

LEGEND		
□	LESS THAN 50	PERCENT
▧	50 - 55	PERCENT
▨	55 - 60	PERCENT
▩	60 - 65	PERCENT
▪	OVER 65	PERCENT

Fig.4.4 Sunshine Intensity
IV-16

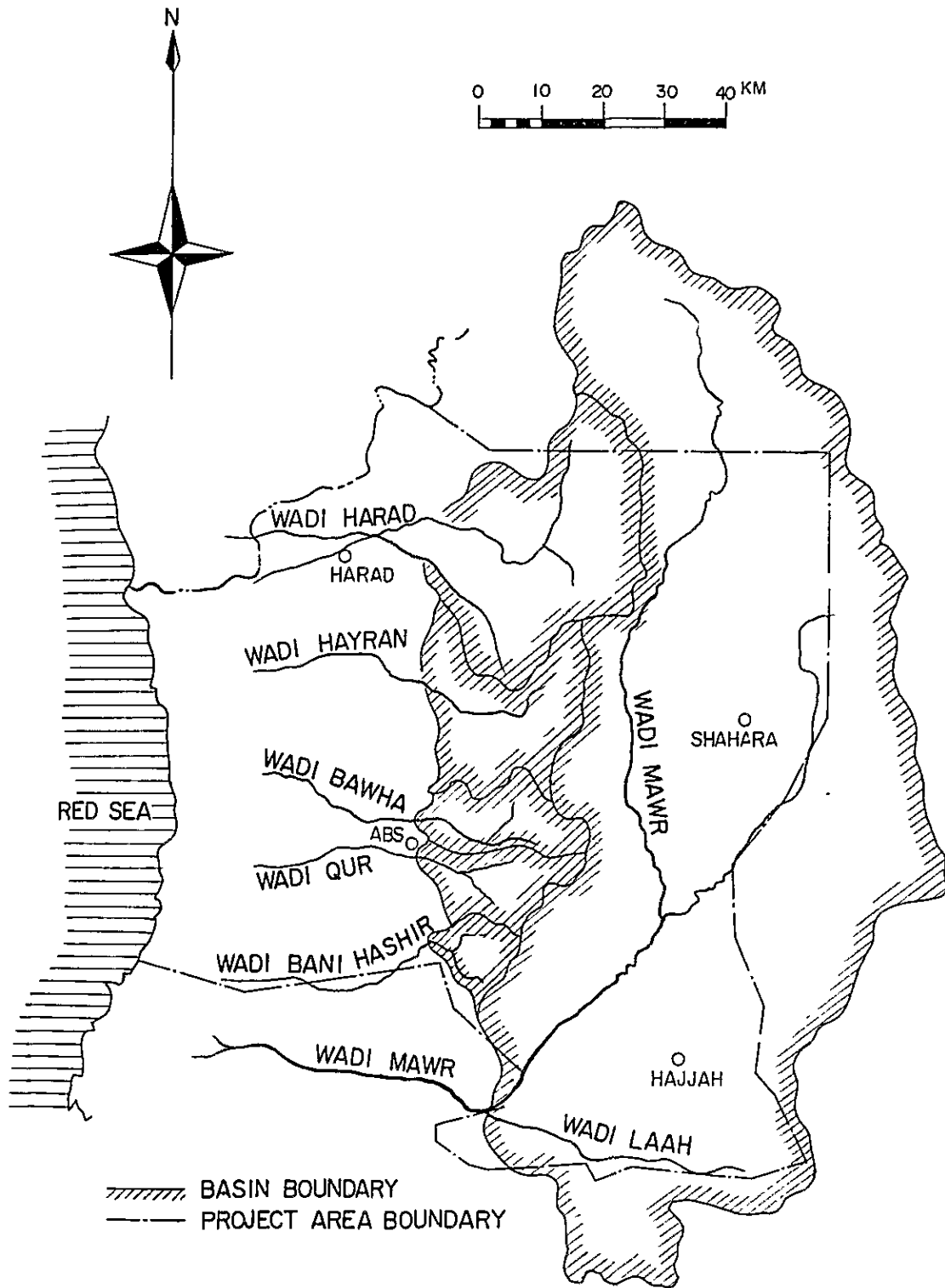


Fig. 4.5 River System and River Basin

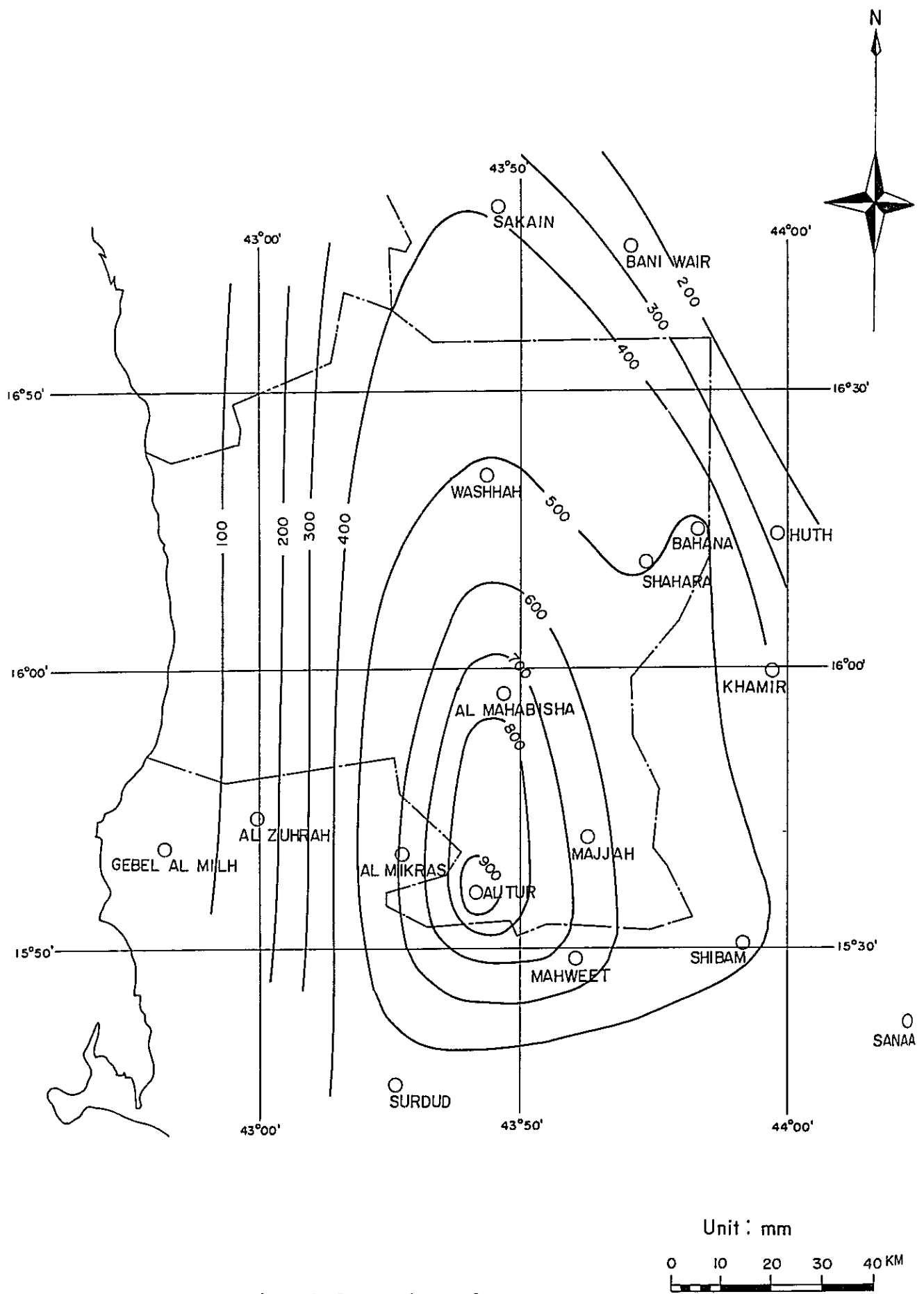


Fig. 4.6 Isohyetal Map

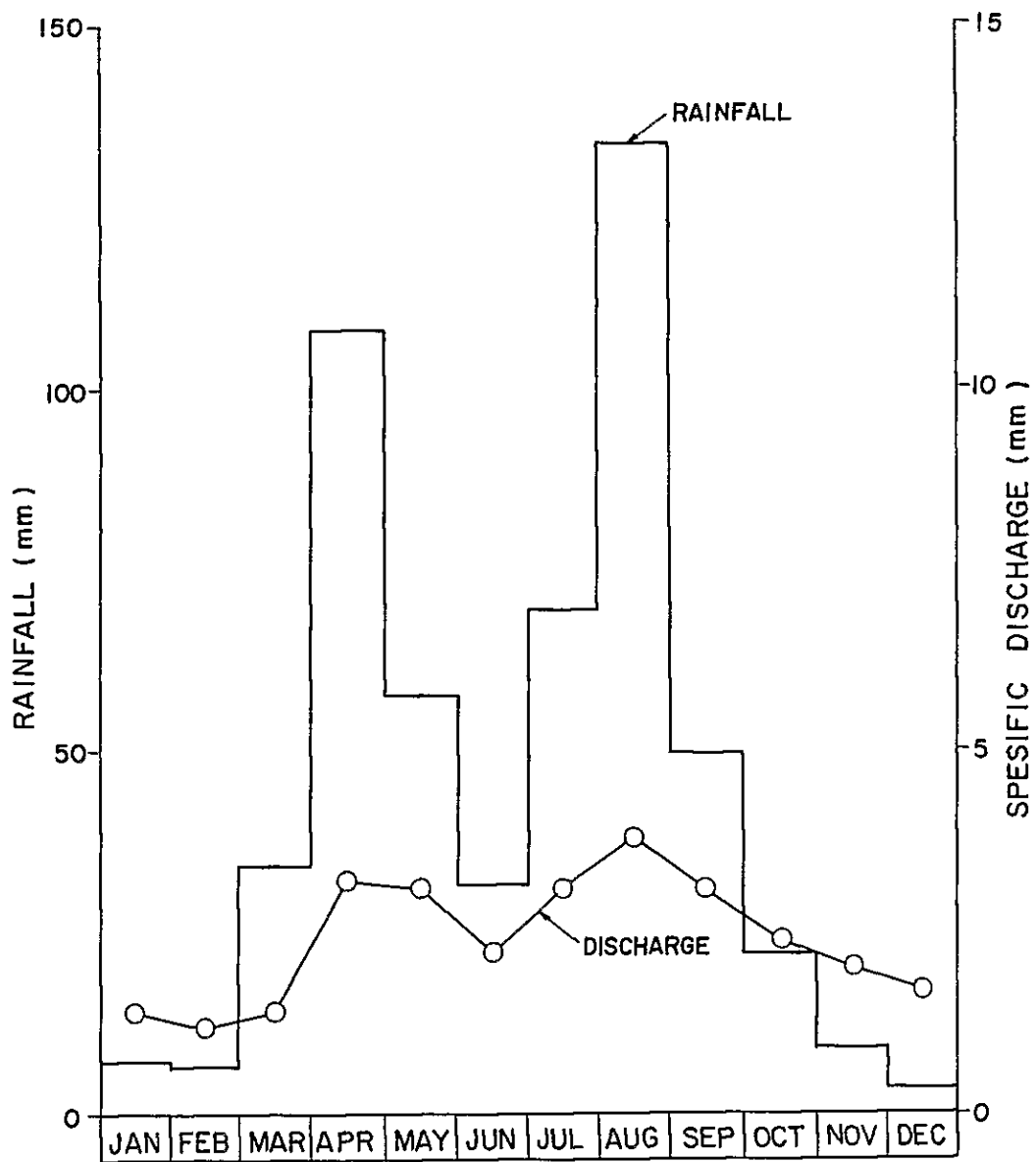


Fig. 4.7 Average Rainfall and Specific Discharge

REFERENCES

- | | |
|---|---|
| Tipton and Kalmbach Inc.
(1979) | Development of Wadi Mawr, Tihama
Development Project |
| Advisory Team to
the Central Planning
Organization (1978) | Al Mahabisha Water Supply Project
(Pre-Feasibility Study) |
| Electrowatt Engineering
Services Ltd. (1978) | Marib Dam and Irrigation Project
Yemen Arab Republic, Main Report |
| FAO / IBRD
Cooperative Programme
(1973) | Draft Report of the Yemen Arab
Republic Southern Upland Rural
Development Project |

V SOIL AND LAND CLASSIFICATION

1.	General	V - 1
2.	Physiography and Soils	V - 2
3.	Soil Associations	V - 4
4.	Land Classification	V - 6

Tables

5.1	Physiography and Soils	V-10
5.2	Key to Soil Symbols	V-11
5.3	Land Classification	V-12

Figures

5.1	Physiography and Soils	V-13
5.2	Land Classification	V-14



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 permanently 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 km², out of which arable lands (Class 1, 2 and 3) are estimated around 3,810 km² or 39.7% as summarized below:

<u>Land Class</u>	<u>Lowland</u> (km ²)	<u>Midland</u> (km ²)	<u>Highland</u> (km ²)	<u>Total</u> (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 centuries 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 retention 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

	<u>Physiography/Terrain Units</u>	<u>Dominant 50%</u>	<u>Soil Units Associated 20 - 50%</u>	<u>Inclusions 20%</u>	<u>Land Class</u>	<u>Area (km²)</u>
L	<u>LOWLAND</u>					
L1	Salty flats	Zg - 2/3a	-	Zt - 2/3a	6	320
L2	Low dunes and sand sheets	Re - la	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 - la	Jc - 1/2a(g)	Re - la(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 - la	Rc - la(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	<u>MIDLAND</u>					
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 - la(g)	I	Xh - 1b(s)	4	890
M5	Dissected upland, medium textured	Xh - 2ab	Je - lab(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 - la(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	<u>HIGHLAND</u>					
H1	Highland scarpment	I	Je - 1c(g)	-	6	30
H2	Dissected mountain on Yemen Volcanics	Yk - lab(1)	Yh - lab(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 - lab(g)	I	-	4	170
H5	Small inter-mountain plain	Yh - 2a	Yk - 2ab	Re - 2ab	1	50 (810)

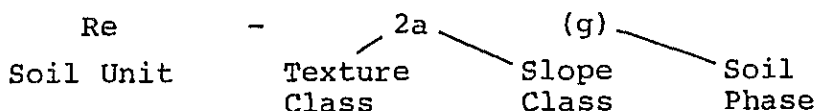
9,590

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% -)

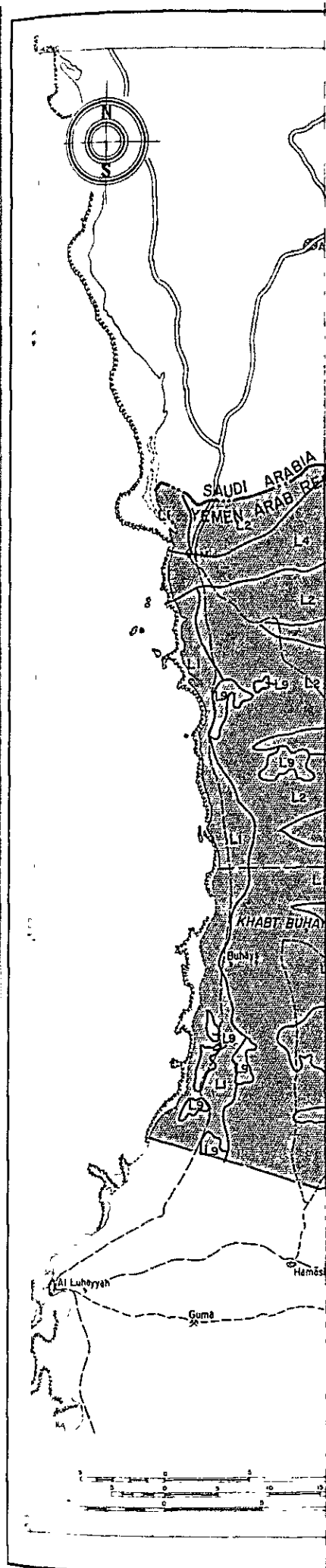
Soil Phase

- (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

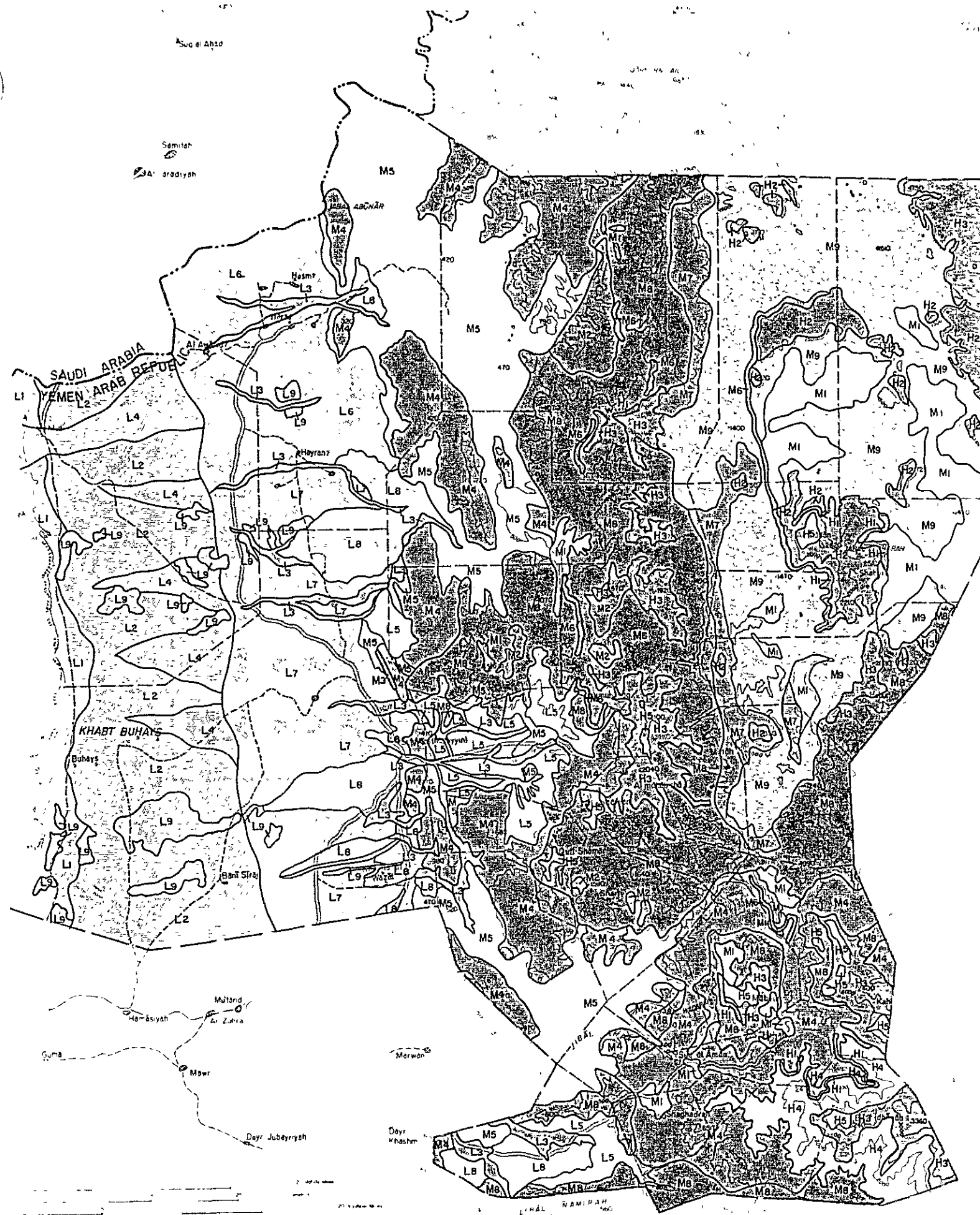
Land Class	Terrain Unit	Area (km ²)
Class 1 (Arable)	L6 Nothern alluvial fan, medium textured	700
	L8 Fluvial terrace	370
	H5 Intermountain plain	50
		1,120
Class 2 (Arable)	L3 Recent wadi alluvium	250
	H3 Highland plateau on limestone and shale	360
		610
Class 3 (Arable)	L4 Alluvial plain (old wadi 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
Total		9,590



LEGEND

Physiography/Terrain Units	Soil Units			Area (10 ³ ha)
	Dominant >50%	Associated 20-50%	Inclusions <20%	
L LOWLAND				469
L1 Sally 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	Je-1/2a	-	2 25
L4 Alluvial plainoid wadi alluvium	Yh-1a	Je-1/2a(g)	Re-1a(g)	3 37
L5 Alluvial fan (pedmont), 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	Je-1a	Re-1a(g)	-	3 100
L8 Fluvial terrace (old wadi terrace)	Yh-2a	Je-2a	-	1 37
L9 Isolated hills	I	-	Yh-2bd	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)	Je-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			Area (10 ³ ha)
	Dominant >50%	Associated 20-50%	Inclusions <20%	
L LOWLAND				
469				
L1 Salty flats	Zg-2/3a	-	Z1-2/3a	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 (pedmont), 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-2bcd	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-2bcd	Yk-2ab	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-2bcd	Yk-2ab	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	I	-	6 117
M9 Rock floor on Old Yemen Volcanics	I	-	Je-1b	6 87
H HIGHLAND				
81				
H1 Highland escarpment	I	Je-1c(g)	-	6 3
H2 Dissected mountain on Yemen Volcanics	Yk-1bc	Yh-1bc	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

REFERENCES

- FAO/UNESCO (1974) Soil Map of the World, Vol. I
Legend, UNESCO - Paris
- Pacheco, R.A. (1978) The Application of Landsat
Imagery to Soil and Land-Use
Mapping in the Central Region
of the Yemen Arab Republic,
FAO, Rome
- Al-Thoor, A., Dewan, H.C. Soils of the Yemen Arab Re-
(1978) public, UNDP/FAO/Ministry of
Agriculture, Taiz (Mimeographed)
- Wambe, V.A., Hardy E. A Soil and Land Resources
(1977) Inventory for Yemen .
(Mimeographed)
- Tipton and Kalmbach Inc. Development of Wadi Mawr, Tihama
(1979) Development Authority, Hodeidah

VI VEGETATION

1.	General	VI-1
2.	Seasonal Changes in Vegetation Cover	VI-2
3.	Vegetation Type	VI-3
4.	Perennial Vegetation Cover	VI-4

Figures

6.1	Density of Vegetation Cover (1975 - 1976)	VI-5
6.2	Density of Vegetation Cover (1978)	VI-6
6.3	Seasonal Changes in Vegetation Cover (1975 - 1976)	VI-7
6.4	Seasonal Changes in Vegetation Cover (1978)	VI-8
6.5	Vegetation Map	VI-9

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

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.

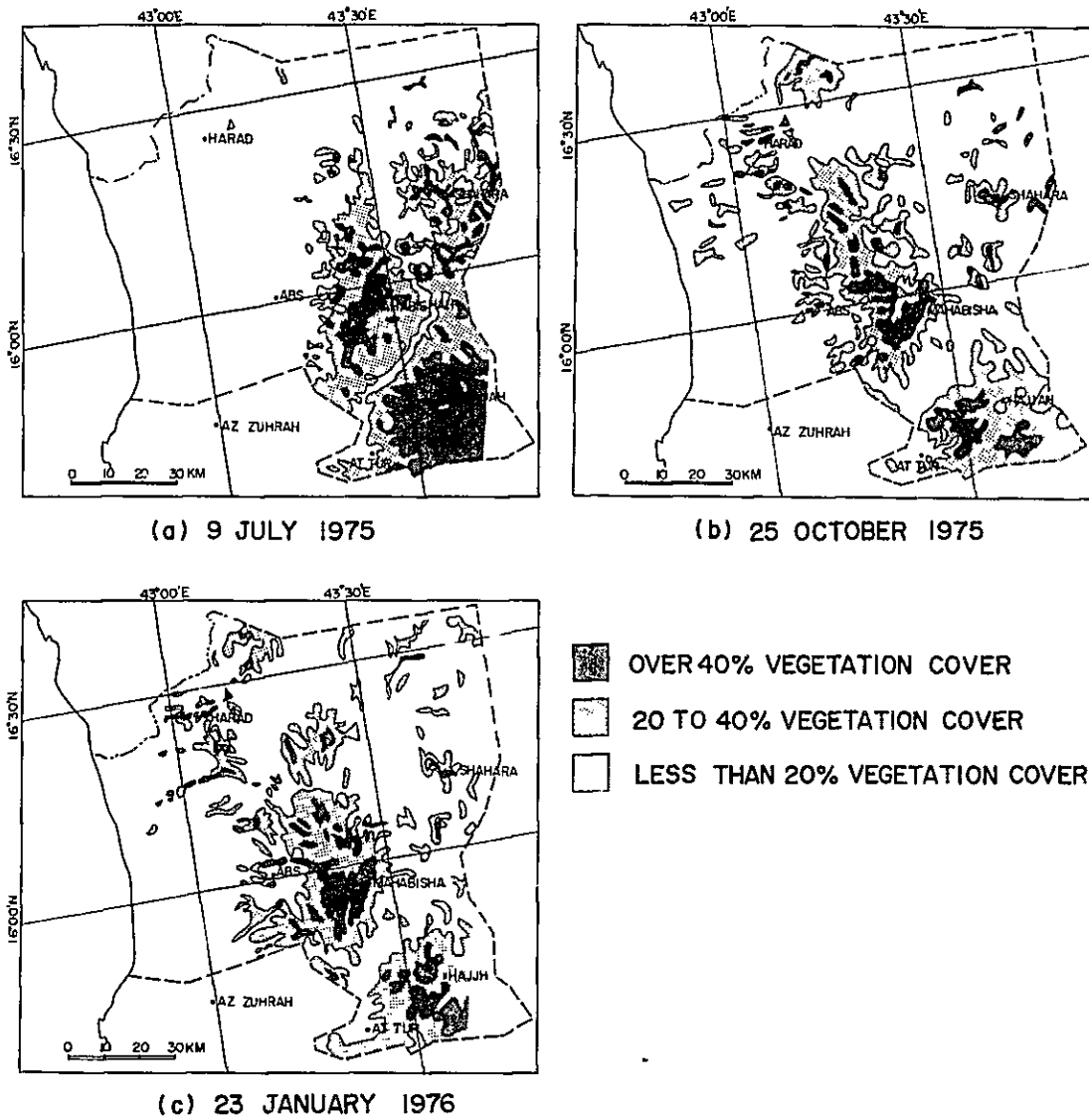


Fig. 6.1 Density of Vegetation Cover (1975-1976)

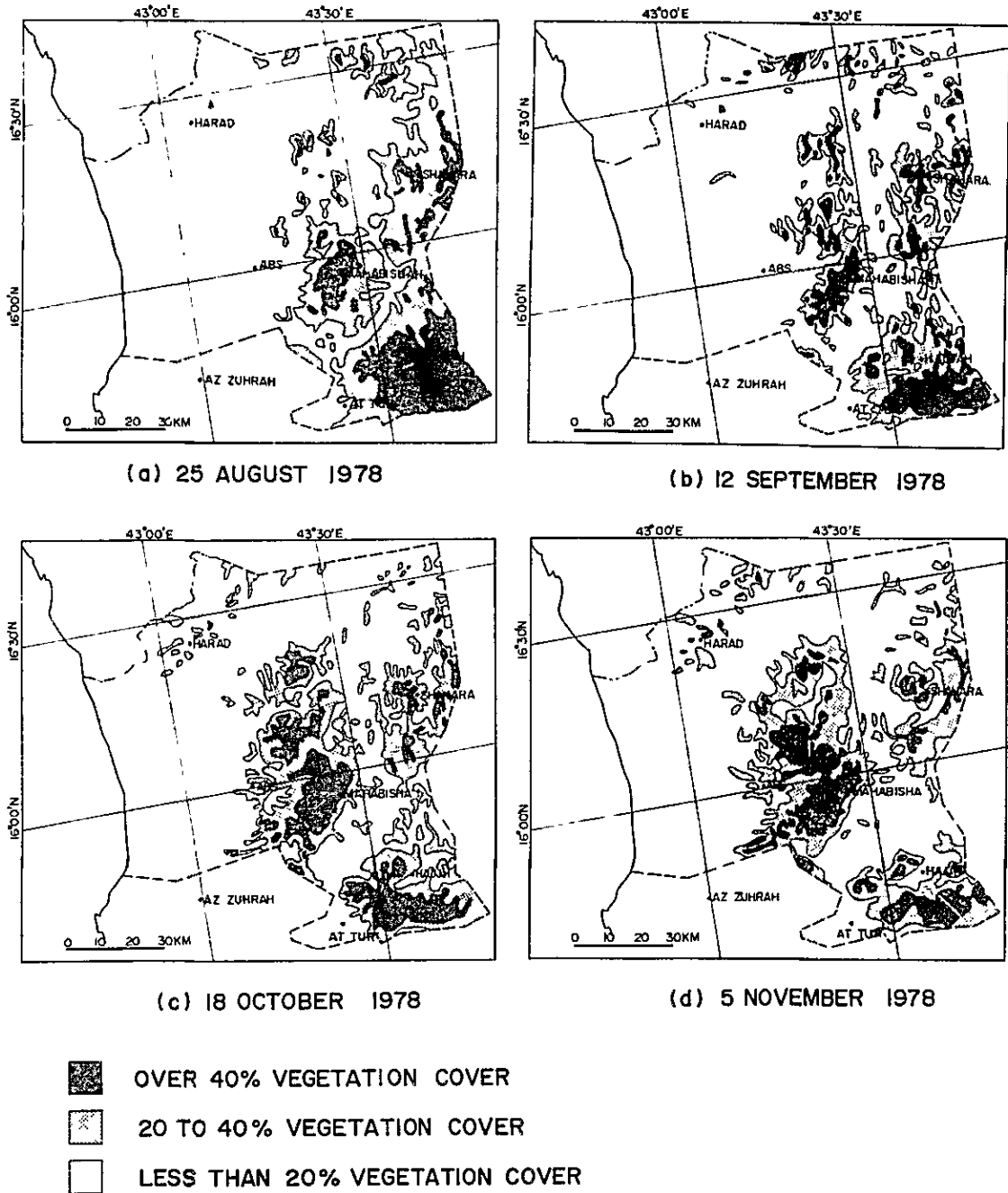


Fig. 6.2 Density of Vegetation Cover (1978)



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)

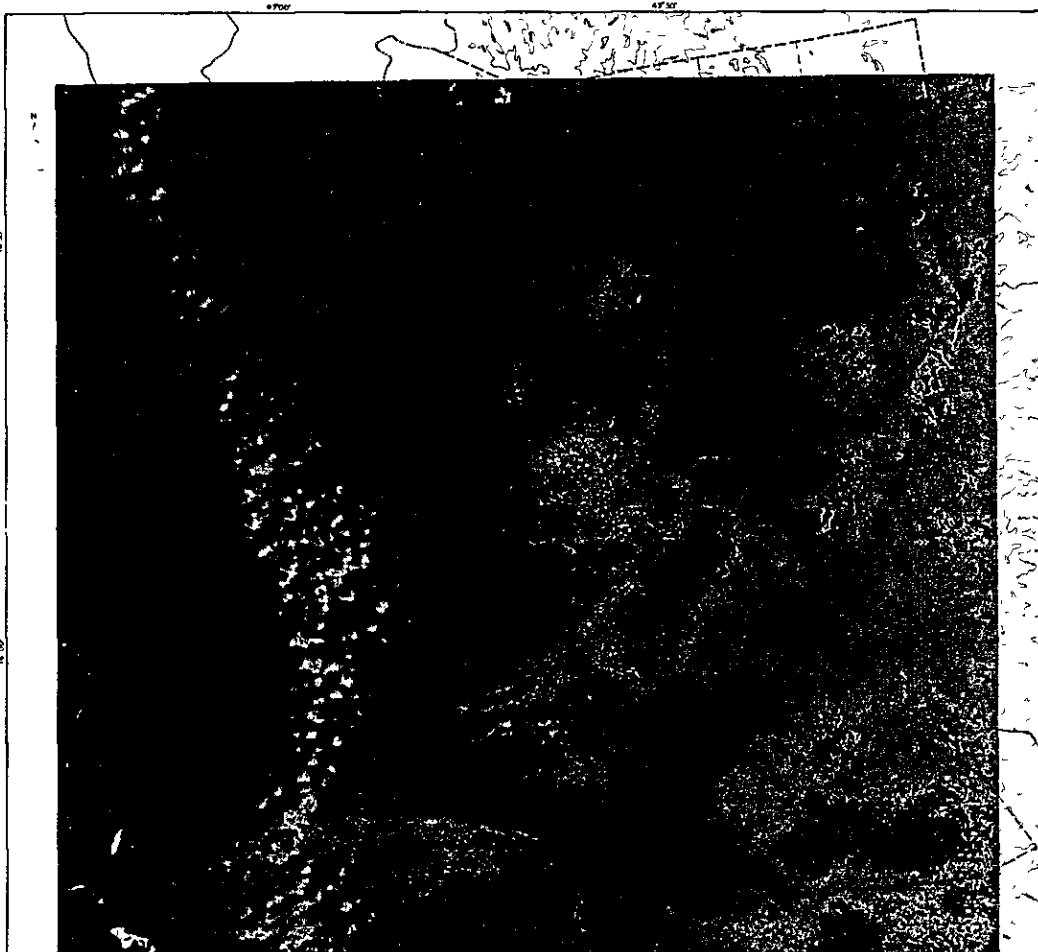
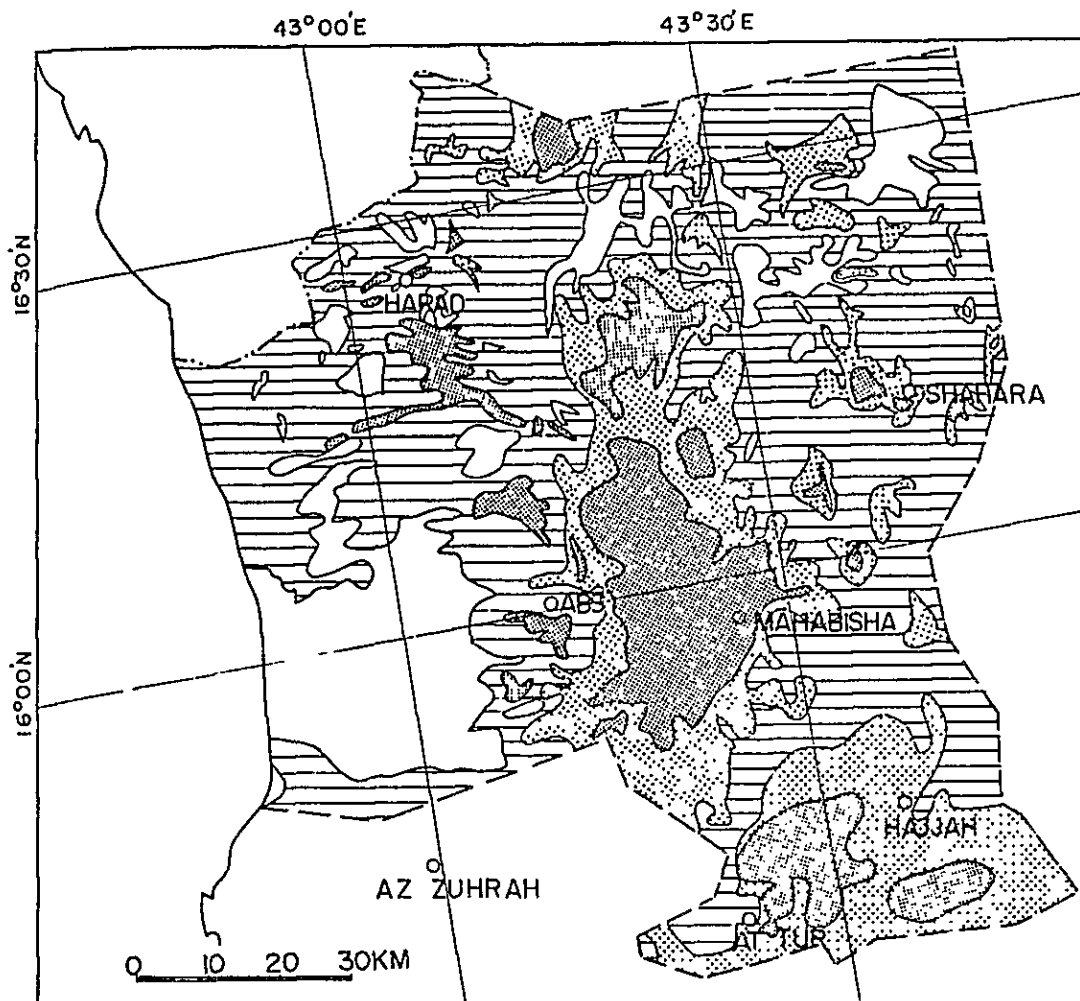


Fig.6.4 Seasonal Changes in Vegetation Cover.

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

REFERENCES

- Dequin, H. (1976) Arabische Republik Jemen,
Wirtschaftsgeographie eines
Entwicklungslandes, Riyadh
- Asahi Shinbun (1976) World Vegetation, No. 23-82, Japan
- Harlan, J. C. et. al.
(1979) Determination of Range Biomass
Using Landsat, Proceedings of
13th International Symposium on
Remote Sensing of Environment,
Ann Arbor, U.S.A.
- Shimizu, M. (1975) Vegetation in Desert Area,
Vegetation and Nature Vol. 9,
Nrs. 5, 6, and 7, Japan

VII PRESENT LAND USE

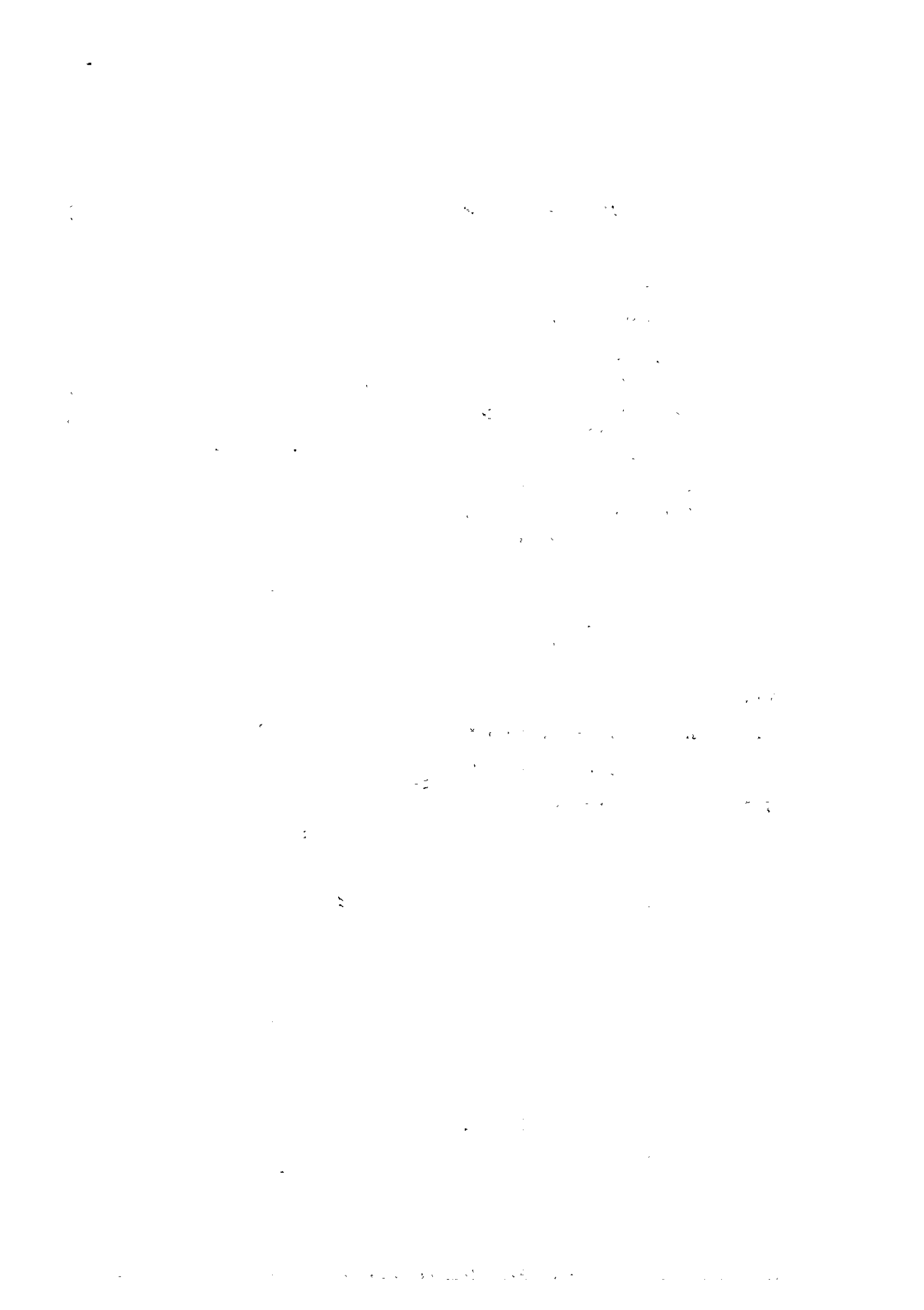
1.	General	VII-1
2.	Present Land Use	VII-1
	Irrigated cropland	VII-2
	Rainfed cropland/Annual cultivation	VII-3
	Rainfed cropland/Oppportunistic cultivation	VII-4
	Rainfed cropland/Terraced	VII-4
	Rangeland	VII-4
	Settlement	VII-5

Table

7.1	Present Land Use	VII-6
-----	------------------	-------

Figures

7.1	Land Cover Map (October 13, 1972)	VII-7
7.2	Land Cover Map (January 23, 1976)	VII-8
7.3	Present Land Use	VII-9



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 sparse 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/Oppportunistic 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.

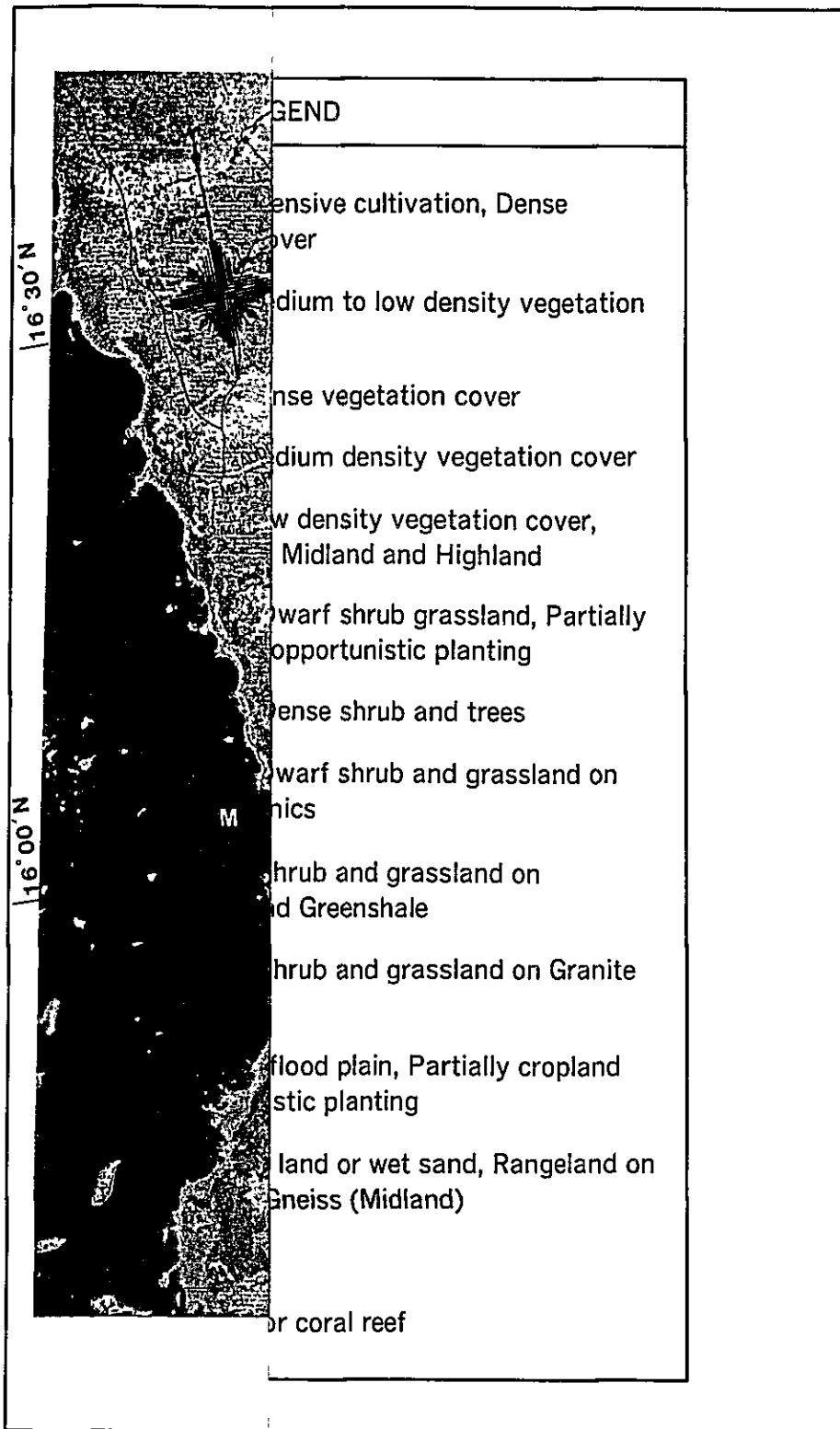
7.16 It should be noted that the rangelands shown on the land use map also include unused land such as bare rocks and isolated steep mountain slopes. Unused rangelands are also extensively located in the midland area where the precipitation is very limited and population is also very small. The extent of the rangeland is about 7,680 km².

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 km² of the land.

Table 7.1 Present Land Use

<u>Land use category</u>	<u>Land use subdivision</u>	<u>Area</u> (km ²)	<u>Proportional extent</u> (%)
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/Oppportunistic cultivation/mainly millet		120	1.3
D. Rainfed cropland/ Terraced	D1 Densely cultivated/sorghum, wheat, barley and cut	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



Land Cover Map (October 13, 1972)

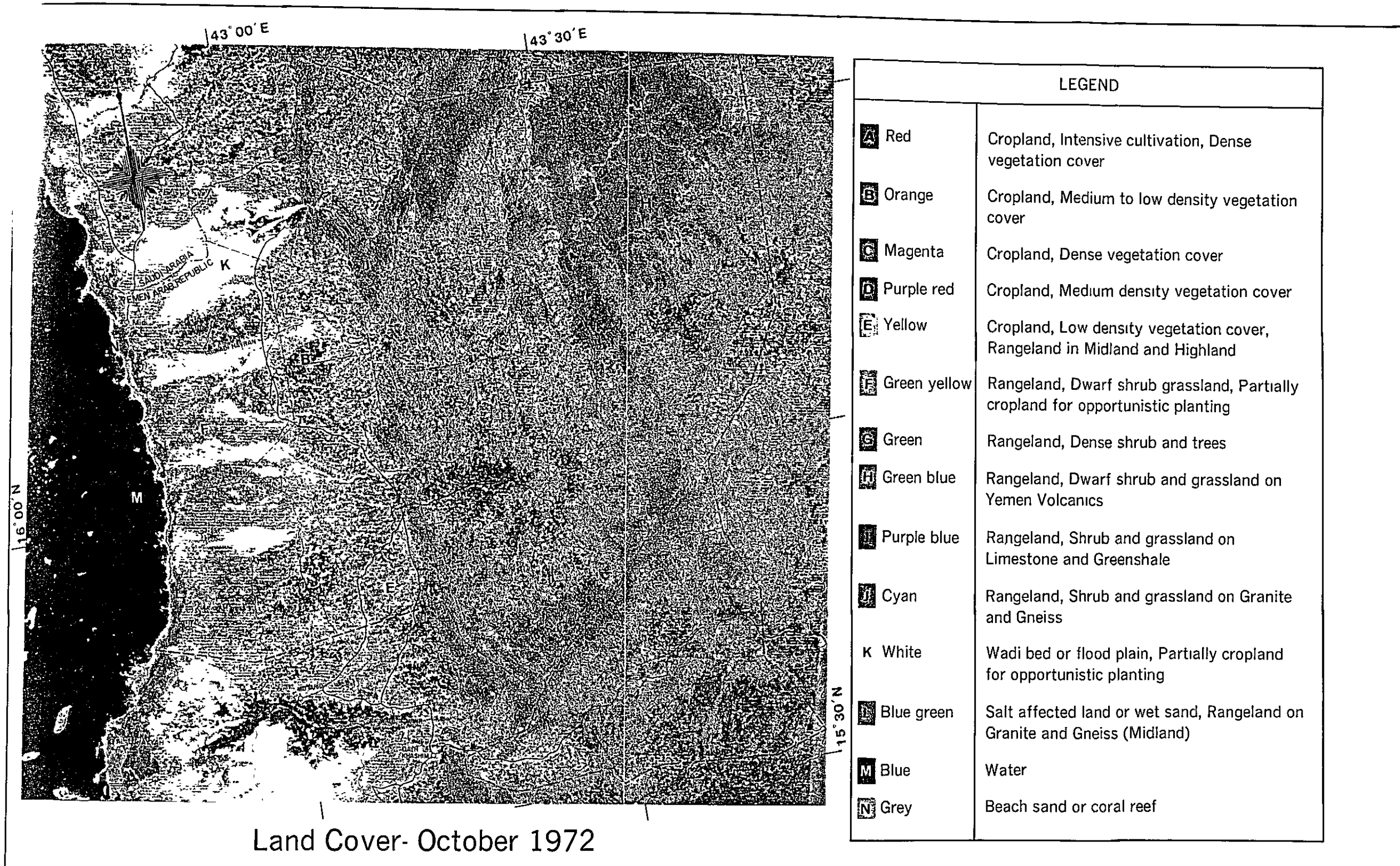
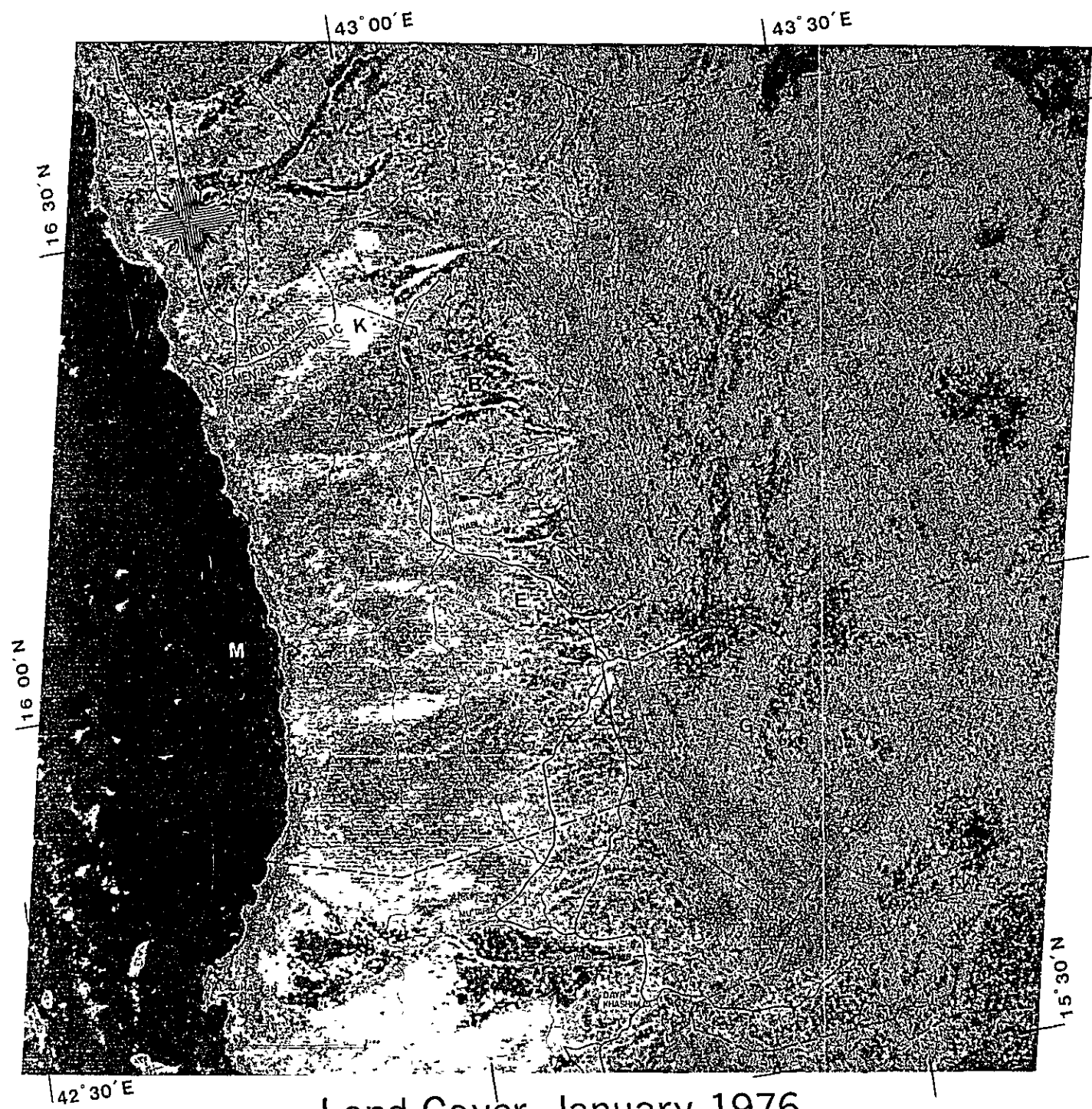


Fig.7.1 Land Cover Map (October 13, 1972)



LEGEND	
A Red	Cropland, Intensive cultivation, Dense vegetation cover
B Orange	Cropland, Medium to low density vegetation cover
C Magenta	Cropland, Dense vegetation cover
D Purple red	Cropland, Medium density vegetation cover
E Yellow	Cropland, Low density vegetation cover, Rangeland in Midland and Highland
F Green yellow	Rangeland, Dwarf shrub grassland, Partially cropland for opportunistic planting
G Green	Rangeland, Dense shrub and trees
H Green blue	Rangeland, Dwarf shrub and grassland on Yemen Volcanics
I Purple blue	Rangeland, Shrub and grassland on Limestone and Greenshale
J Cyan	Rangeland, Shrub and grassland on Granite and Gneiss
K White	Wadi bed or flood plain, Partially cropland for opportunistic planting
L 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	B1 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 oat
	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



REFERENCES

- Ministry of Overseas Development (Y.A.R.) (1977) Yemen Arab Republic Montane Plains and Wadi Rima Project: a land and water resources survey, YAR-01-30/REP-17/77, Sana'a
- Central Planning Organization (Y.A.R.) (1978) Yemen Arab Republic, Final Report on the Airphoto Interpretation Project of the Swiss Technical Co-operation Service, Berne, carried out for the Central Planning Organization, Sana'a
- Pacheco, R. (1978) The Application of Landsat Imagery to Soil and Land-use Mapping in the Central Region of the Yemen Arab Republic, Series AGLT 6/78, FAO, Rome
- Colwell, R. N. (1971) Monitoring Earth Resources from Aircraft and Spacecraft, NASA SP-275, NASA, Washington D.C.

VIII SOCIO-ECONOMY

1.	General	VIII - 1
2.	General Economic Situations	VIII - 3
	Economic structure and activities	VIII - 3
	Marketing	VIII - 4
	Price characteristics	VIII - 5
	Supply and demand for labour and wages	VIII - 6
3.	Socio-economic Regions	VIII - 7
4.	Rural Infrastructural Facilities and Social Services	VIII-10
	Rural water supply	VIII-10
	Rural road	VIII-11
	Education	VIII-12
	Health facilities	VIII-12
	Electric power supply	VIII-13
	Telecommunications	VIII-14
5.	Major Socio-economic Problems	VIII-14
Table		
8.1	Population of the Hajjah Province	VIII-17
Figure		
8.1	Administrative Division of the Hajjah Province	VIII-18

VIII SOCIO-ECONOMY

(1) General

8.01 The Hajjah Province has a total area of 9,590 km² with a population of some 400 thousand in 1975. Population density is estimated at about 41.4 persons per km². 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 nomadic herders. 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 pots 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 weekly 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 km² 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 km², 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 km² 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 km², 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 km² 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 km². 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 km² 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 km². 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 autonomy 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 km² 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 km², 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 land-owners 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 day-time 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

kilowatts are used in villages. However, such generators can supply electricity only to a part of the houses in such villages. Welders, carpenters and oil stations have bigger power generators for power supply as well as for lighting. Total number of households enjoying the benefit of power supply is quite limited at present.

8.39 The Government has been making efforts to increase power supply in the Province. Ras Kateriv Power Station Project is one of such projects. It aims to generate the power of 150,000 kW in the target year of 1982. After the implementation of this project, the power supply capacity in the Province will increase to about ten times of the present one. However, it is not clear at this moment whether the power to be generated at this station will be supplied in Hajjah Province, or not.

Telecommunications

8.40 Telecommunication networks are hardly available in the Province except telephone service between Hajjah and Sana'a for which the test operation is now underway. It is planned to connect Hajjah and Al Mahabisha by telecommunication system in 1979. However, the communication capacity, as a whole, is still poor. Therefore, information and action lags occur in the Province especially in the economic sector, which shows the backwardness of this Province.

(5) Major Socio-economic Problems

8.41 About 96 % of the whole population of the Province are living in the rural areas and more than 70 % of them are engaged in agriculture. The Province, however, is by no means richly endowed with agricultural resources with small and erratic rainfall and limited area of cultivable

land. Moreover, the traditional production techniques are still prevalent without the use of high yielding varieties, fertilizer and pesticides. The total area of irrigated farm land is also quite limited. Consequently, the productivity in agriculture remains low, falling behind the national average.

8.42 About 70 % of the total cultivable land in the Province is owned by tribal leaders and merchants. About 20 % is the property of religious institutions. A large majority of the farmers are engaged in agriculture as tenants under crop sharing arrangements. About 50 % to 80 % of the total proceeds is usually taken by the landowners as farm rent. The rest, or only 20 % is left for the tenants. Moreover the 10 % zaqat tax is frequently borne by the tenants. There are also considerable number of peasants. Their land holding size is quite limited, just sufficient for maintaining their subsistence, taking into account the current low cropping intensity and low productivity. The agriculture in the Province is thus characterized by a large number of tenants and small independent farmers whose incomes are quite low.

8.43 The low income level of the large majority of the rural people coupled with the insufficient infrastructural facilities and social services has caused the massive out-migration of the rural inhabitants of the Province, especially among able-bodied male workers. The outflow is more prevalent in the Tihama area. In Abs Nahiya, for instance, it is reported that about 50 % to 65 % of the total male population are working elsewhere outside the Nahiya. They either head for the neighbouring Arab countries or the urban areas where they can earn higher wages and enjoy better living conditions, such as Sana'a, Taiz and Hodeidah. Inside the Province, the towns of

Al Mahabisha and Hajjah are the major destinations. The massive outflow of the rural inhabitants has drained the agriculture of its labour force. In consequence, extensive area of the terrace lands has been desolated in the mountainous area and millions of farm lands have been abandoned in the Tihama plain, posing serious problem of the weakening of the key industry in the rural areas.

Table 8.1 Population of Hajjah Province

<u>Quada</u>	<u>Nahiya</u>	<u>Population</u>		
		<u>Total</u>	<u>Female</u>	<u>Male</u>
Hajjah		133,910	69,463	10,736
	Hajjah	22,053	11,317	10,736
	Mabyan	20,357	10,446	9,911
	Al Maghrabah	6,232	3,062	3,170
	Al Jamimah	5,441	2,788	2,653
	At Tur	16,065	8,119	7,946
	Beni Al Awam	16,606	8,795	7,811
	Kahlan Afar	11,452	6,017	5,435
	Maswar	16,612	8,890	7,722
	Najrah	6,682	3,510	3,172
	Al Shaghadrah	12,410	6,519	5,891
Midi		74,896	35,763	39,133
	Midi	7,294	3,535	3,759
	Harad	17,394	8,336	9,013
	Abs	25,421	12,603	12,818
	Kaidenah	24,832	11,289	13,543
Al Mahabisha		74,817	38,727	36,090
	Al Mahabisha	8,567	4,465	4,102
	Al Mufleh	7,298	3,803	3,493
	Aflah & Kheiran	26,790	13,911	12,879
	Al Qof	13,682	6,893	6,789
	Kahlan Al Sharaf	7,408	3,934	3,474
	Al Sharhil	11,072	5,721	5,351
Washha		64,033	33,420	30,613
	Aslam	16,918	8,481	8,437
	Washha	19,035	9,955	9,080
	Kasher	16,380	9,056	7,324
	Mustabah	11,700	5,928	5,772
Shahara		48,922	25,210	23,712
	Shahara	15,951	8,349	7,602
	Al Madan	9,394	4,874	4,520
	Al Qufila	8,182	3,989	4,193
	Swair	4,917	2,480	2,437
	Falimat Harbour	10,478	5,518	4,960
	Total	396,578	202,583	193,995

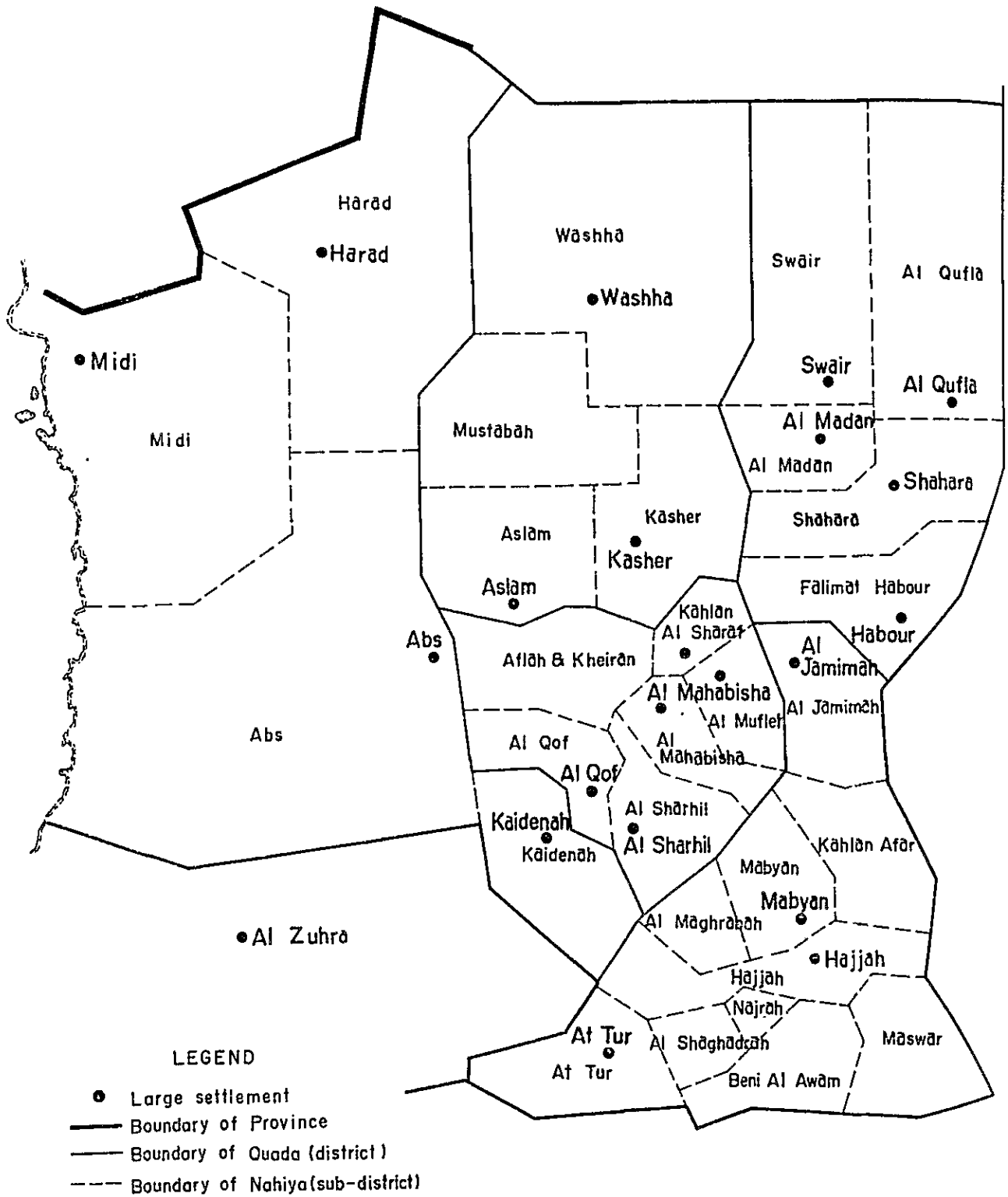


Fig. 8.1 Administrative Division of Hajjah Province

REFERENCES

- USAID (1978) Socio-Economic Problems, Hajjah
and Hodeidah
- IBRD (1979) Effects of Migration of Rural
Labour on Agricultural Development
- Central Planning Organi- Statistical Year Book, 1976/77
zation, Yemen Arab
Republic (1978)

IX AGRICULTURAL ECONOMY

1.	General	IX - 1
2.	Agricultural Resources	IX - 1
	Agricultural land	IX - 1
	Land use	IX - 3
	Water resources	IX - 4
	Labour force	IX - 5
	Draught power	IX - 6
3.	Current Agricultural Production	IX - 7
	Crops	IX - 7
	Livestock	IX-10
4.	Prevailing Farming Patterns	IX-10
5.	Present Farming Practices	IX-13
6.	Agricultural Income	IX-14
7.	Results of Farm Economic Survey	IX-15

Tables

9.1	Cropland and Farm Size	IX-16
9.2	Labour Force and Draught Power	IX-17
9.3	Crop Production Value	IX-18
9.4	Gross Crop Production Value, Production Cost and Net Crop Production Value	IX-19
9.5	Gross Livestock Production Value, Production Cost and Net Livestock Production Value	IX-25
9.6	Results of Farm Economy Survey	IX-31

Figure

9.1	Present Cropping Pattern of Typical Farms	IX-39
-----	--	-------

IX AGRICULTURAL ECONOMY

(1) General

9.01 The economy of the Hajjah Province primarily depends on agriculture, and the other industrial activities are also closely associated with the agricultural sector. The present chapter briefly presents survey results relating to agricultural resources, agricultural techniques and farming pattern, factors affecting agricultural production, and agricultural incomes. Present level of production, unit yields and input-output relations are also studied for most of the important crops grown under different ecological conditions.

9.02 There is no agricultural census which gives a dependable base to formulate development plans. The government publications and statistics cover only limited aspects of the present agricultural production and are far from adequate for the study. The farm economy survey was therefore carried out in the sampled areas of Mabyan, Abs and Al Mahabisha. About 150 farmers were interviewed during this survey. The agro-economic study is roughly made on the basis of the findings derived from the farm economic survey and is supported by background information available from government publications and facts on land use and soils obtained from interpretation of Landsat imagery.

(2) Agricultural Resources

Agricultural land

9.03 The total land area of the Hajjah Province is 959,000 ha. In due consideration of topography, soil, climate and farming pattern, the Hajjah Province would conveniently be divided into 3 agricultural zones, i.e., lowland, midland and highland. The main features of each agricultural zone are summarized as follows:

a. Lowland

This agricultural zone extends on the coastal lowland which forms 40 km wide belt along the Red Sea. The elevation ranges from sea level to about 500 m. Extent of area is approximately 321,600 ha, or 34 % of the total area. The soil consists of mainly coarse to medium textured Fluvisols. It is level or slightly undulating and intersected by shallow-wide wadis draining from the eastern mountains toward to the Red Sea. This agricultural zone generally receives less than 300 mm rain annually which falls in the period between April to October. The mean monthly temperature does not vary much and is over 22°C all the year round. In this zone, about 79,000 ha of the lands are cropped annually. The farming pattern prevailed is of cereals - single cropping type. Draught animals are commonly used. Cropping intensity is very low.

b. Midland

The midland agricultural zone ranges from 500 to 1,500 m in elevation between lowland and highland. The landscape is generally rugged, cut by deep wadis which drain to the Tihama lowland. The estimated area is approximately 553,000 ha or 57 % of the total. The soils are composed mainly of gravelly or stony phases of Yermosols. The rainfall is over 200 mm in the foothills and concentrated around August and September. It increases by altitude reaching over 800 mm around Hajjah with two peaks in April/May and July/August. Winters are rainless. The mean monthly temperature is rather even all the year round and does not fall below 16°C. Main wind direction is east in winter and spring, and west in summer and autumn. Various farming patterns are observed in this zone. High-value cash crops such as qut, coffee and grapes are grown in the higher

elevation areas. In lower elevation areas, a combined farming of cereals and some tropical fruit is common. Along the wadi bed, small scale vegetable farming associated with cereals and livestock raising is prevailing.

c. Highland

The highland agricultural zone consists of higher mountains with elevation ranging from 1,500 m to 3,360 m. The topography is very rugged. The area of this zone is 84,400 ha and mainly covered by coarse to medium textured Yermosols. The rainfall is over 1,000 mm around Al Mahabisha and decreases towards the north-east (470 mm around Shahara). The rainfall pattern and climatic characteristics are similar to those of midland agricultural zone. Common farming pattern is of a mixed livestock-crop type. The farmers grow sorghum and some fruit trees and keep poultry as a side line.

Land use

9.04 The present land use map in the Hajjah Province is prepared on the basis of interpretation of aerial photos and Landsat imagery and results of the field survey (see Chapter VI). Large part of the area is occupied by less developed area in terms of the land use. Out of a total land area of 959,000 ha, approximately 770,000 ha (80 %) are dwarf grassland, open shrub and grassland on rocky slopes. About 28,000 ha (3 %) is unused land. An additional 20,000 ha (2 %) is occupied for village and house yard. The crop lands are only 141,000 ha (15 %) out of which 84,000 ha is regularly cultivated for agricultural production and the remaining 57,000 ha of marginal agricultural land is cultivated only during high rainfall years. The areas of cropland and farm size by Quada (district) are given in Table 1.

9.05 About 88 percent (125,000 ha) of cultivated land depends solely on rainfall. About 9 percent (12,000 ha) is supplied with a spate irrigation by seasonal flood flow, and 3 percent (4,000 ha) is supplied with regular irrigation by wells.

9.06 The irrigated croplands occupy scattered, narrow strips along the wadis in the Tihama lowland. Sorghum, maize and vegetables are commonly grown twice a year. The rainfed croplands are widely distributed on both flat lowland and rugged mountains. In the mountain regions, the croplands are usually terraced. As major crops, sorghum, millet and maize are grown. Vegetables and some of subtropical fruit trees are also grown on the wadi lands. The marginal croplands where cultivation is made only in the high rainfall year dominant on low rainfall areas extending along low reaches of wadis.

Water resources

9.07 There are approximately 16,000 ha of irrigated croplands in the Hajjah Province. These irrigated croplands have been developed on the flat lowlands where irrigation water is available. Water sources of existing irrigation facilities are the seasonal wadi flood flows and groundwater by wells. In a few cases, the permanent spring water is also utilized for irrigation. Inter-mountain plains where springs are exploited, extend around Al Mahabisha and by using sufficient amount of water, cash crops like paddy, vegetables and sub-tropical fruits are annually cultivated. Water resources, however, is quite limited for further expansion of irrigated croplands.

Labour force

9.08 According to the latest population census in 1975, the resident labour force of the Hajjah Province was estimated at about 100,300 or 25.3 % of a total population of 396,600, and 73,200 or 73 % resident labour force was engaged in agriculture. The population census also gives a figure of 76,900 as a total number of household. Since about 55,400 or 72 % of a total number of household is considered as farm households, an average farm labour per farm household would be 1.3 persons, which is extremely less than those of other agricultural countries. This figure perhaps results from limited participation of women in agriculture and serious outmigration of inhabitants to Saudi Arabia. The available labour force by Quada is given in Table 9.2.

9.09 The Hajjah Province, in terms of land use, have approximately 141,000 ha of cropland comprising 83,900 ha of regular cropland and 57,500 ha of marginal cropland. Based on the population structure and present land use, average farm size, cropped area and economic active labour force per farm household by Quada are estimated as shown below:

<u>Quada</u>	<u>Farm holding</u> <u>(A)</u> (ha)	<u>Area under</u> <u>cultivation</u> <u>(B)</u> (ha)	<u>Cropping</u> <u>intensity</u> <u>(B/A)</u> (%)	<u>Available</u> <u>labour</u> <u>force</u> (No.)
Hajjah	1.4	1.0	71	1.3
Midi	5.6	4.3	77	1.4
Al Mahabisha	1.3	0.8	62	1.3
Washha	1.4	0.8	57	1.3
Shahara	1.4	0.9	64	1.3
Average	2.5	1.5	60	1.3

9.10 Even under the traditional farming practices and low cropping intensity, the present low family labour force seems to be insufficient for the labour requirement. The Midi Quada having most of the lowland agricultural zone faces serious shortage of resident farm labour force.

Draught power

9.11 Oxen are the main sources of draught power. However, there is a shortage of draught power during the period of plowing, harrowing and seeding. The number of cattle and available draught power are estimated on the basis of the farm economic survey and are given below:

<u>Quada</u>	<u>Total number of cattle</u> (head)	<u>No. of cattle/farm</u> (head)	<u>Available draught ^{1/} power/farm</u> (ha)	<u>Area under cultivation per farm</u> (ha)
Hajjah	19,400	1.05	1.05	1.0
Midi	39,700	3.90	3.90	4.3
Al-Mahabisha	14,000	1.06	1.06	0.8
Washara	7,400	1.10	1.10	0.8
Shahera	7,500	1.10	1.10	0.9
Total or Ave.	88,000	1.64	1.64	1.5

1/: Available draught power per farm household is estimated on the following basis:

- a. A couple of oxen can plough 0.2 ha per day.
- b. The period for field preparation is 40 days per cropping season.
- c. Available number of coupled oxen is 12.5 % of a total cattle population.

Available Draught Power

$$\begin{aligned}
 &= \text{No. of coupled oxen available} \\
 &\quad \times 0.2 \text{ ha/day (work efficiency per coupled oxen)} \\
 &\quad \times 40 \text{ days (No. of working days)}
 \end{aligned}$$

9.12 In Hajjah Quada, for example, a figure of 1.05 ha available draught power means that the farmers have enough draught power for field preparation of 1.05 ha cropland. In the midland and highland areas, available draught power seems to be short. However, problem is not acute because a considerable part of fields are occupied by perennial crops. In the Midi Quada, on the other hand, shortage of draught power results in continuous abandonment of the marginal lands.

(3) Current Agricultural Production

Crops

9.13 In the Hajjah Province, crop production is heavily concentrated on foodgrains, namely, sorghum and millet. More than 80 % of all cropped area are planted to these crops as follows:

<u>Crops</u>	<u>Cultivated area</u> (ha)	<u>Production</u> (ton)	<u>Unit yield</u> (ton/ha)
Sorghum/Millet	70,000	56,000	0.8
Wheat	500	400	0.8
Barley	400	400	1.0
Maize	500	750	1.5
Legumes	1,000	800	0.8
Qut	6,800	15×10 ⁶ bundles	2,200 bundles
Coffee	1,000	400	0.4
Grapes	1,000	4,800	4.8
Fruits	1,800	14,400	8.0
Potatoes	200	1,600	8.0
Sesame	100	50	0.5
Tobacco	100	120	1.2
Cotton	100	60	0.6
Total	83,900		

9.14 Historically, more than 90 % of a total cropped area was planted to these foodgrains. In recent years, diversification of cropping practices has reduced this to about 85 % of all cultivated area. Despite this predominance of grains, the distinctly different ecological zones of the Province permit the growing of a wide range of crops. In the midland and highland, low temperature zone crops like potatoes, grapes and deciduous fruits are grown successfully. Various legumes such as beans and pulses are also grown extensively. In the sub-tropical climate and relatively ample rainfall of the areas extending along wadi beds, sorghum, millet, maize are the principal crops. A large variety of fruits and vegetables are also grown, including bananas, citrus fruits, tomatoes and onions. In the lowland agricultural zone with its tropical climate, warm winters, hot summers and scant rainfall, sorghum and millet are the staple crops. With irrigation, the area is well adopted for

the growing of tobacco and sesame. Also melons, green and dry edible beans, tomatoes and onions are nice crops for this zone. Fruit crops of the lowland zone are dates, bananas, papaya and mangoes.

9.15 Farming method is still very primitive. Seeds are provided locally and is of inferior quality. Fertilizer is used only in the irrigated fields. No pest and insect control measures are applied. Crop yields are generally low. For example, sorghum and millet yields of 800 kg per ha, wheat yields of 800 kg per ha, barley yield of 1,000 kg per ha, maize yield of 1,500 kg per ha are among the lowest in the country.

9.16 The most important cash crop in the Hajjah Province and also the most controversial, is qut, a mildly narcotic plant which is widely consumed by the population. Although there are no statistics estimating the acreage planted to qut, the farm inputs used and the value of annual production, there is ample evidence suggesting that qut growing has expanded rapidly in recent years and that agricultural resources are increasingly diverted to this crop. Qut owes its popularity among farmers to a strong consumer demand, high prices and relatively low production cost. Qut is more drought resistant and requires less care than most competing crops, especially coffee. As a result, qut is extremely profitable to farmers and its returns generally exceed those of competing crops by a wide margin. The area under qut cultivation is estimated at about 6,800 ha or only 8 % of the total cropped areas. The production value from qut, however, occupies approximately 80 % of the total crop production values of the Hajjah Province as shown in Tables 9.3 and 9.4.

Livestock

9.17 It is estimated that over 360,000 sheep and goats, 42,000 donkeys and 88,000 cattle exist in the Province. There are also considerable numbers of camels. Semi-nomadic husbandry is common. Animal diseases are widespread owing to the lack of veterinary facilities. Among the livestock products, hides and skins occupy an important place in the local economy. Meager and uncertain feed supplies together with lack of modern veterinary care create heavy losses and keep production rates at very low level. The Livestock Credit and Processing Project sponsored by World Bank reported that offtake of cattle would be estimated about 9 % to population and milk yields at 200 liters per lactation, and offtake of sheep and goats including unrecorded domestic slaughtering would be estimated at about 35 %, and the milk yields at 17 liters per lactation. Annual animal production in the Province is roughly estimated and given in Table 9.5.

(4) Prevailing Farming Patterns

9.18 As mentioned in Paragraph 9.03, the Hajjah Province is divided into 3 agricultural zones, i.e., lowland, midland and highland agricultural zones. The farming patterns prevailing in each zone are as follows:

<u>Agricultural zone/Quada</u>	<u>Dominant farming pattern</u>	<u>Major crops</u>
Lowland (0 - 500 m) Quada: Midi	<ul style="list-style-type: none"> - Large scale rainfed cereal (millet, sorghum) production - Seminomadic rough grazing (cattle, camels, goats, sheep) - Small scale irrigated cereal and cash crops production by diverted stream flow 	<ul style="list-style-type: none"> Sorghum Millet Maize Sesame Tobacco Legumes Vegetables Tropical fruits
Midland (500 - 1,500 m) Quada: Hajjah Shahara Washha	<ul style="list-style-type: none"> - Rough grazing on perennial low vegetation (sheep, goats) - Small scale irrigated cereal and vegetables production (by diverted and sheet flow) on the wadi lands - Small scale rainfed cereal production on the terraced lands - Qut production 	<ul style="list-style-type: none"> Sorghum Maize Vegetables Legumes Qut Sub-tropical fruits
Highland (1,500-2,500m) Quada: Al Mahabisha	<ul style="list-style-type: none"> - Intensive cereal production under rainfed condition - Grazing (goats, sheep, cattle) - Intensive qut production on the gentle-slope lands complementally irrigated by hill-slope run off - Intensive coffee production 	<ul style="list-style-type: none"> Sorghum Qut Coffee Grapes

9.19 Lowland agriculture is popular in Midi Quada, midland agriculture in Washha, Shahara and Hajjah Quadas, and highland agriculture prevails in Al Mahabisha Quada. Midi Quada extends over large and flat lowland of the Hajjah Province. The lowland agriculture is characterized by large farm size, low labour force and low rainfall. Water shortage is serious in this area. Although there are many shallow wells for drinking and irrigation purposes, excessive use of groundwater has already lowered the water table in some areas and increased salinity problem for use in others. Spate irrigation is practised in some areas, but is not reliable owing to irregular stream flow. Low and erratic rainfall makes the lowland agriculture unstable. Agricultural income is generally low. Outmigration of the rural inhabitants is accelerated by harsh environment, low agricultural income and better wages offered by neighbouring oil-producing countries. In consequence, a large number of the rural inhabitants have left their villages and millions of farmlands are being abandoned. As a result, sand dunes are rapidly spreading in these areas.

9.20 The midland agricultural zone receives more rainfall than the lowland area. In this area, rainfed sorghum cultivation is common. The sorghum planting is usually done in late May. If it rains in March, farmers grow two crops of sorghum. In the wadi beds, sub-tropical crops like papaya, bananas, hot peppers, tomatoes and okra are grown. The choice of planting crop is also determined by the timing of spring rains. Generally, on the cropland range between 500 m to 1,000 m in elevation, sorghum, millet and maize are the principle crops. Relying on rain alone, only one crop is harvested a year, but if the wadi water rises, two or three crops plus some vegetables can be raised. On the lands over 1,000 m in elevation, qut is main crop. Some deciduous

fruit trees are also grown for supplementary income. Soil erosion is serious problem in this area.

9.21 Al Mahabisha Quada represents the highland agriculture in the Hajjah Province. Al Mahabisha Quada is located on the central part of the Hajjah Province. The annual rainfall is around 1,000 mm. Blessed with ample rainfall, farming practices are intensively carried out and crop production is relatively high. Almost all the farm lands are terraced. The major crop is qut followed by sorghum, grapes, coffee and vegetables.

(5) Present Farming Practices

9.22 Sorghum and millet are the staple food for inhabitants of the Hajjah Province and these crops are planted over 70,000 ha or 83 % of a total cultivated land. The total production of these crops in 1976 - 1977 was estimated at approximately 56,000 tons. The productivity of these cereals remain relatively low, though straw and leaves play an important role for the fodder sources for livestock raising. The common farming practices for these crops are outlined as follows:

Sorghum: Main varieties cultivated in the Hajjah Province are local varieties such as Hamra, Saifi and Chariba. Sowing time varies from area to area. There are two planting seasons on the regularly irrigated lands, i.e., July and February. On the rainfed farm lands, March to May is common for planting and the crops are harvested in the period from September to middle of November. The growth period spans over 4 to 5 months in main crop and 40 to 80 days in ratoon crops. Seeding rate is about 30 kg per ha. Spacing of rows is generally 30 to 60 cm. Fertilizers and agro-chemicals are not generally applied. Labour requirement

for the cultivation is estimated at about 75 man-days per ha.

Millet: The seed is sown at the beginning of the rain, often in furrow between the ridges on which sorghum will later be sown. If the rainfall is poor and sorghum likely to fail, a second millet crop is sown or seedlings transplanted, as the crop will be less likely to suffer from drought. Quick-maturing varieties are sometimes interplanted with sorghum as a catch crop. The crop generally grown from seed but suckers of the previous season may be cut back and planted. In some areas, it is grown alone, one or two crops a year depending on the rainfall. Thus, Millet plays an important role in the rotation system of northern area. In the harvesting season, the stems are cut low down, huddled together, and stocked in the field. The heads are cut in 30 cm from the stem and are dried and stored. The bundles are rolled up ready for transport. The head may be threshed and winnowed on the house yard.

(6) Agricultural Income

9.23 The estimated agricultural production, production value and production costs are given in Tables 9.4 (crop) and 9.5 (livestock) and are summarized as in the followings. The production cost is estimated on the basis of the results of farmer's field trials conducted by Tihama Development Authority and data obtained from the farm economy survey.

(Unit: 10⁶ YRs)

<u>Description</u>	<u>Crop</u>	<u>Livestock</u>	<u>Total</u>
Gross production value	1,348	71	1,419
Production cost	227	22	249
Net production value	1,121	49	1,170
No. of farm household			55,400
Net production value per farm household		YRs	21,120

(7) Results of Farm Economic Survey

9.24 There is no agricultural census which gives a dependable base to formulate development plans. The farm economic Survey, therefore, is carried out in the sampled areas of Mabyan, Al Mahabisha and Abs in close cooperation with Planning and Statistics Department, Ministry of Agriculture. The results of farm economic survey is summarized in Table 9.6.

Table 9.1 Cropland and Farm Size

<u>Quada</u>	<u>No. of farm household</u>	<u>Cropland (ha)</u>	<u>Cropped area (ha)</u>	<u>Average farm size (ha)</u>	<u>Average cropped area (ha)</u>
Hajjah	18,600	25,500	18,600	1.4	1.0
Midi	10,200	79,100	43,500	5.6	4.3
Al Mahabisha	13,100	17,200	10,300	1.3	0.8
Washha	6,700	9,400	5,600	1.4	0.8
Shahara	6,800	9,800	5,900	1.4	0.9
Total or Ave.	55,400	141,000	83,900	2.5	1.5

Table 9.2 Labour Force and Draught Power

<u>Quada</u>	<u>Population</u>	<u>No. of household</u>	<u>No. of farm household</u>	<u>Active force labour</u>	<u>No. of farm labour</u>	<u>No. of farm labour/farm</u>	<u>No. of cattle</u>	<u>No. of cattle/farm</u>
Hajjah	133,900	25,900	18,600	33,900	24,700	1.3	19,400	1.05
Midi	74,900	14,200	10,200	18,900	13,800	1.4	39,700	3.90
Al Mahabisha	91,800	18,200	13,100	23,200	16,900	1.3	14,000	1.06
Washha	47,100	9,200	6,700	11,900	8,700	1.3	7,400	1.10
Shahara	48,900	9,400	6,800	12,400	9,100	1.3	7,500	1.10
Total	396,600	76,900	55,400	100,300	73,200	Ave. 1.3	88,000	1.64

Table 9.3 Crop Production Value

<u>Crops</u>	<u>Cultivated area</u> (ha)	<u>Unit yield</u> (ton/ha)	<u>Unit price</u> (YRS/ton)	<u>Products</u> (tons)	<u>Value</u> ($\times 10^3$ YRS)
Cotton	100	0.6	2,000	60	120
Coffee	1,000	0.4	28,000	400	11,200
Qut	6,800	2,200 bundles	70	14,960 $\times 10^3$	1,047,200
Wheat	500	0.8	2,000	400	800
Barley	400	1.0	1,800	400	720
Grapes	1,000	4.8	12,000	4,800	57,600
Vegetables	400	8.0	5,000	3,200	16,000
Legumes	1,000	0.8	6,000	800	4,800
Tobacco	100	1.2	21,000	120	2,520
Sesame	100	0.5	25,000	50	1,250
Potatoes	200	8.0	4,000	1,600	6,400
Maize	500	1.5	1,500	750	1,125
Sorghum/Millet	70,000	0.8	2,000	56,000	112,000
Fruits, etc.	1,800	8.0	6,000	14,400	86,400
Total	83,900				1,348,135

Table 9.4 Gross Crop Production Value, Production Cost
and Net Crop Production Value (Hajjah Province)

Crops	(A) Cultivated area (ha)	(B) Gross production value ($\times 10^3$ YRS)	(C) Unit production cost (YRS/ha)	(D) Total production cost, (A) \times (C) ($\times 10^3$ YRS)	(E) Production tax, (B) \times 1.0% (YRS)	(F) Gross production cost, (D) + (E) ($\times 10^3$ YRS)	(G) Net production value, (B) - (F) ($\times 10^3$ YRS)
Cotton	100	120	220	22	12	34	86
Coffee	1,000	11,200	4,000	4,000	1,120	5,120	6,080
Qut	6,800	1,047,200	4,000	27,200	104,720	131,920	915,280
Wheat	500	800	200	100	80	180	620
Barley	400	720	200	80	72	152	568
Grapes	1,000	57,600	15,000	15,000	5,760	20,760	36,840
Vegetables	400	16,000	2,500	1,000	1,600	2,600	13,400
Legumes	1,000	4,800	1,500	1,500	480	1,980	2,820
Tabacco	100	2,520	2,500	250	252	502	2,018
Sesame	100	1,250	2,000	200	125	325	925
Potatoes	200	6,400	2,500	500	640	1,140	5,260
Maize	500	1,125	270	135	115	250	875
Sorghum/Millet	70,000	112,000	240	16,800	11,200	28,000	84,000
Fruits, etc.	1,800	86,400	14,000	25,200	8,640	33,840	52,560
Total	83,900	1,348,135		91,987	134,816	226,803	1,121,332

- to be continued -

Table 9.4(a) Gross Crop Production Value, Production Cost and Net Crop Production Value (Hajjah Quada)

Crops	(A) Cultivated area (ha)	(B) Gross production value ($\times 10^3$ YRS)	(C) Unit production cost (YRS/ha)	(D) Total production cost, (A) \times (C) ($\times 10^3$ YRS)	(E) Production tax, (B) $\times 10\%$ (YRS)	(F) Gross production cost, (D) + (E) ($\times 10^3$ YRS)	(G) Net production value, (B) - (F) ($\times 10^3$ YRS)
Cotton	-	-	-	-	-	-	-
Coffee	500	5,600	4,000	2,000	560	2,560	3,040
Out	900	138,600	4,000	3,600	13,860	17,460	121,140
Wheat	200	320	200	40	32	72	248
Barley	100	180	200	20	18	38	142
Grapes	200	11,520	15,000	3,000	1,152	4,152	7,368
Vegetables	100	4,000	2,500	250	400	650	3,350
Legumes	200	960	1,500	300	96	396	564
Tobacco	-	-	-	-	-	-	-
Sesame	-	-	-	-	-	-	-
Potatoes	-	-	-	-	-	-	-
Maize	100	225	270	27	23	50	175
Sorghum/Millet	16,100	25,760	240	3,864	2,576	6,440	19,320
Fruits, etc.	200	9,600	14,000	2,800	960	3,760	5,840
Total	18,600	196,765	-	15,901	19,677	35,578	161,187

- to be continued -