivated lands are mainly Zizyphus Spina-christi and Acacia species.

6.07 In the midland, the annual rainfall is around 400-600 mm. The vegetation cover in October is denser than in August. This shows that the total biomass of trees, grasses, and crops reaches its maximum extent at the end of the rainy season. The natural vegetation on the uncultivated hillslopes includes open Acacia shrub (Dominant species are A. tortilis, A. numbica, and A. humlosa). The main tree species around the terraced land are Zizyphus spina-christi, Acacia spp. and Celastraceae spp. Main species found in the wadi courses are Salvadore spp., Adenium spp., Ficus spp. and Tamarindus spp. Some tropical fruits (e.g. Mango, Banana and Papaya) are also found along the wadi courses.

6.08 The lowland is divided into two zones. In a 10 km wide zone extending from the foothills, the annual rainfall is around 300-500 mm. Normal vegetation cover is found only after September in this zone. Natural vegetation is of the

woody vegetation type and the dominant species are Acacia savannah, A. flava, A. ehrenbergiana, and A. toritilis. At the foots of mountains, the vegetation type is of scattered trees or open stands, and dominant species are Dobera roxburghii and Celastraceae spp. There is a large area of croplands in this region, and the total biomass of the crops (mainly sorghum and millet) as well as the natural vegetation reaches its maximum extent at the end of the rainy season. In a zone extending along the 20 km-wide coastal belt, the annual rainfall is less than 200 mm, and the vegetation cover is very sparse all the year round. Most of the zone is treeless.

(4) Perennial Vegetation Cover

6.09 The areas with perennial vegetation cover are found to a very limited extent in the Hajjah Province. Figs. 6.3 and 6.4 were produced by combining three vegetation cover maps of the periods of 1975-1976 and 1978, respectively. It should be noted that the thresholds of the vegetation cover are also different in these Figures. As shown in green colour in Fig. 6.3, the areas with some vegetation (more than 10 % cover) in all three seasons extend around Al Mahabisha, Hajjah, Shahara, Bani Al Awwam, and the boundary between Mustaba and Washha sub-districts. Figs. 6.4 resulted by applying stricter threshold (denser vegetation cover) to the vegetation cover maps of August, October, and November 1978. In Fig. 6.4, green colour indicates dense vegetation area in the said three seasons. One of these areas is located near Al Mahabisha, including the Jayah, Tahannen, and Sharhil areas. The western slopes of Al Mahabisha area are covered with woody vegetation (Acacia spp. and Celastraceae). The other dense vegetation areas extended Bani Al Awwam, Shahara, Banitah, and Zulaymat.

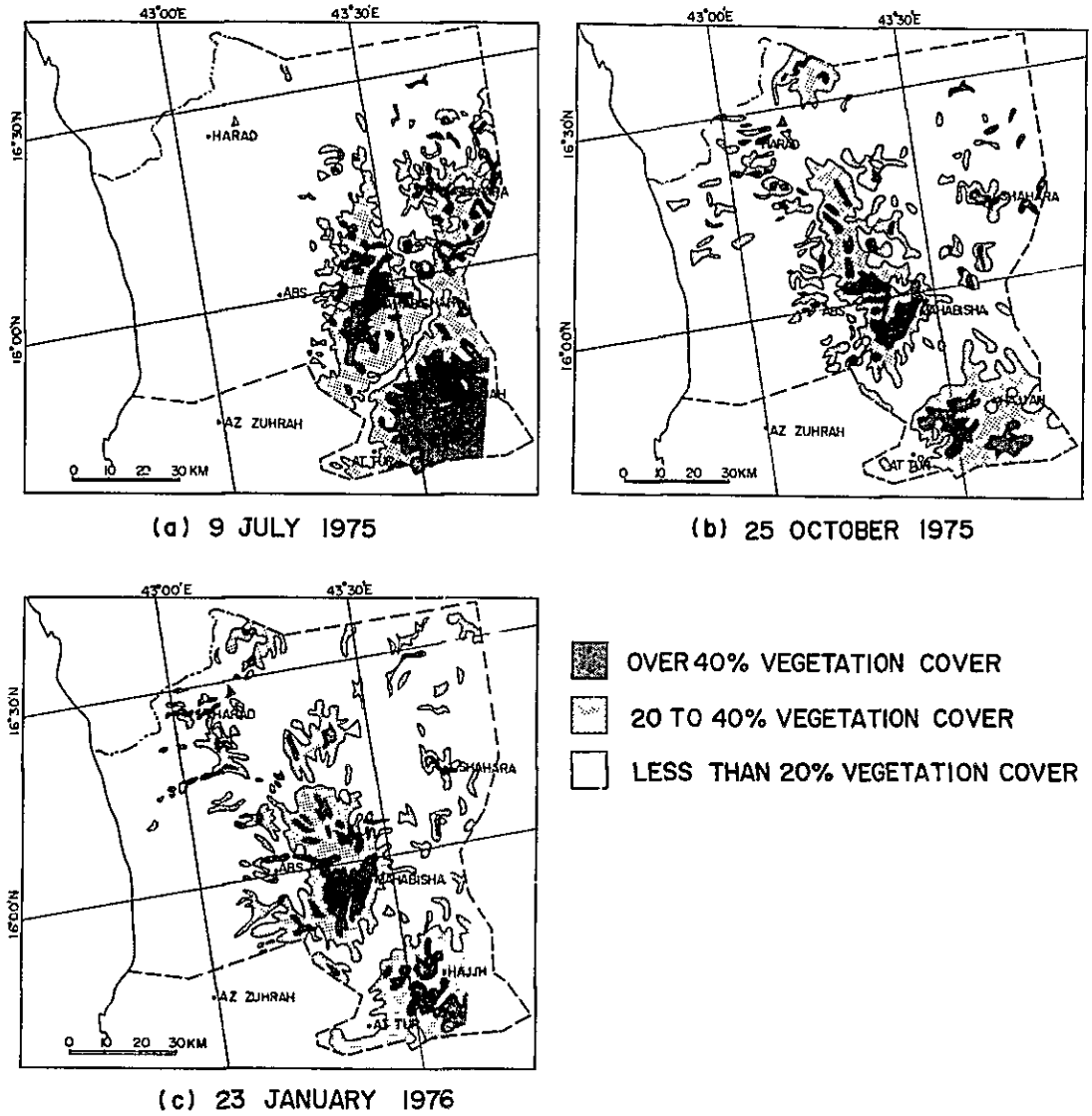


Fig. 6.1 Density of Vegetation Cover (1975-1976)

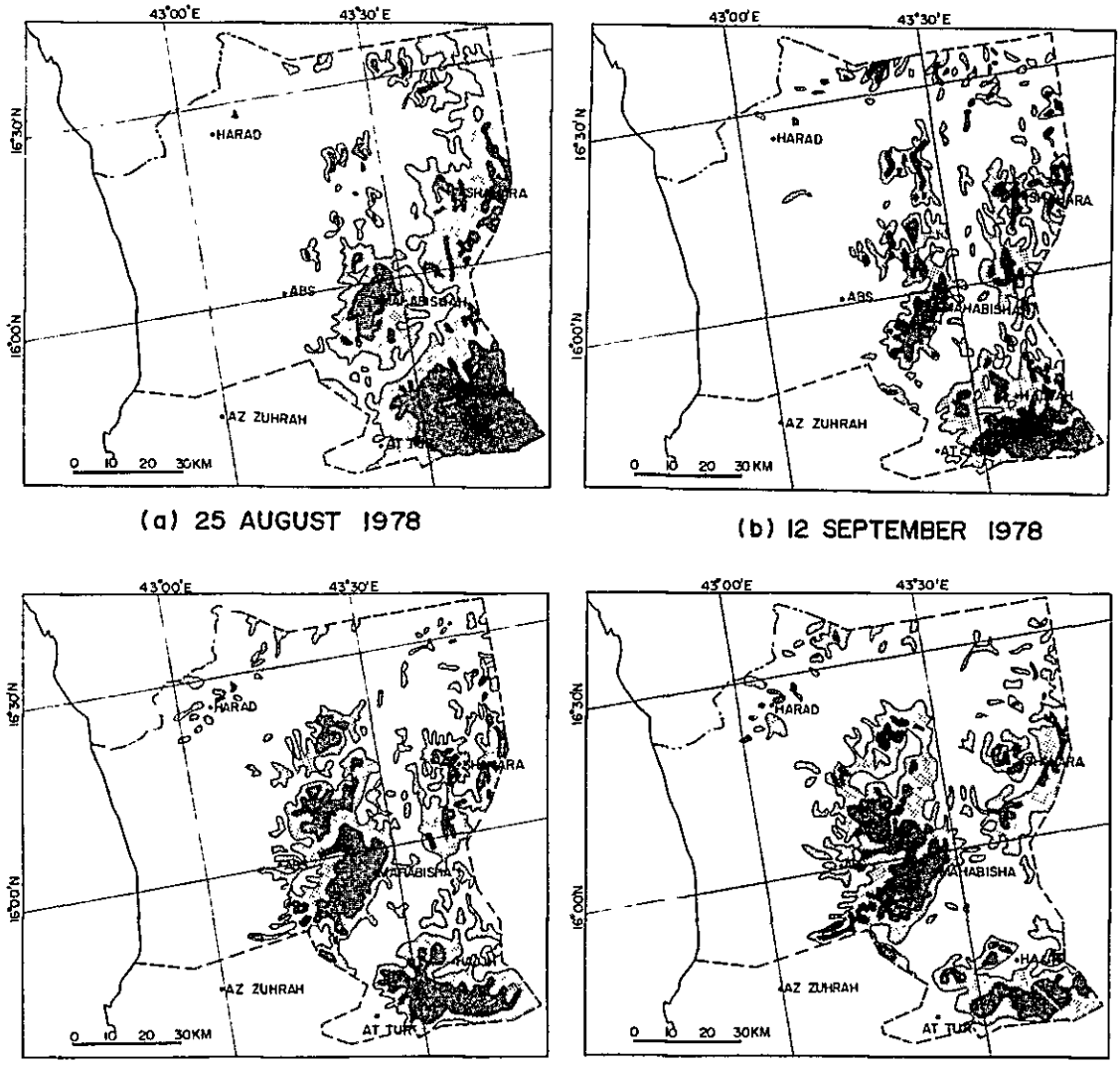


Fig. 6.2 Density of Vegetation Cover (1978)

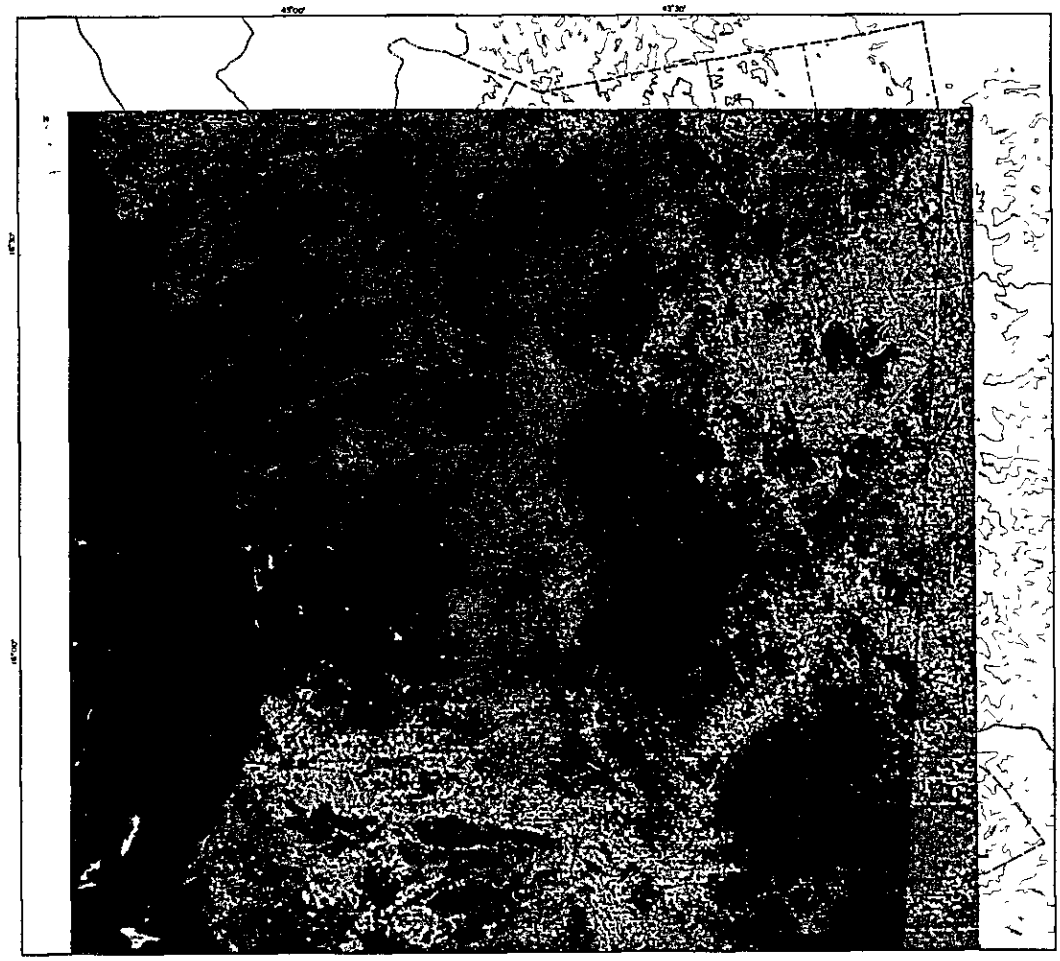


Fig.6.3 Seasonal Changes in Vegetation Cover.
More than 10 % of the land is covered with vegetation as shown in colors : Green / July, October, January ; Green Blue / October, January ; Orange / October ; Green Yellow / July, October ; Magenta / Non ; Yellow / July ; Blue Green / January ; Cyan / July, January.
(Data : July, October 1975 ; January 1976)

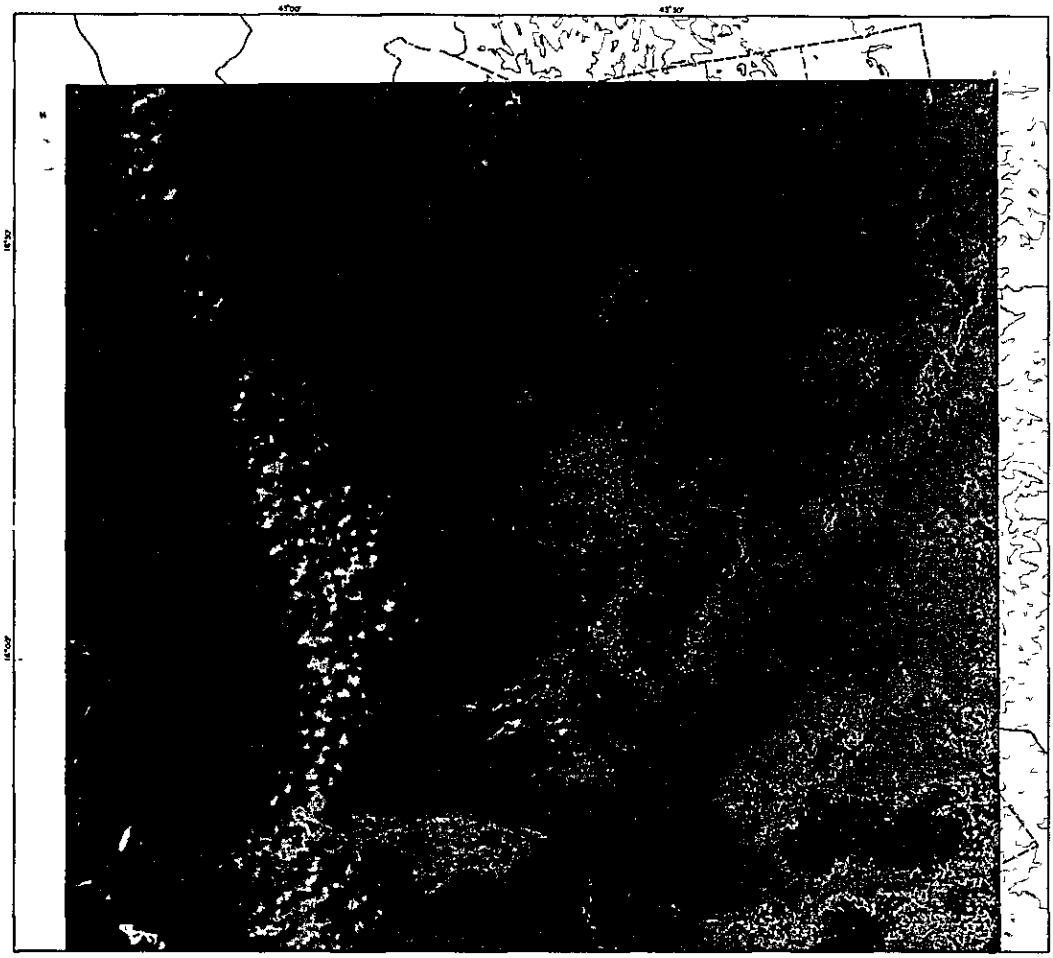
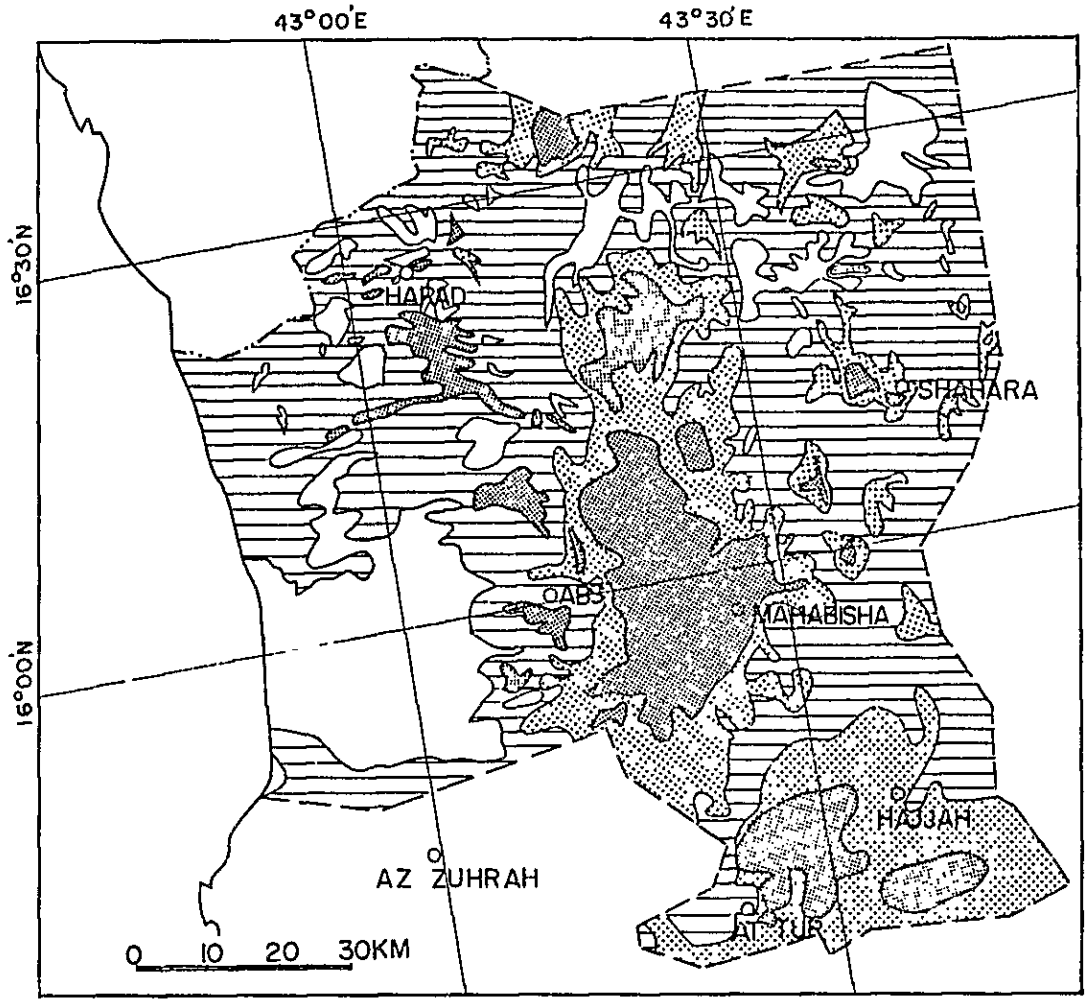


Fig.6.4 Seasonal Changes in Vegetation Cover.
More than 40 % of the land is covered with vegetation as shown in colors : Green / August, October, November ; Green Blue / August, October ; Orange / August ; Green Yellow / August, November ; Magenta / Non ; Yellow / November ; Blue Green / October ; Cyan / October, November. (Data ; 1978)



Dense Vegetation Cover / Mainly Croplands

Scrub and Trees / Acacia and Eucalyptus Species

Sparse Scrub on Rocky Slopes Mainly Acacia Species / or Grassland with Scrub

Grassland with Sparse Scrub

Fig. 6.5 Vegetation Map

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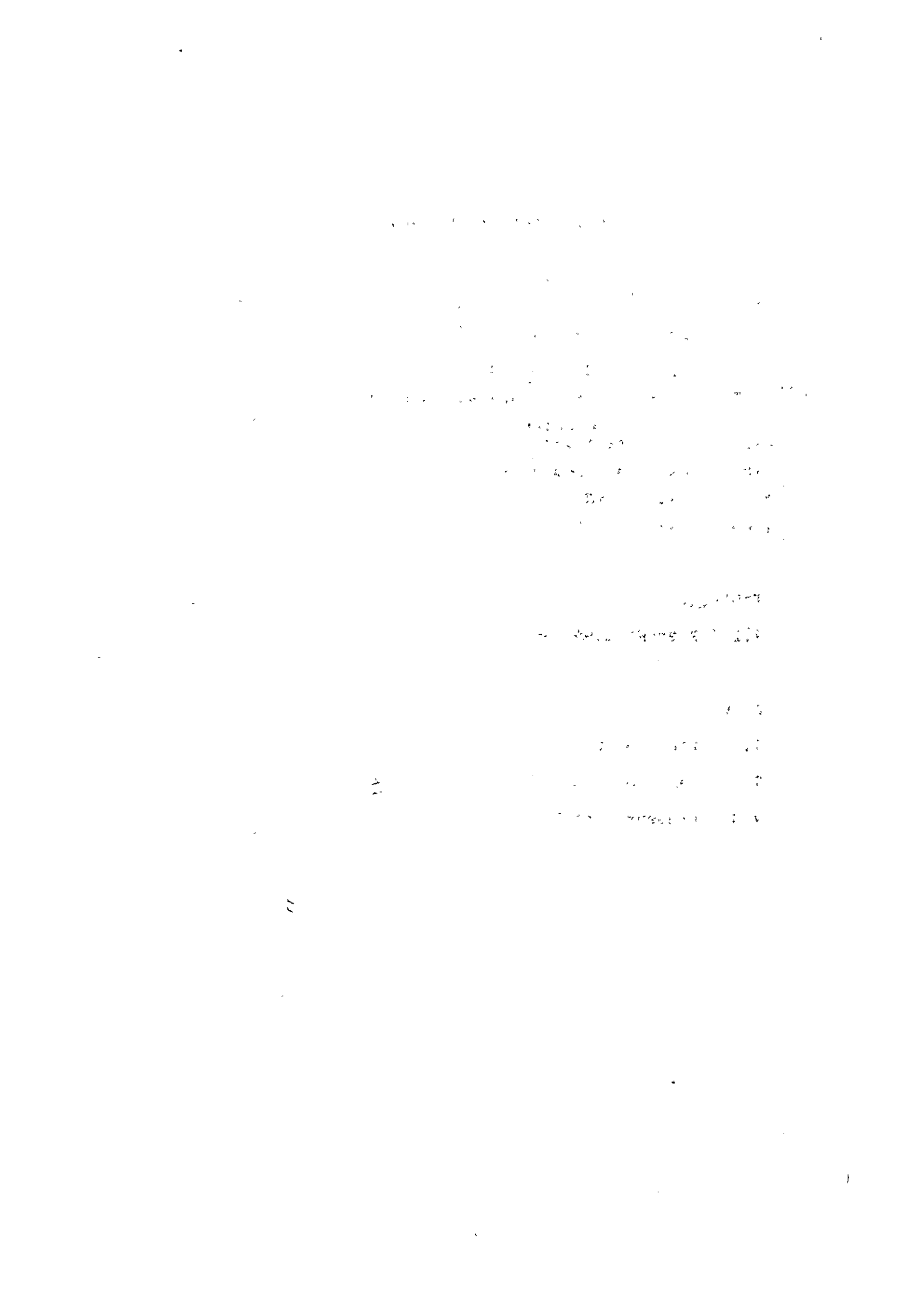
VII PRESENT LAND USE



VII PRESENT LAND USE

(1) General

7.01 Use to which land is put in the Hajjah Province is very much characterized by geographical location in the area since relief, climate, especially distribution of rainfall, hydrography, soils, etc. have a great influence on land use. Landsat remote sensing has been utilized, in conjunction with aerial photo interpretation and ground surveys, to make a land use map of the area.

(2) Present Land Use

7.02 Figs. 7.1 and 7.2 show land cover map, which explain the condition of the ground's surface at the time of remote sensing, and have been compiled from digital multispectral data taken by the Landsat satellite on October 13, 1972, and January 23, 1976 from an orbital altitude of 920 km. Among many Landsat images taken over the Hajjah Province, only these two data are available in a computer compatible digital form, and are considered to be appropriate for the analysis as representatives of data taken during wet and dry seasons. The only limitation encountered is that a portion of the subject area was not covered in the 1976-data due to Landsat II's orbital shift.

7.03 The four-band multispectral data were classified into 14 land cover patterns, based on the spectral characteristics in a digital image analysis system. These land cover patterns are shown in 14 different colours in Figs. 7.1 and 7.2. Aerial photographs were also used to supplement these land cover data, and the following major land use categories were mapped as shown in Fig. 7.3 (Land use map). Areas of the major and sub-divided land use categories are given in Table 7.1.

a) Irrigated cropland
b) Rainfed cropland/Annual cultivation
c) Rainfed cropland/Opportunistic cultivation
d) Rainfed cropland/Terraced
e) Rangeland
f) Settlement

Irrigated cropland

7.04 Irrigated croplands are found along major wadi courses in the Tihama plain. The irrigation is mainly made by diverting high stream flow during the rainy season by small earthen dams and leading it by means of simple channels on to the fields located along the wadi courses. Some of these spate irrigation lands are supplementally irrigated by pumps or other means during the dry season. These lands are intensively cultivated for growing mainly sorghum; and sorghum, vegetables and tropical fruits are grown under supplemental irrigation. On the land cover maps of the Tihama plain, these areas are shown in red (A). In Fig. 7.1, the densely vegetated, red coloured area appears only around Harad, while areas under similar land cover are found widely along major wadi courses and show different cropping patterns in Fig. 7.2.

7.05 Irrigated lands are also found in the bottoms of some valleys which have perennial springs; over abundant ground water in these valleys is exploited by wells with pumps or traditional lifting methods. These areas are, however, categorized as a part of the annually cultivated, rainfed cropland because of their limited extent.

7.06 Irrigated croplands are also used for supplying feed for animals. About 16,000 ha are cultivated under irrigation excluding the land in valley bottoms.

Rainfed cropland/Annual cultivation

7.07 There are rainfed croplands under annual cultivation in the east Tihama plain as well as in the intermountain valley bottoms. Apart from the irrigated croplands, about 19,000 ha of lands are cultivated annually, receiving irregular spate irrigation from wadis. They are located slightly off the wadi courses or downstream of the wadis. These areas are densely cultivated and sorghum is the main crop.

7.08 At the hill front of the Tihama plain, there are more reliable rainfall and runoff from hill slopes and minor wadis. Thus, annual planting of sorghum and millet is possible in the area. In the land cover maps, these lands are shown in orange (B) and yellow (E), which differentiate the densities of vegetation or crop coverage. Seasonal changes of such zones are clearly shown in the two land cover maps. These areas extend about 26,000 ha and are densely cultivated, although many of the fields are fallow. In the cultivated fields, we can also find large scattered trees, the branches of which are cut during the dry seasons and used to feed animals and also used as fire wood.

7.09 There is a greater availability of water in the lands in the bottoms of valleys from perennial springs, shallow wells, hill slope runoff, etc. Thus, much of the areas are annually cultivated, and even perennially cultivated lands are found in this area. Main crops are vegetables, subtropical fruits, maize, sorghum, coffee, etc. Lands on wadi terraces or gently sloping areas receive runoff from the nearby hill slopes, and sorghum and maize are annually cultivated. These lands in the midland and highland areas extend to 30,000 ha in total, and are shown mostly in red (A) or magenta (C) colours in the land cover maps.

Rainfed cropland/Opportunistic cultivation

7.10 There is a transition zone between rangeland and annually cultivated cropland that is used for opportunistic planting. These areas are usually spot-planted to millet and sorghum in response to favourable rainfall.

7.11 Similar opportunistic croplands also exist at the heads of the fans of major wadis, where the great floods occasionally inundate the land. These croplands are usually left uncultivated and become dwarf shrub grassland. Main crop is millet. These areas total about 22,000 ha.

Rainfed cropland/Terraced

7.12 Intensively terraced agricultural lands can be found on the rain-exposed slopes in the highland area. This area is the most appropriate region for agricultural land use, and is shown in reddish colours on the land cover maps. In areas of sufficient precipitation, the main crops are sorghum, wheat, barley and qut. In areas of less rainfall or drier soils, the more resistant millet can be found. The croplands are organized so as to catch all available runoff from surrounding areas. The extent of the area is 28,000 ha.

Rangeland

7.13 Rangelands are lands which are not normally cultivated, excluding sand dunes, salt affected lands, wadi beds, etc. which have no agricultural value. Rangelands are used as a source of grazing and wood fuel and also as a catchment to provide runoff for neighbouring croplands.

7.14 In the coastal Tihama plain, the rangelands are only sparsely vegetated and are essentially bare except for isolated clumps of bushes or trees in depressions and ephemeral

flushes of grass following rain. Most of these rangelands are unused. In the wadi depressions and banks, and in the area closer to the mountains where rainfall is higher, the vegetation increases, and is used for grazing livestock such as camels, goats, sheep, etc.

7.15 In the midland and highland and where precipitation is higher, the rangelands with relatively dense shrub and trees are found extensively. They are shown in green (G) colour on the land cover maps, although only dense shrub and trees lands have been mapped on the land cover and land use maps. Most parts of the rangelands in the midland and highland areas are covered with open shrub and grasses though the degree of vegetation coverage differs from one place to other, depending on the precipitation and geologic environment (see Chapter VI, "VEGETATION"). The rangelands located near villages are intensively used for grazing goats, sheep, etc.

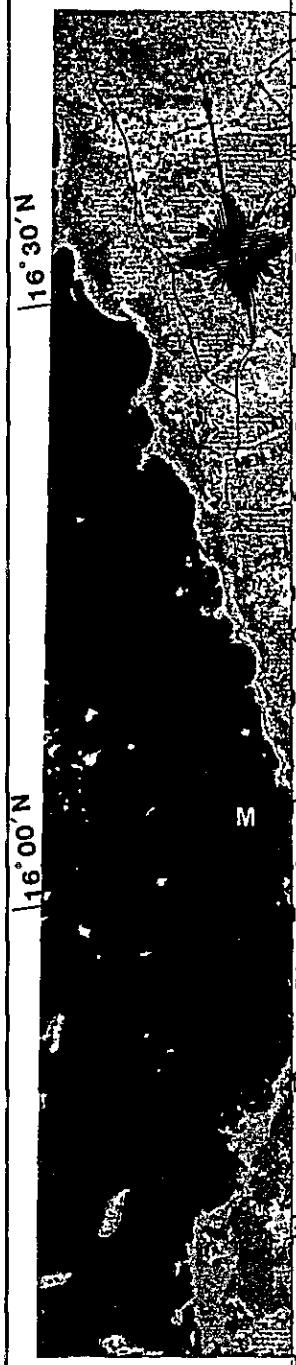
7.16 It should be noted that the rangelands shown on the land use map also include unused land such as bare rocks and isolated steep mountain slopes. Unused rangelands are also extensively located in the midland area where the precipitation is very limited and population is also very small. The extent of the rangeland is about 7,680 km^2.

Settlement

7.17 The prevailing small size settlements scattered over the entire areas of the Hajjah Province almost always occupy unproductive land in rocky, barren areas or on gravel hills. These settlements occupy about 200 km^2 of the land.

Table 7.1 Present Land Use

Land use category	Land use subdivision		Area (km^2)	Proportional extent (%)
A. Irrigated cropland	A1	Intensively cultivated under irrigation/pumping and diverted stream flow/ sorghum vegetables and fruits	40	0.4
	A2	Intensively cultivated under regular spate irrigation/mainly sorghum	120	1.3
(Sub-total)			(160)	1.7
B. Rainfed cropland/ Annual cultivation	B1	Densely cultivated/ irregular spate irrigation/ mainly sorghum	190	2.0
	B2	Densely cultivated/ sorghum and millet	260	2.6
	B3	Wadi lands/vegetables and sub-tropical fruits	150	1.6
	B4	Gently sloping lands receiving hill-slope runoff/sorghum and maize	150	1.6
(Sub-total)			(750)	7.8
C. Rainfed cropland/Opportunistic cultivation/mainly millet			120	1.3
D. Rainfed cropland/ Terraced	D1	Densely cultivated/ sorghum, wheat, barley and qut	130	1.3
	D2	Sparsely cultivated/ sorghum, millet, wheat and barley	150	1.6
(Sub-total)			(280)	2.9
E. Rainfed cropland/Rangeland, Opportunistic cultivation, otherwise dwarf shrub grass land/mainly millet			100	1.0
Total Cropland (A + B + C + D + E)			1,410	14.7
F. Rangeland			7,680	80.1
G. Unused land			300	3.1
H. Settlement areas			200	2.1
Total			9,590	100.0



GEND

ensive cultivation, Dense
ver

dium to low density vegetation

nse vegetation cover

dium density vegetation cover

w density vegetation cover,
Midland and Highland

warf shrub grassland, Partially
opportunistic planting

ense shrub and trees

warf shrub and grassland on
nics

hrub and grassland on
d Greenshale

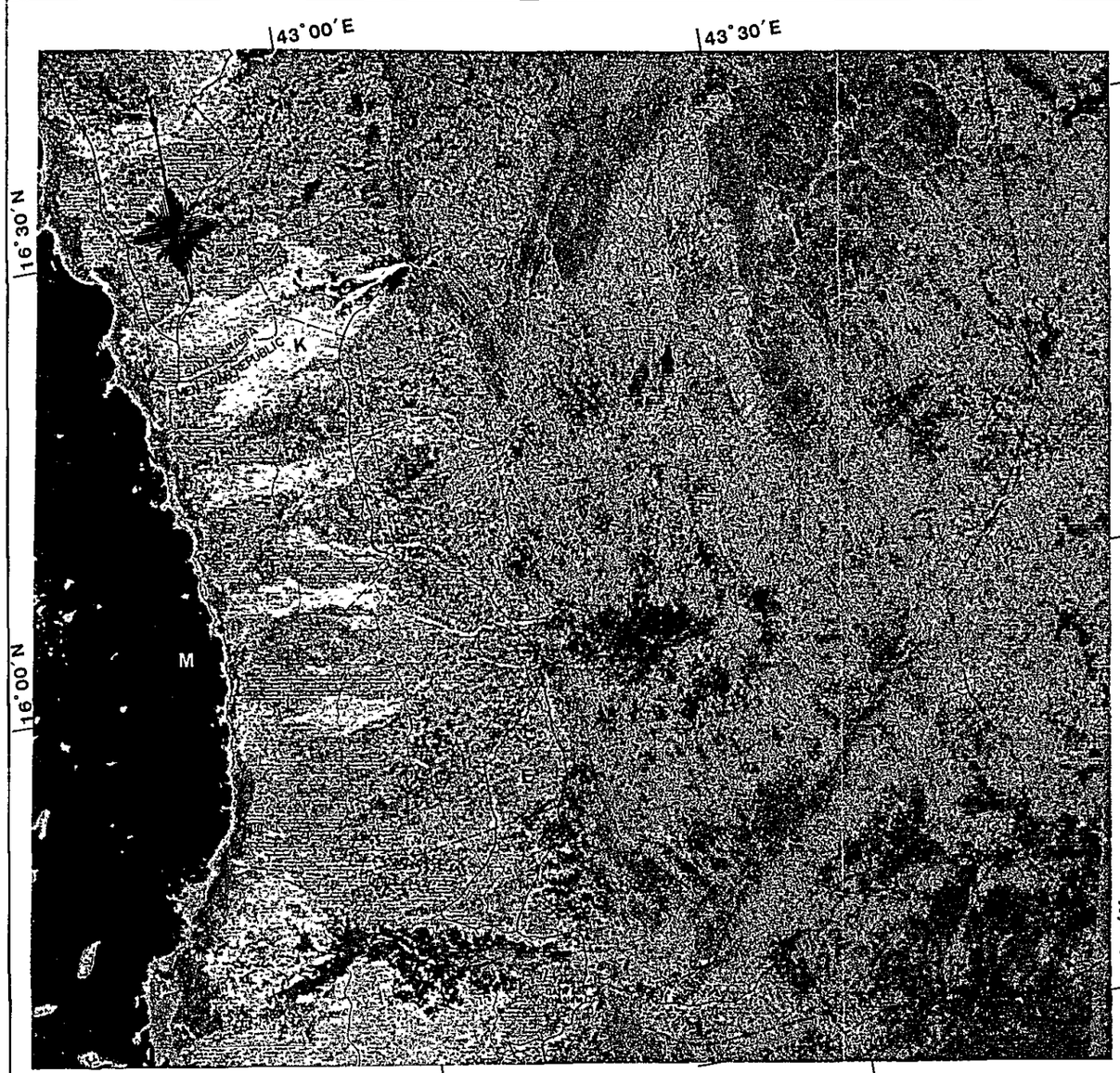
hrub and grassland on Granite

lood plain, Partially cropland
stic planting

land or wet sand, Rangeland on
Gneiss (Midland)

r coral reef

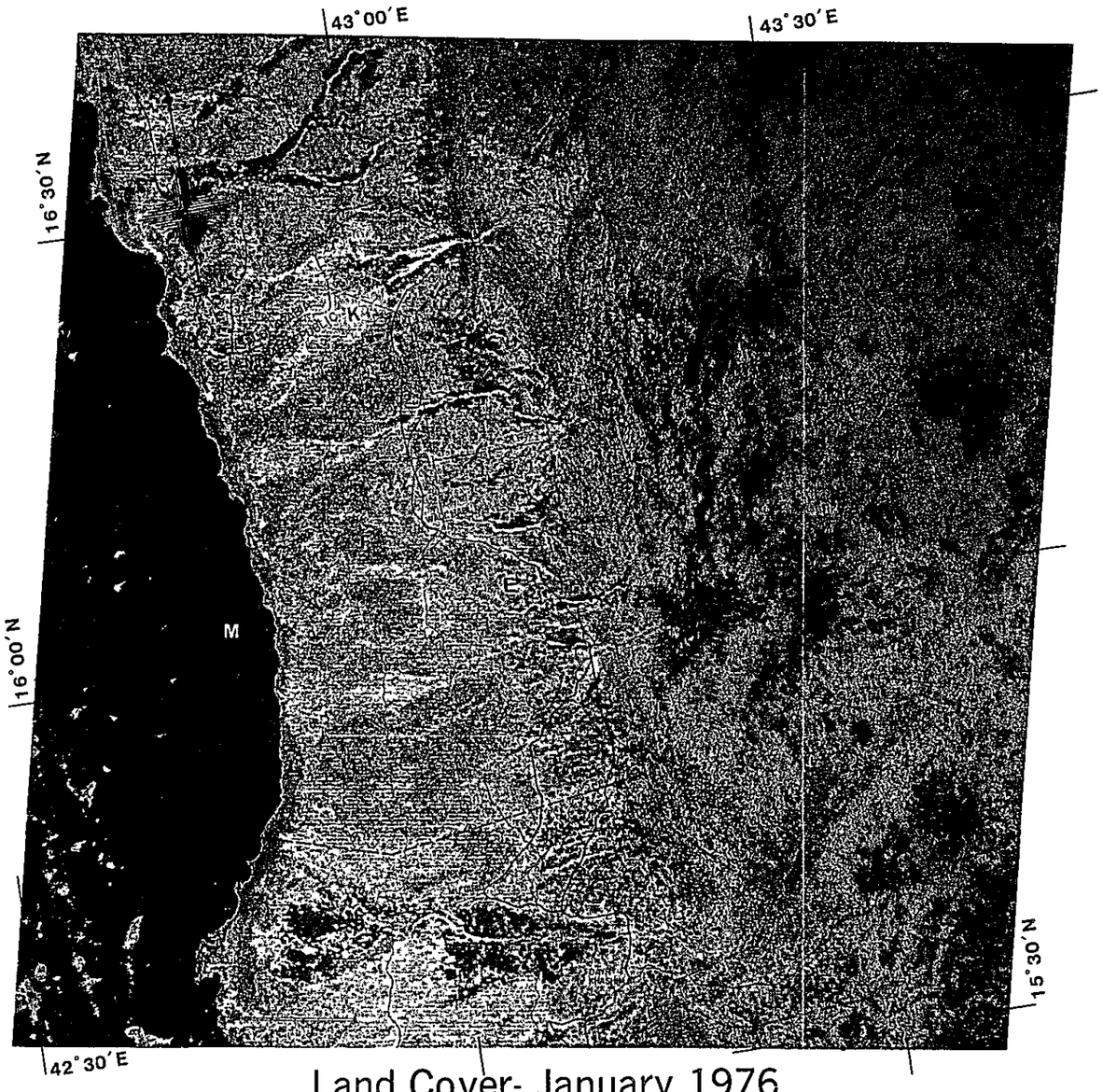
Land Cover Map (October 13, 1972)



LEGEND	
Red	Cropland, Intensive cultivation, Dense vegetation cover
Orange	Cropland, Medium to low density vegetation cover
Magenta	Cropland, Dense vegetation cover
Purple red	Cropland, Medium density vegetation cover
Yellow	Cropland, Low density vegetation cover, Rangeland in Midland and Highland
Green yellow	Rangeland, Dwarf shrub grassland, Partially cropland for opportunistic planting
Green	Rangeland, Dense shrub and trees
Green blue	Rangeland, Dwarf shrub and grassland on Yemen Volcanics
Purple blue	Rangeland, Shrub and grassland on Limestone and Greenshale
Cyan	Rangeland, Shrub and grassland on Granite and Gneiss
K White	Wadi bed or flood plain, Partially cropland for opportunistic planting
Blue green	Salt affected land or wet sand, Rangeland on Granite and Gneiss (Midland)
M Blue	Water
N Grey	Beach sand or coral reef

Land Cover- October 1972

Fig.7.1 Land Cover Map (October 13, 1972)



Land Cover- January 1976

LEGEND	
Red	Cropland, Intensive cultivation, Dense vegetation cover
Orange	Cropland, Medium to low density vegetation cover
Magenta	Cropland, Dense vegetation cover
Purple red	Cropland, Medium density vegetation cover
Yellow	Cropland, Low density vegetation cover, Rangeland in Midland and Highland
Green yellow	Rangeland, Dwarf shrub grassland, Partially cropland for opportunistic planting
Green	Rangeland, Dense shrub and trees
Green blue	Rangeland, Dwarf shrub and grassland on Yemen Volcanics
Purple blue	Rangeland, Shrub and grassland on Limestone and Greenshale
Cyan	Rangeland, Shrub and grassland on Granite and Gneiss
K White	Wadi bed or flood plain, Partially cropland for opportunistic planting
Blue green	Salt affected land or wet sand, Rangeland on Granite and Gneiss (Midland)
M Blue	Water
N Grey	Beach sand or coral reef

Fig.7.2 Land Cover Map (January 23, 1976)

LEGEND

Category of Land Use	Land Use Subdivision	
Irrigated Crop Land	A1	Intensively cultivated under irrigation / Pumping and diverted stream flow / Sorghum, vegetables and tropical fruits
	A2	Intensively cultivated under irrigation / Diverted stream flow/ Mainly sorghum
Rainfed Cropland/ Annual Cultivation	BT	Densely cultivated / Irregular spate irrigation/ Mainly sorghum
	B2	Densely cultivated / Sorghum and millet
	B3	Wadi lands / Vegetables and sub-tropical fruits
	B4	Gently sloping lands receiving hill slope runoff / Sorghum and maize
Rainfed Cropland/ Opportunistic Cultivation	C	Mainly millet and sorghum
Rainfed Cropland/ Terraced	D1	Densely cultivated/ Sorghum, wheat, barley, and qat
	D2	Sparsely cultivated/ Sorghum, millet, wheat and barley
Rainfed Cropland/ Rangeland	E	Opportunistic planting, otherwise dwarf shrub grassland/ Mainly millet
Rangeland	F1	Dwarf grassland
	F2	Trees and shrub
	F3	Open shrub and grassland on rocky slopes
	F4	Grassland and scattered shrub
Unused	G1	Sand dunes and isolated hills
	G2	Salt affected land
	G3	Wadi bed

Fig.7.3 Present Land Use

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VIII SOCIO-ECONOMY

SECTION VIII [illegible]

VIII SOCIO-ECONOMY

(1) General

8.01 The Hajjah Province has a total area of 9,590 km^2 with a population of some 400 thousand in 1975. Population density is estimated at bout 41.4 persons per km^2. Average size of household is about 5.1. More than 70 % of the population are engaged in agriculture and a few percents of the population are normadic hersmen. Administratively, the Hajjah Province consists of five quadas, 29 nahiyas and 1,929 villages. The capital of the Province is the town of Hajjah located at the south-east corner in the Province. The administrative division of the Hajjah Province is as shown in Fig. 8.1.

8.02 The town of Hajjah has the biggest population of some 5,800 as of 1975. Hajjah, Mabyan, Al Mahabisha and Shahara are the major towns in the mountainous area and Abs, Midi and Harad are the principal ones in the Tihama area. About 4 % of the whole population are living in these towns. The rest are living in small settlements with the population of 1,000 or less. As of 1975, there are 873 small settlements with the population of 250 or more. The population of the quadas and nahiyas of the Province as of 1975 are as shown in Table 8.1.

8.03 The Hajjah Province is located in the north-western part of YAR, being surrounded by Sadah Province and Saudi Arabia in the north, Sana'a Province in the east, Hodeidah and Al Mahwit Provinces in the south and the Red Sea in the west. Though the Hajjah Province enjoys very favourable location, being close to Sana'a, the capital of the Republic, and to Hodeidah, the biggest and actually the only foreign trade port in YAR, its development has long been hindered principally because of the lack of adequate road network due

to mountainous topography and the strong tribal system over which the administration of the central government is not always effective. Socio-economic environment of the Province lags far behind the advanced provinces and the Province is facing the serious problem of massive outmigration of the inhabitants. The overall development of the Hajjah Province, exploiting its physical and human resources, is urgent and of vital importance.

8.04 In the social-cultural-economic context, the Hajjah Province could be divided into two distinct divisions, i.e., the mountainous area and the Tihama area in the same way as in the division according to physical conditions.

8.05 In the mountainous area, people are mostly Arabs. In the Tihama area, on the other hand, people are consisting of the descendants of the Africans who migrated from Ethiopia and Somalia across the Red Sea and intermarried with Arabic people. People in the mountainous area seem to have more faith in the religion relative to those in the Tihama area. People in the Tihama area are not too strict in observing the religion. Women are more active, participating in public meetings and being engaged in farming operations. People dwell in relatively better houses including those made of stone in the mountainous area. In the Tihama area, on the other hand, people usually live in humble huts made of straw. People are on the average more well-off in the mountainous area. Most of the landlords of the Tihama lands are the inhabitants of the mountainous area. In the Tihama area, the large majority of the people are either tenants or peasants. Outmigration is more prevalent and even these migrant workers mostly put up with low incomes. In the social context, people in the mountainous area usually occupy higher positions. Most of the tribal leaders and local

government heads in the Hajjah Province are from the mountainous area.

8.06 On the whole, the mountainous area is founded on stronger economic base and has been exerting economic and social influence over the Tihama area. Moreover, the rapid outmigration in recent years has further drained the Tihama area of its economic base and the disparity between the two divisions has been widened.

(2) General Economic Situations

Economic structure and activities

8.07 Economy of the Hajjah Province has been centering around agriculture, which presumably employs more than 70 % of the labour force of the Province, though no precise data are available about this. Other industries including home industry, local manufacture, transport service, building and construction industry, commerce and public services still remain at their initial stage of development and they play rather minor role in the overall economic operations of the Province.

8.08 As of 1975, the Hajjah Province has only seven enterprises employing ten or more workers, whereas the advanced provinces of Sana'a, Taiz and Hodeidah where the three principal cities of Sana'a, Taiz and Hodeidah are located, has 84, 81 and 270 enterprises, respectively. As for the number of workers employed in the enterprises, provinces of Sana'a, Taiz and Hodeidah employ 18,169, 18,484 and 24,596 workers, respectively, while the Hajjah Province employs only 3,237 workers as of 1975. In the enterprises employing ten or more workers, only 90 men are employed in the Province while 3,259, 2,524 and 8,529 men are employed in the provinces of Sana'a, Taiz and Hodeidah, respectively.

8.09 In the Five-Year Plan which started in the 1976/77 fiscal year, the development of industrialization and the improvement of the economic infrastructure are to be centering on the three principal cities of YAR. The disparity in industrialization between the Hajjah Province and the advanced ones is further widened at present.

Marketing

8.10 Agricultural products comprising cereals, vegetables, fruits, cotton, coffee and qut and livestock including sheep, goats, camels, cows and horses are the major products to be marketed in the Hajjah Province. However, major portion of the products is for home consumption and little is usually put on market. Handiworks such as clay ports and straw hats are also brought to market. Their volume is, however, limited. Imported goods such as sugar and fruits are placed on market mainly through Hodeidah.

8.11 The agricultural products and livestock are brought to market either by producers or by middlemen. Imported goods are handled by private importers in the first place, then forwarded to traders and to retailers.

8.12 All the seed cotton is bought up by the General Cotton Company. The major portion is forwarded to Zabid and Hodeidah for ginning and is then shipped abroad. A part of it is sent to the Textile Corporation in Sana'a for spinning and weaving. Qut has long been the most important luxury for the people in YAR. Wherever people gather, qut market can be found. Both producers and traders make transaction according to relatively accurate and speedy market information.

8.13 Almost all the transactions are made in souqs, which have a long history in YAR. In the Hajjah Province,

marketing area covers two or three nahiyas, usually within a wadi flood basin or sub-range of mountains. Within the marketing area, five to seven places are specified by the Governor as souqs, which are usually located so that every villager in the area has access to at least one of them once a week. Most of the souqs are opened on weeky basis. In densely populated area including Hajjah-Mabyan area, Al Mahabisha area and Abs area, the souqs are opened more frequently.

8.14 In the Hajjah Province, marketing organization is yet to be developed and the transport facility is quite inadequate. The total length of jeepable roads is quite limited and during rainy seasons even these roads are frequently closed. The communication facilities which are indispensable for obtaining market information timely are almost nil. Marketing organization and structure in the Province are yet to be developed both from the viewpoints of facilities and institutions and have long been the major bottleneck of the economic development of the Province.

Price characteristics

8.15 Market prices of agricultural products have kept a rising trend in these years. The rising rate, however, is rather low compared with these of other commodities such as clothing and dwellings. Among the agricultural commodities, meat, legumes, vegetables and fruits have shown relatively sharp price hike. On the other hand, the prices of cereals went up rather slowly, mainly due to the recent change in dietary life in YAR.

8.16 There exists big disparity in the prices received by farmers and paid by consumers. There also exists a strong tendency that the price increase at the retail level is not fully reflected on the farm gate prices. The major causes

are presumed to be as follows:

a. organizational weakness of the producers (farmers).

b. producers are often in debt to traders and therefore placed in an awkward situation in having dealings with them.

c. agricultural products must be sold within short period after harvest due to the severe shortage of storage facilities of the products.

8.17 Heavy seasonal fluctuation in the prices of the agricultural products has been observed, mainly due to the lack of adequate storage and transport facilities and the shortcomings of appropriate and timely market information.

8.18 Not only in the Hajjah Province but everywhere in YAR, prices received by farmers and paid by consumers are uniformly much higher for all commodities, notwithstanding whether they are produced domestically or imported, except cotton, than those of similar internationally traded goods, presumably due to a combination of scanty domestic supply and inefficiencies in market organization and structure.

Supply and demand for labour and wages

8.19 As it is the case almost everywhere in YAR outmigration of population in the Hajjah Province either to urban areas or to neighbouring oil producing countries has been under way at a striking rate particularly in the recent years, resulting in the severe shortage of labour supply. In Abs area of the Province for example, roughly 50 to 65 % of the labour force are reported to be working elsewhere.

8.20 Due to this imbalance in supply and demand for labour in the Province and to the rapid rate of inflation as well, the wages of labour have been rising sharply. In particular, agricultural wages increased to YR60 to YR80 per day in 1979 from YR5 per day in 1975, some 12 to 16 times hike. In general, wages are higher in the mountainous area than in the Tihama area. In the vicinity of the towns of Al Mahabisha and Hajjah, wages are higher, reflecting the strong demand for labour in these towns.

(3) Socio-economic Regions

8.21 The Province could be further sub-divided into five (5) socio-economic zones which are exactly conformable to existing quadas, i.e., Al Mahabisha Quada, Hajjah Quada, Washha Quada, Shahara Quada and Midi Quada. Midi Quada almost represents the Tihama area except Kaydinah Nahiya which is located in the mountainous area. The other four quadas and Kaydinah Nahiya together represent the mountainous area. All these quadas are heavily dependent on agriculture, with some 22 % of the total households being classified as farm households as of 1979.

8.22 Al Mahabisha Quada is located at the central part of the Province, being adjacent to Hodeidah Province in the south and the Tihama plain in the west. The Quada is developed with the town of Al Mahabisha as its core. It has an area of 1,120 km^2 or 11,7 % of the total area of the Province. The total cultivated area is 10,300 ha as of 1979. It had a population of some 92,000 as of 1975, accounting for some 23 % of the total population of the Province. The population density is estimated at as high as 82 persons per km^2, the second highest among the five quadas next to Hajjah Quada. The net annual crop production value amounts to about YR768 million or 68.5 % of the total net crop production value of the Province. The

net annual crop production value per farm household is estimated at about YR59,000, more than six times as large as these for the other quadas (see Chapter IX, AGRICULTURAL ECONOMY, Table 9.4). Al Mahabisha Quada is characterized as the most economically advanced zone in the Province, being most densely populated and earning the highest income among the zones.

8.23 Hajjah Quada is located at southeasternmost part of the Province, neighbouring on Sana'a Province in the south and east. Though geographically, it is located very close to Sana'a, the Capital and a principal economic center of the country, there is no road which directly connects the Quada with Sana'a. Hajjah and Mabyan are the major towns of the Quada. The town of Hajjah is the Capital of the Province and the center of the administrative system of the Province. It is also the biggest town of the Province with a population of 5,800 as of 1975. It has an area of 1,560 km^2 or 16.3 % of the total area of the Province. The total cultivated area is 18,600 ha as of 1979. It has the biggest population among the quadas with 134,000 inhabitants as of 1975 or about one third of the total population of the Province. The population density is estimated at as high as 86 persons per km^2, the highest among the quadas. The net annual crop production value amounts to about YR 161 million or 14.4 % of the total of the Province. Though the figure is the second largest among the quadas, it is only about one fifth of that for Al Mahabisha Quada. The net annual crop production value per farm household is estimated at about YR 8,700. Though this figure is about equal to these for Midi Quada and Washha Quada and higher than that for Shahara Quada, it falls for behind that for Al Mahabisha Quada.

8.24 Washha Quada is located at the northernmost part of the Province, being adjacent to the northern Province

of Sadah. Though the town of Washha is the biggest settlement in the Quada, its population was only around 500 in 1975. The Quada has an area of 1,710 km^2 or 17.8 % of the total area of the Province. The total cultivated area is 5,600 ha as of 1979. It had a population of some 47,000 as of 1975 or 11.9 % of the total population of the Province. The population density is estimated at about 28 persons per km^2. The net annual crop production value amounts to about YR57 million. The net annual crop production value per household is estimated at YR8,500, about equal to these for Midi Quada and Hajjah Quada.

8.25 Shahara Quada is located at the northeasternmost part of the Province, neighbouring on Sana'a Province and Sadah Province. Though the town of Shahara is the principal town of the Quada, its population was only about 500 as of 1975. The Quada has an area of 1,840 km^2 or 19.2 % of the total area of the Province. The total cultivated area is 5,900 ha as of 1979. It had a population of some 49,000 as of 1975 or 12.3 % of the total population of the Province. The population density is estimated at about 27 persons per km^2. The net annual crop production value amounts to only YR 44 million or only about 4 % of the total value for the Province, being the lowest among the quadas. The net annual crop production value per household is estimated at mere YR 6,500, also being the lowest among the quadas. The Quada is rather characterized by economic backwardness. There also exists a strong tendency toward local automy against central administration.

8.26 Midi Quada is located in the Tihama plain, neighbouring on Saudi Arabia in the north, the mountainous area in the east, Hodeidah Province in the south and the Red Sea in the west. Quada Midi is developed around the three major towns, i.e., Abs, Midi and Harad, each having a population

of 2,500 or more as of 1975. Abs and Harad are connected with Hodeidah via Bajil, a major economic center and the principal international trade port of YAR, by a north-south road running in the Tihama plain. Abs is also linked with Al Mahabisha, a key economic center of the Province, by road transport. Midi Quada has an area of 3,360 km^2 or 18.9 % of the total area of the Province. The total cultivated area is 43,500 ha as of 1978. It has a population of some 75,000 as of 1975, accounting for some 19 % of the total population of the Province. The population is rather dispersedly located with the density of some 22 persons per km^2, the lowest among the quadas. The net annual crop production value amounts to about YR 91 million. Though the cultivated land per farm household is the highest among the quadas with 4.3 ha, the net annual crop production value per farm household is estimated at only about YR 8,900, being ranked second with Hajjah Quada and Washha Quada but far behind Al Mahabisha Quada. A large majority of the people in the Quada are tenants and peasants. Few landowners are mostly the residents of the mountainous area.

(4) Rural Infrastructural Facilities and Social Services

Rural water supply

8.27 No towns except Hajjah is equipped with domestic water supply system. Even in this town, only a portion of the population is provided with water due to the limited capacity of the system. The quality of the water is not sufficient for drinking.

8.28 In the mountainous area, rainy water, which is stored in cisterns, is generally used for domestic use. However, the absolute quantity is not sufficient and the shortage is made up for by carrying water from wadis and springs usually located away from the villages. In the Tihama area, several villages possess their own wells and

ground water which is drawn either by manpower, animal drought or pumps is utilized for domestic use.

8.29 All the villages in the Province, except Hajjah, have no water distribution system to convey domestic water to homes. Women and children usually engage in the transport of the water. In some villages, a greater portion of daytime is consumed for this laborious work due to a long distance between the houses and the water sources. The shortage of domestic water accompanied by its poor quality has caused various water-borne diseases, resulting in the poor health condition of the rural population.

8.30 Under these circumstances, the Government is planning to execute three (3) water supply projects in the Province, besides the one in Al Mahabisha which is under construction. Even with these projects, however, a large majority of the population in the Province are left uncovered by water supply systems.

Rural roads

8.31 All the roads running in the Province are primitive tracks, suitable only for four-wheel drive vehicles and animal transport. Most of them have no wadi crossings. Wadis themselves are frequently used for inland transport in many places in the Province. During the rainy season, almost all the roads are closed. Under these conditions, most of the villages and towns are socially and culturally isolated from each other and marketing areas are usually confined within wadis flood basins and sub-range of mountains. There is also general lack of consumer goods in the Province.

8.32 Although the Highway Authority contemplates to construct new trunk roads to connect the major towns in the

Province, only the Amran-Hajjah route is underway at present. Lack of adequate road network is one of the major restrictions on the social, cultural and economic development of the Province.

Education

8.33 Although the number of primary schools can be considered sufficient, their quality is far from adequate. They suffer from an acute shortage of qualified teaching staffs as well as a lack of instruction materials. Only a limited number of schools offer the full range of six grades, a large majority having only three grades or less. In order to complete the full six-grade primary education, children, therefore, must go to schools located away from their villages, that is usually not practicable due to their responsibility for daily water fetching. Very few school children finish the six-grade primary education and dropouts remain the most serious problem. Lower and higher secondary schools are insufficient in number and school enrollments are low at present. Adult education has also hardly been conducted in the Province. Under these conditions, illiteracy is prevalent in the Province with a rate of 91.3 % which is higher than the national average.

Health facilities

8.34 Of the diseases spreading throughout the country, diarrhoeal diseases and schistosomiasis are the most prevailing in the Hajjah Province. Diarrhoeal diseases largely caused by contaminated water are the major causes for the high infant mortality in the Province. The estimated prevalence of schistosomiasis in the Province is the highest in the country with 255 patients per 1,000 inhabitants.

8.35 As of 1975, according to the Statistical Year Book 1976/77, there was only one hospital with 68 beds in the Province, which was located in Hajjah. Significant progress has been made since that time. As of July 1979, according to the field survey conducted by the Study Team, four (4) hospitals with 10 beds each have been constructed in Kahlam, Midi, Al Mahabisha and Harad, and a hospital with 20 beds in Abs. The number of beds of the Hajjah hospital has been increased to 100. Furthermore, a hospital with 10 beds is under construction at Sharhil.

8.36 These, however, are in no sense adequate for the whole population of some 400,000 of the Province. The number of population per hospital bed of the Province is smaller than the national average. The beds are always fully occupied and most of the patients stay in their villages without receiving any medical treatment.

8.37 There are only two (2) health centers in the Province, which are established for providing the inhabitants with basic health care and health guidance. Even these centers have not yet effectively been operating due to the lack of required medical service facilities and medical personnel. Accordingly, there is general lack of consciousness of health and sanitation among the inhabitants, leading to a high contraction rate in the Province. Further, there is no childbirth facilities. Vaccinations, periodical medical check and childcare guidance are hardly provided. As a result, the infant mortality remains high.

Electric power supply

8.38 Electric power is used mainly for lighting in the Province. The town of Hajjah has a power station, and the electricity is supplied to houses. In the other areas, small portable generators with a capacity of three to five